O/L MATHS JUNE 1982

SECTION A

1. (a) Let $D(n)$ denotes the set of all factors of the natural numbers n. For example $D(8) = \{1, 2, 4, 8\}$.

   (i) List the elements of $D(12), D(15), D(12) \cup D(15)$.

   (ii) State the least value of r such that $D(12) \cup D(15) = D(r)$.

   (b) In the fifth form of a school, 70% of the students study Science and 40% study French. If every student studies at least one of the two subjects, draw a Venn diagram and use it to find the percentage which study both Science and French.

2. (a) (i) $p = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$ and $q = \begin{pmatrix} -2 \\ 7 \end{pmatrix}$, find $4p - 2q$.

   (ii) What can you say about your answer in (i) and the vector $\begin{pmatrix} -10 \\ 1 \end{pmatrix}$?

   (b) Simplify $\dfrac{4.8 \times 10^{17}}{0.12 \times 10^{6}}$ and express your answer in the form $b \times 10^{n}$ where $1 \leq b < 10$ and n is an integer.

3. (a) (i) Simplify $\sqrt{2}\left(\sqrt{8} - \dfrac{2}{\sqrt{8}}\right)$.

   (ii) Given that $\sqrt{5} = 2.236068$, find the value of $\dfrac{1}{\sqrt{5}}$, correct to five significant figures.

   (b) (i) Find the truth set of the equation $-3 \leq \dfrac{2}{3}(x - 1) \leq \dfrac{1}{2}x$, where x is a real number.

   (ii) Illustrate your answer on the number line.

4. The following table gives the production of timber in five districts in Ghana in a certain year.

District	Production of timber (Tonnes)
Bibiani	600
Nkawkaw	900
Wiawso	1800
Ahafo	1500
Agona	2400

   (i) Draw a pie chart to illustrate the above information.

   (ii) What percentage of the timber produced in the five districts of Ghana that year was from Nkawkaw?

5. (i) Using a ruler and a pair of compasses only, construct the quadrilateral $PQRS$ in which $|PQ| = 7.3cm, |PS| = 5cm, angle\ QPS = 90°\ and\ angle\ PQR = 120°$.

   (ii) Measure the length of QR.

SECTION B

6.   Abubakar and Babatunde entered into a business partnership. The capital for the business is made of ₦25,000.00 from Abubakar and ₦7,000.00 from Babatunde. They agreed to share yearly profit in the following manner: Babatunde as Managing Director is paid ₦1,000.00 and in addition 7.5% of the total profit. Each partner is paid a sum equal to 3% of the capital he invested. The remainder of the profit is shared between the partners in the ratio of their contributions to the capital. If the profit at the end of certain year was ₦6,400.00, calculate the total amount each partner received from the profit.

7.   (i)   Using a scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw on the same axes the graphs of
        (a) $y = 6 + 2x - x^2$ (b) $y = x + 2$, for $-3 \leq x \leq 5$
        (ii)   Use your graphs in (i) to determine the truth set of the simultaneous equations $y = x + 2$, $y + x^2 = 6 + 2x$, giving your answers correct to one decimal place.

8.   (a)   Write down three properties of a right angled triangle which has $30°$ as one of its angles.
        (b)   An aeroplane flew form city A on a bearing of $135°$ to another city B, a distance of 200km. It then flew from city B on a bearing $045°$ to city C, a distance of 250km. Calculate:
                (i)   The distance from city A to city C, correct to three significant figures.
                (ii)   The bearing of city A from city C.

9.   Using a scale of 2cm to 1 unit, draw the x and y axes for $0 \leq x \leq 8$ and $-6 \leq y \leq 6$.
                (i)   Plot the points $A(3, 1)$, $B(1, 1)$ and $C(3, 5)$ and describe the triangle ABC.
                (ii)   Find the equation of AC.
                (iii)   Draw triangle $A_1B_1C_1$ which is the reflection triangle ABC in the x-axis, where $A \rightarrow A_1, B \rightarrow B_1$ and $C \rightarrow C_1$. Indicate clearly the co-ordinates of A_1, B_1 and C_1.
                (iv)   Draw triangle $A_2B_2C_2$ which is the image of triangle ABC under the mapping $\begin{pmatrix} x \\ y \end{pmatrix} \rightarrow \begin{pmatrix} 2x \\ -y \end{pmatrix}$, where $A \rightarrow A_2, B \rightarrow B_2$ and $C \rightarrow C_2$, indicating clearly the co-ordinates of A_2, B_2 and C_2.

10.   A sector of angle $130°$ is removed from a thin circular metal sheet of radius 10cm. It is then folded, with the straight edges coinciding to form a right circular cone.
        Calculate: (i)   the base radius, correct to two significant figures;
                        (ii)   the semi-vertical angle, correct to the nearest degree;
                        (iii)   the greatest volume of liquid in cm^3, which the cone can hold giving your answer, correct to two significant figures.

11. The following shows the distribution of the marks scored by 200 candidates in an examination.

Mark	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89
Frequency	3	18	20	25	34	50	25	15	10

(i) Construct a cumulative frequency table and use it to draw a cumulative frequency curve.

(ii) Use the cumulative curve to estimate:

(a) the median.

(b) the probability that a candidate passes, if the pass mark is 42%.

(c) the lowest mark for a distinction if 10% of the candidates passed with distinction.

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SECTION A

1. (a) Consider the following statements;

X: All policemen wear uniform   Y: No civil servant wear uniform

(i) If $P = \{policemen\}$, $U = \{people\ wearing\ uniform\}$ and $C = \{civil\ servant\}$, draw a Venn diagram to illustrate the above statement.

(ii) Using your Venn diagram, or otherwise, determine which of the following Implications are valid deductions from X and Y.

(α) Bulla wears uniform   Bulla is a policeman

(β) Offei is a policeman   Offei is not civil servant

(γ) Dom is not a civil servant   Dom wears uniform

(b) In a school there are 30 Science students and 40 Arts students in the lower sixth form. 80% of the Science students are boys and 70% of the Arts students are boys. Find the percentage of boys in the form.

2. (a) (i) Copy and complete the following table for multiplication $\otimes$ modulo 9 on the set $P = \{2, 3, 7, 8\}$.

$\otimes$	2	3	7	8
2	4	6	5	
3	6	0		6
7	5		4	
8		6		1

(ii) Find the truth set of P $(8 \otimes m) = 2$, where $m \in P$.

(b) Find the number base x such that $365_7 + 43_x = 217_{10}$.

3. (a) A is the point $(5, 3)$ and B is the point $(0, 9)$.

(i) Express the $\overrightarrow{AB}$ in the form $\begin{pmatrix} x \\ y \end{pmatrix}$;

(ii)   Calculate the length of $|\overrightarrow{AB}|$.

(b)   If $2^{5x} = \dfrac{16}{2^{1-x}}$, find x.

(c)   Without using tables, calculate the value of $\sqrt{\dfrac{X}{Y}}$, where $X = 8.1 \times 10^{-2}$ and $Y = 2.25 \times 10^5$, giving your answer in the standard form.

4.   The total resistance R of an electrical circuit which consists of two resistances R_1 and R_2 in parallel is given by $\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$. If the total resistance R is between 5 and 10 ohms and R_1 is 50 ohms, find the possible values of R_2.

5.   (a)   Kwame left his home in Takoradi at 7 am to walk to Apremdu, 14km away. After walking 2.5km during the first 30mins, he was given a ride in a car to Apremdu. The car travelled at an average speed of 40km/h. Draw Kwame's travel graph.

(b)   Kojo also left Kwame's house at 7 am and cycled to Apremdu, arriving there at the same time as Kwame. Using the same axes and scale as in (a), draw Kojo's travel graph.

(c)   Use your graphs to determine the speed in km/h at which Kojo cycled, correct to two significant figures.

SECTION B

6.   In a certain year, Kwaku paid for electricity consumed each month as follows, the cost of the first 30 units was 10p per unit; the cost of the next 30 units was 7p per unit; the cost of each additional unit is 5p.

(i)   If Kwaku used 420 units of electricity in July that year, calculate the amount he paid.

(ii)   If Kwaku paid ¢27.10 in August last year, calculate the number of units of electricity he used.

(iii)   Find, correct to two decimal places, the percentage change in Kwaku's consumption of electricity from July to August that year.

7.   The following is an incomplete table for the relation $y = 2x(4x - 7) - 9$, where $-2 \le x \le 4$

x	-2	-1	0	0.5	1	1.5	2	3	4
y	51		-9						63

(a)   Copy and complete the table;

(b)   Using a scale of 2cm to 1 unit on the x-axis and 1cm to 5 units on the y-axis, draw the graph of the relation.

(c)   Estimate, correct to one decimal place;
   (i)   the x-co-ordinate of the point y starts increasing with respect to x;
   (ii)   the truth set of $2x(4x - 7) - 4 = 0$.

8. A triangular plot of land ABC is such that $|AB| = 85m, |BC| = 110m$ and angle $CAB = 60°$.
   (a) Using a ruler and a pair of compasses only and a scale of 1cm to 10m, construct:
      (i) the triangular plot;
      (ii) the position of vertical telegraph post X which equidistant to AC and BC and is on the perpendicular form B to AC.
      (iii) the position of another telegraph post T which is equidistant from the three boundaries of the plot.
   (b) Hence, find the actual distance from X to T.

9. $P(Lat\ 36°S,\ long.\ 120°E)$ is a point on the Earth's surface. Q another point 840km due North of P. T, a third point, is 840km due East of P. Calculate, correct to two significant figures:
   (a) the radius of latitude P;
   (b) the latitude of Q;
   (c) the longitude of T. (Take $\pi = 3.142$, Radius of the Earth as 6400km)

10. (a) Simplify $\frac{3}{4}\sqrt{128} - \sqrt{50}$, leaving your answer in surd form.
    (b) Solve the equation $(x - 2)(x - 3) = 12$
    (c) Given that $E = \frac{W(R - r)}{2RP}$,
       (i) Make R the subject of the formula.
       (ii) Find the value of R, correct to three significant figures, when $r = 12$, $P = 60, W = 1024$ and $E = \frac{5}{6}$.

11. The following table gives the marks of 30 students in Form 3X.

45	68	65	67	61	59	59	79	60	64
68	71	59	67	64	63	50	62	54	64
76	57	68	55	72	53	80	74	70	57

   (a) Form a grouped frequency table using the class intervals 45 – 49, 50 – 54 etc.
   (b) What is the probability that a candidate scores a mark in the modal class?
   (c) Draw a histogram for this distribution.
   (d) Calculate the mean of the distribution.

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SECTION A

1. 50 children had a choice of beans, plantain and rice, of which 21 of them took beans, 24 took plantain and 18 took rice, 3 took beans only, 9 took plantain only and 2 took rice only, 5 took all the three items of food.
   (i) Draw a Venn diagram to illustrate this information.
   (ii) Use your diagram to find the number of children who took;
      (a) plantain and beans only

       (b)   rice and beans

       (c)   none of the three items of food

2.   Draw a table for multiplication $\otimes$ modulo 7 on the set $P = \{2, 3, 5, 6\}$. Use your table to find on P the truth set of;

      (i) $n \otimes n = 2$ (ii) $n \otimes (n \otimes 6) = 3$

3.   (a)   A solid circular cylinder of base radius r cm and height h cm has a total surface area S cm^2 and volume V cm^3. Express:

           (i) S in terms of r and h (ii) h in terms of S

           (iii) V in terms of r and S

      (b)   Find the truth set of the equation $6x^2 = 23x + 55$, where x is a real number.

4.   Use a ruler and a pair of compasses only;

      (i)   construct triangle ABC such that $|AB| = 10.4cm, angle\ BAC = 90°$ and $angle\ ABC = 30°$.

      (ii)   By using (i) above with any necessary additional lines, determine;

           (a)   a point P on BC which is equidistant from A and B;

           (b)   the area of triangle ABP.

5.   The following is the frequency table of the ages (to the nearest year) of the children at a birthday party.

Age(years)	1	2	3	4	5	6	7	8	9	10
No. of children	1	3	5	7	12	9	6	3	2	2

      (i)   Calculate the mean of the distribution.

      (ii)   If a child at the party is selected at random, what is the probability that he is older than the modal age?

SECTION B

6.   Jones, George and Green are partners in a business and their contribution to the capital are respectively, Le 15,000 and Le 30,000. They agree to share 40% of any net profit in the ratio of their contribution to the capital. In 1978, their profit before tax was Le 16,800 and 45% was paid to the government as tax. Calculate the share of the profit received by each partner. Green invested his share of the profit in 1978 at 12% per annum simple interest. Express Green's share of the profit in 1978 together with the interest earned on it in 8 years as a percentage of his initial contribution to the capital, giving your answer correct to two decimal places.

7.   The following is an incomplete table of values for the relation $y = \dfrac{x + 5}{x^2 + 1}$

x	-3	-2	-1	0	0.2	0.5	1	2	3
y	0.2				5		1.4		

      (i)   Copy and complete the table.

      (ii)   Using a scale of 2 cm to 1 unit on each axis, draw the graph of the relation for the given interval.

(iii)   Find the greatest value of $y = \dfrac{x+5}{x^2+1}$ within the interval.

(iv)   Using the same axes and scale, draw the graph of the relation $y = x$.

(v)   From the graphs write down the truth set of $\dfrac{x+5}{x^2+1} = x$, giving your answer correct to two significant figures.

8.   Using a scale of 2 cm to 2 units on each axis, draw on a sheet of graph paper two perpendicular axes Ox and Oy for interval $-10 \le x \le 8$ and $-10 \le y \le 10$.
Draw:

    (a)   triangle PQR with vertices $P(2,8), Q(5,8)$ and $R(2,4)$.

    (b)   the image triangle $P_1Q_1R_1$ of triangle PQR a reflection in the line $y = 2$ where $P \to P_1, Q \to Q_1$ and $R \to R_1$.

    (c)   the image triangle $P_2Q_2R_2$ of triangle PQR under a half turn about the origin O, where $P \to P_2, Q \to Q_2$ and $R \to R_2$.

    (d)   Describe precisely two transformations that will map triangle $P_2Q_2R_2$ onto triangle $P_1Q_1R_1$ where $P_2 \to P_1, Q_2 \to Q_1$ and $R_2 \to R_1$.

9.   L and M are respectively the midpoints of the sides AB and BC of a triangle ABC with vertices $A(-2,6), B(4,-2)$ and $C(7,2)$.

    (i)   If O is the origin, express $\overrightarrow{OL}$ in terms of $\overrightarrow{OA}$ and $\overrightarrow{AB}$ and hence calculate the coordinates of L.

    (ii)   Use the method in (i) to calculate the coordinates of M.

    (iii)   Find the vector relation between $\overrightarrow{LM}$ and $\overrightarrow{AC}$ and interpret the relation geometrically.

10. $P\,(Lat.\,40°N, Long.\,20°W)$ and $Q\,(Lat.\,40°N, Long.\,36°E)$ are two points on the surface of the Earth. Assuming that the Earth is a sphere of radius 6400km, calculate;

    (i)   correct to 2 decimals places, the time taken for an aircraft to fly at an average speed of 540km/h from P to Q along the line of latitude.

    (ii)   the shortest distance through the Earth from P to Q, correct to 2 significant figures. (Take $\pi = 3.142$)

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SECTION A

1.   (a) U is a Universal set consisting of prime numbers. P and Q are subsets of U given by $P = \{n: 3(n+1) \ge 2(n+10)\}$ and $Q = \{n: 7 < n < 31\}$. List the elements of $P \cap Q$.

    (b)   Consider the following two statements:
    X: All students are hardworking.   Y: No hardworking person is careless.
    Draw a Venn diagram to illustrate the above statements. Which of the following are valid conclusions from the statements X and Y?

        (i)   Kwasi is a student $\Rightarrow$ Kwasi is not careless.

        (ii)   Damba is hardworking $\Rightarrow$ Damba is a student.

        (iii)   Afua is not careless $\Rightarrow$ Afua is not a student.

2.   (a)   Simplify $2424_{five} \times 224_{five}$ leaving your answer in base five.

        (b)   A woman trader bought 458 oranges for ¢5496.00. She kept 62 oranges for her family and sold the rest at ¢16.00 each. Calculate, correct to one decimal place, her percentage profit.

3.   Without using tables:

        (a)   (i)   Find the value of x such that $16^{2x} = \frac{1}{16}$ (ii) $\frac{10}{\sqrt{75}} \times \sqrt{147}$

        (b)   The kinetic energy T units of a moving body (of constant mass) varies directly as the square of its speed V m/s. If $T = 800$ units when $V = 20$ m/s, calculate V when $T = 1800$ units.

4.   (i)   Given that the value of the expression $\frac{p}{2-x} + \frac{p}{2+x}$ is 6 when $x = -3$. Find the value of p.

        (iii)   Using the value of p in (i),

                (a)   Write the expression as a single fraction, stating the values of x for which it is not defined;

                (b)   Find the truth set of $\frac{p}{2-x} + \frac{p}{2+x} = 6$, where x is a real number.

5.   (a)   The sum of interior angles of a rectangular polygon is $1260°$. Calculate the number of sides of the polygon.

        (b)   The following table shows the distribution of the grades by 120 students in an examination. Draw a pie chart of the distribution.

Grade	A	B	C	D
Number of Students	14	30	52	24

SECTION B

6.   Using a ruler and a pair of compasses only;

        (i)   construct a quadrilateral ABCD such that angle $BAD = 150°$,

        (ii)   determine by construction a point P which is equidistant from AB, BC and CD.

        (iv)   Find the area of triangle BCD.

7.   The following is an incomplete table for the relation $y = 4x^2 - 8x - 21$ for $-2.0 \le x \le 4.0$.

x	−2.0	−1.5	−1.0	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	11		−9	−21	−24			−21		−9	0	

        (i)   Copy and complete the table.

        (ii)   Using a scale of 2 cm to 1 unit on the x axis and 2 cm to 5 units on the y axis, draw a graph for the relation for $-2.0 \le x \le 4.0$

        (iii)   Using your graph, find in the given interval the truth set of:

(a) $4x^2 - 8x = 3$;   (b) $4x^2 - 7x - 21 = 0$

Giving your answers, correct to one decimal place.

8.   (i)   Using a scale of 2 cm to 2 units on each axis, draw on a sheet of graph paper two perpendicular axes Ox and Oy for $-10 \leq x \leq 10$ and $-12 \leq y \leq 12$.

(ii)   Draw on this graph, indicating the coordinates of all vertices:

(a)   A quadrilateral ABCD with vertices $A(-4, -5), B(2, -1), C(0, 3)$ and $D(-8, 4)$;

(b)   The image $A_1B_1C_1D_1$ of ABCD under a translation by the vector $\begin{pmatrix} 3 \\ -8 \end{pmatrix}$ where $A \to A_1, B \to B_1, C \to C_1$ and $D \to D_1$.

(c)   The image $A_2B_2C_2D_2$ of ABCD under an enlargement from the origin with a scale factor of $-\frac{1}{2}$, where $A \to A_2, B \to B_2, C \to C_2$ and $D \to D_2$.

(d)   Find the equation AB.

9.   Mr. Manjang left Banjul on his motor cycle at 9:00am to travel to Lamin, 24km away. He expected to arrive at Lamina at 10:12am but had to stop 8km from Banjul for 20 minutes. He arrived at Lamina 8 minutes late. Draw a travel graph for the journey.

(i)   Use your graph to find:

(a)   His average speed for the last stage of the journey.

(b)   The average speed for the last stage of the journey if he was to arrive at Lamina at 10:12am.

10.   The following is the frequency distribution of the marks scored by the Form Five students of a school at a Mock Examination.

Mark	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Freq.	2	6	9	13	42	25	13	7	2	1

(i)   Draw a histogram for the distribution.

(ii)   Estimate, correct to two significant figures, the mean of the distribution.

(iii)   The pass mark for the examination is 40. If you happen to meet a student of the Form, what is the probability that he has passed?

11.   Two vertical electricity poles, each of 18m high stands at the points A and B along a straight horizontal road. A straight foot path meets the road at B. From a point C on the footpath, 43m from the road, the angles of elevation of the top of the poles at A and B are respectively 14.6° and 16.4°. Calculate, correct to one decimal place:

(a)   the distance $|AC|$ and $|BC|$.

(b)   the angle which the footpath meets the road.

(c)   the distance between the poles.

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SECTION A

1. (a) Given that $K = \{x: x \geq 2\}$, $Y = \{x: 1 \leq x \leq 6\}$, $Z = \{x: x \leq 3\}$, where x is a real number. Find:

   (i) $K \cap (Y \cup Z)$ (ii) $(K \cap Y) \cup (K \cap Z)$

   What property of operation on set is shown by your answer to (i) and (ii)?

   (b) If $\underline{p} = \binom{3}{2}$, $\underline{q} = \binom{1}{3}$ and $\underline{r} = \binom{-2}{3}$, evaluate:

   (i) $\underline{p} + \left(\underline{q} + \underline{r}\right)$ (ii) $\left(\underline{p} + \underline{q}\right) + \underline{r}$

   What property of operation on vectors is shown by your answer to (i) and (ii)?

2. (a) (i) Simplify $\left(1 - \sqrt{3}\right)\left(\frac{1}{3} + \sqrt{3}\right)$, giving your answer in the form $P + Q\sqrt{3}$.

   (ii) Given that $\sqrt{2} = 1.414214$, find, correct to five significant figures the value of $\left(3 - \frac{1}{\sqrt{2}}\right)$.

   (b) (i) Find the truth set of $2 > -\frac{1}{3}(2x - 1) > \frac{2}{3}x$, where x is a real number.

   (ii) Illustrate your answer on the number line.

3. Solve the simultaneous equations: $3^{x+1} = 27^{y-1}$ and $\left(\frac{1}{3}\right)^{2x} = \left(\frac{1}{9}\right)^{y+2}$.

4. (i) Draw addition $\oplus$ and multiplication $\otimes$ tables for the arithmetic modulo 5.

   (ii) Use your table to find the truth set of:

   (a) $(x \otimes 3) \otimes (x \oplus 2) = 0$ (b) $(2 \otimes x) \oplus = 3$

5. A rectangular sheet of metal made of uniform material is 9cm long and 8cm wide. Six circular holes of radius R cm are drilled through the sheet.

   (i) Find an expression for the volume of the metal left after the drilling, if h cm is the thickness of the metal.

   (ii) If the ratio of the new weight of the sheet to the original weight is 13:20, find, correct to two decimal places, the value of R. ($\pi = 3.14$)

SECTION B

6. (i) A trader buys 3750 articles at a cost of Le 6.00 per article. He fixes the selling price so that, if only 3000 articles are sold, he will make a profit of 40% on his total cost. Calculate the selling price of one article.

   (ii) If, in fact, he sells 3150 articles at this price, find the actual profit as a percentage of the total cost price.

   (iii) If he wanted 100% profit, for how much should he have sold the 3150 articles?

7. (a) Copy and complete the following table for the relation $y = x^3 - 5x$.

x	−2.5	−2.0	−1.5	−1.0	−0.5	0.0	0.5	1.0	1.5	2.0	2.5
y	−3.1			4	2.4		−2.4		−4.1		

(b) Using a scale of 2 cm to 1 unit on the x-axis and 2 cm to 2 units on the y-axis, draw the graph of $y = x^3 - 5x$, for $-2.5 \leq x \leq 2.5$

(c) From your graph, correct to two significant figures,
(i) the least value of $(x^3 - 5x)$ in the interval;
(ii) the truth set of $x^3 - 5x = -1$.

8. Using a ruler and a pair of compasses only, and leaving all construction lines clearly visible;
(i) construct a parallelogram PQRS with $|PQ| = 10cm, |PS| = 8cm$ and $angle\ QPS = 120°$;
(ii) construct the bisectors of angles PSR and QPS, and mark their point of intersection O;
(iii) construct the line OA from O to meet SR at right angles at the point A;
(iv) Hence draw a circle to touch the sides PQ, PS and SR. Shade the region which lies within the circle and less than 8 cm from Q.

9. The marks obtained by candidates in a Mathematics examination were first grouped $0 - 9, 10 - 19, 20 - 29, 30 - 39$ and so on. The midpoint mark of each group was then taken as the mark representing the group. The following table gives the distribution of the marks.

Mark	4.5	14.5	24.5	34.5	44.5	54.5	64.5	74.5	84.5
Frequency	18	19	x	12	9	5	2	2	1

If the mean mark for the candidates was found to be 26.06,
(i) determine the value of x;
(ii) find the probability that a candidate chosen at random obtained 55 marks or more.

10. (i) Draw on a sheet of graph paper using a scale of 2 cm to 2 units, two perpendicular axes Ox and Oy for $-10 \leq x \leq 10$ and $-10 \leq y \leq 10$, plot the points $P(-2, 8), Q(5, 10)$ and $R(5, 2)$.
(ii) Draw the image triangle $P_1Q_1R_1$ of triangle PQR under an anticlockwise rotation 90° about the origin where $P \rightarrow P_1, Q \rightarrow Q_1$ and $R \rightarrow R_1$.
(iii) Draw the image triangle $P_2Q_2R_2$ of triangle PQR under a reflection in the line $y = 0$, where $P \rightarrow P_2, Q \rightarrow Q_2$ and $R \rightarrow R_2$.
(iv) Draw the image triangle $P_3Q_3R_3$ of triangle PQR under an anticlockwise rotation of 90° about the origin, where $P \rightarrow P_3, Q \rightarrow Q_3$ and $R \rightarrow R_3$.

11. A pyramid with vertex V has a square horizontal base PQRS of side 8.5cm. Its slant faces slope at an angle of 60° to the base. Calculate, correct to three significant figures,
(i) the height of the pyramid;   (ii) the length of the slant edge;
(iii) the area of the net of the pyramid.

O/L MATHS NOVEMBER 1984

SECTION A

1. $U = \{x: 1 \le x \le 20\}$, where x is an integer, and P, Q and R are subsets of U such that
$P = \{x: x \text{ is multiple of } 2\}, Q = \{x: x \text{ is a multiple of } 3\}$ and
$R = \{x: x \text{ is multiple of } 9\}$
    (i)   What is the relationship between P and Q?
    (ii)   Show the relationship between P, Q and R in Venn diagram, listing the
         elements of each region.
    (iii)   List the elements of: (a) $P \cap Q \cap R'$ (b) $P' \cap Q \cap R'$
    (iv)   A disc is selected form twenty congruent disc numbered 1 to 20. What is the
         probability that the disc bears a number which is not divisible by 2, 3 or 9?

2.   (a) $P(2, 3), Q(5, -2)$ and $R(3, -5)$ are points in the Oxy plane.
        If $k\overrightarrow{OP} + i\overrightarrow{OQ} = \overrightarrow{PR}$, where k and i are real numbers, calculate the value of:
        (i) k (ii) i
    (b)   (i)   Find the truth set of $5\frac{3}{4} \le \frac{1}{2}x \le 7$, where x is a real number.
        (ii)   Illustrate your answer on the number line.

3.   The following statements are true of an examination class in a school.
    P: Students offering Geography do not offer History.
    Q: Students offering Literature also offer History.
        (i)   Write p and q as an implication using the sign $\Rightarrow$, concerning Kweku,
            a student in the class.
        (ii)   State whether or not each of the following is a valid deduction from p
            and q concerning Kweku, given that he offers Literature.
            (α)   Kweku offers History.   (β)   Kweku offers Geography.

4.   (i)   Draw a multiplication table $\otimes$ for arithmetic modulo 7.
    (ii)   Using your table or otherwise,
        (a)   State with reasons whether or not the operation $\otimes$ is commutative.
        (b)   Evaluate $(3 \otimes 5) \otimes (5 \otimes 3)$
        (c)   Find the truth set of $2 \otimes u = 5$

5.   The dimensions of cylindrical container are: diameter = 10.0cm and height = 14.0. A
first year student of St. Joseph's Academy measured the cylinder and obtained the
following results, diameter = 9.8 and height = 14.0cm.
    (i)   Find the error made by pupils in circulating the volume of the container,
    (ii)   Hence, calculate, correct to three significant figures, the percentage error in
         the volume. $\left(\pi = \frac{22}{7}\right)$.

SECTIONB

6.   A publisher prints 30,000 copies of as edition of a book. Each copy of the book costs
the publisher ₦0.45 to produce and it is sold to the publisher for ₦0.76. The publisher
agrees to pay the author 10% of the selling price of the first 6,000 copies sold, and

12% of the selling price for all copies sold in excess 6,000. Altogether 25,300 copies of the books and sold. Calculate, correct to the nearest Naira;

(i)   the total amount received by the author.

(ii)   the net profit the publisher makes after he has paid the author.

(assume that the unsold copies are donated to various libraries)

(iii)   the author's total receipts as a percentage of the publisher's net profit.

(correct to one decimal place)

7.   (i)   Copy and complete the following table for the relation

$$y = 3x - 21 + \frac{84}{x+4}, x \neq -4$$

x	-1	0	0.5	1	1.5	2	2.5	3	4	5
y	4		0.83		-1.23		-0.58		1.5	

(ii)   Using a scale of 2 cm to 1 unit on each axis draw the graph of

$$y = 3x - 21 + \frac{84}{x+4}, x \neq -4 \text{ for } -1 \leq x \leq 5.$$

(iii)   From your graph, obtain, correct to two significant figures:

(a)   the least value of $3x - 21 + \frac{84}{x+4}$, in the given internal.

(b)   the truth set of $3x - 21 + \frac{84}{x+4} = 1$

8.   (i)   QR is a line segment in a given plane. Find the complete locus of a point P in this plane in each of the following case. Illustrate your answer with a diagram.

(a)   Angle QPR is of constant value

(b)   Triangle QPR is of constant area

(ii)   (a)   Using a ruler and a pair of compasses only, construct triangle PQR such that $|QR| = 6.4cm$, angle $QPR = 60°$ and the area of the triangle PQR is $8cm^2$.

(c)   Measure $|PQ|$ and $|PR|$.

9.   The table below shows the percentage marks distribution of 600 candidates in an examination.

Mark	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Freq.	20	46	60	126	163	101	56	20	5	3

(i)   Draw a cumulative frequency curve for the distribution.

(ii)   From your graph, estimate the median mark;

(iii)   What is the probability of picking a script with a mark lower than 45%.

10.   Draw on a sheet of graph paper two perpendicular axes Ox and Oy for $-10 \leq x \leq 10$ and $-10 \leq y \leq 10$ using a scale of 2cm to 2 units on both axes.

(i)   Given the point $A(3, 2)$ and $\overrightarrow{AB} = \begin{pmatrix} -4 \\ 3 \end{pmatrix}, \overrightarrow{BC} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$ and $\overrightarrow{CD} = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$, draw on the same graph:

(a)   The quadrilateral ABCD;

(b) The image $A_1B_1C_1D_1$ of ABCD under an anticlockwise rotation of 90° about the origin $(0, 0)$, where $A \rightarrow A_1, B \rightarrow B_1, C \rightarrow C_1$ and $D \rightarrow D_1$.

(c) The image $A_2B_2C_2D_2$ of $A_1B_1C_1D_1$ under a reflection in the line $y = x$, where $A_1 \rightarrow A_2, B_1 \rightarrow B_2, C_1 \rightarrow C_2$ and $D_1 \rightarrow D_2$.

Label all the vertices clearly with their coordinates.

(ii) Describe precisely the single transformation T for which
T: $ABCD \rightarrow A_2B_2C_2D_2$.

(iii) The side A_1B_1 of the quadrilateral $A_1B_1C_1D_1$ cuts the x-axis at the point P.

(a) Write the coordinates of P?

(b) What type of quadrilateral is $A_1D_1C_1P$?

(c) Calculate, correct to one decimal place, the area of $A_1D_1C_1P$.

11. P and Q are two observations posts on the same horizontal ground as the foot R of a vertical pole RT. P is 1.4km south of R. Q is west of R and is on a bearing of 300° from P. The image of elevation of T from P is 35°. Calculate, correct to three significant figures:

(i) the distance RT.   (ii) the distance RQ.

(iii) the distance PQ.   (iv) the angle of elevation of T from Q.

O/L MATHS JUNE 1985

SECTION A

1. In a class of 55 students, some study at least one of the following subjects: General Science; Commerce and Accounts. 20 students study none of them. The following table gives further details of the subjects studied.

General Science only   4
Commerce only   5
Accounts only   7
All three subjects   7
General Science and Accounts   7
Commerce and Accounts   8

(a) Illustrate the above information in a Venn diagram.

(b) Find the number of students who study;

(i) General Science or Accounts or both, but not Commerce;

(ii) Commerce

2. (a) Draw up   (i) the addition $\oplus$,

(ii) the multiplication $\otimes$ for the sets $\{1, 3, 5, 7\}$ in arithmetic modulo 9

(b) From your tables,

(i) Evaluate $(5 \otimes 5) \oplus (3 \otimes 7)$;

(ii) Find the truth set of $n \otimes 3 = 3$.

3. (a) Express $\dfrac{1 + \sqrt{2}}{\sqrt{2}}$ in the form $p + q\sqrt{2}$ where $p, q \in R$.

(b) Use logarithm tables to evaluate, $\dfrac{\sqrt{16.34}}{10.5 \times 41.3}$, correct to three significant figures.

4. Without using a set square or protractor:
   (a) construct a quadrilateral EFGH in which $|EF| = 6.5cm, |FH| = 9cm,$ $|EH| = 7cm,$ angle $HFG = 60°$ and angle $GEH =$ angle FEG.
   (b) Measure $|EG|$.

5. (a) Multiply 313_{four} and 123_{four}, leaving your answer in base four.
   (b) Given $\overrightarrow{AB} = \begin{pmatrix} -2 \\ 12 \end{pmatrix}$, calculate;
      (i) the length $|AB|$, correct to three significant figures;
      (ii) the bearing B from A, correct to the nearest degree.

SECTIONB

6. Mr. Oppong buys a house for ¢126,000.00. The ground rent is ¢600.00 a year. Annual repairs average $3\frac{1}{2}\%$ of the cost of the house. The property rate payable for the year is 35p in the cedi on an assessment of ¢6,550.00. After the ground rent, the bill for repairs and property rate have been paid, Mr. Oppong has to pay 40p in the cedi as income tax on what is left of the rent paid by Mr. Kojo. Calculate the annual rent so that he can receive $5\frac{1}{2}\%$ of the cost of the house per annum.

7. (a) Copy and complete the following table for the relation, $(x - 1)(y - 1) = 6$ for $2 \le x \le 7$.

x	2	2.5	3	4	5	6	7
y	7			3			2

   (b) Using a scale of 2cm to represent 1 unit on both axes, draw the graphs
      (i) $(x - 1)(y - 1) = 6$ (ii) $x + y = 8$ within the interval
   (c) Use your graphs to find, correct to two significant figures, the truth set of the simultaneous equations $(x - 1)(y - 1) = 6, \; x + y = 8$.

8. Mr. Brakatu and Mr. Jojo walk from house A to house B, 11.2km away. Mr. Jojo starts at 10:00 am and walks at a constant speed of 4.8kmh⁻¹, but makes a call lasting 30 minutes at a point on the journey 6.4km from house A. Mr. Brakatu starts at 11:00 am and walks at a constant speed of 6.4kmh⁻¹.
   (a) Taking 2cm to represent 20 minutes on the time axis and 2cm to represent 1km on the distance axis, draw the travel graphs of Mr. Brakatu and Mr. Jojo using the same axes.
   (b) Use your graph to find:
      (i) where Mr. Brakatu overtakes Jojo;
      (ii) the times Mr. Brakatu and Mr. Jojo arrive at their destination.

9. The following is the frequency distribution table of the marks scored by candidates in an examination.

Marks%	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Freq.	5	5	17	23	32	18	11	4	3	2

(a) Make a cumulative frequency table and use it to draw a cumulative frequency curve for this distribution.

(b) Use your graph to estimate the median mark;

(c) Find the pass mark if 30% of the candidate failed.

10. (a) Using a scale of 2cm to 1 unit on both axes, $-4 \le x \le 5$ and $-5 \le y \le 5$, draw triangle PQR with vertices $P(-1,2), Q(1,4)$ and $R(2,1)$.

(b) Draw: (i) the image triangle $P_1Q_1R_1$ of triangle PQR under a reflection in the line $y = 0$, where $P \to P_1, Q \to Q_1$ and $R \to R_1$.

(ii) the image triangle $P_2Q_2R_2$ of triangle PQR under a translation by the vector $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$, where $P \to P_2, Q \to Q_2$ and $R \to R_2$.

(iii) the image triangle $P_3Q_3R_3$ of triangle PQR under a clockwise rotation of 90° about the origin where $P \to P_3, Q \to Q_3$ and $R \to R_3$.

(c) Name to coincident points in your diagram.

(d) Describe precisely a single transformation that maps triangle $P_1Q_1R_1$ onto $P_3Q_3R_3$ where $P_1 \to P_3, Q_1 \to Q_3$ and $R_1 \to R_3$.

11. The horizontal base of a vertical pyramid is a regular pentagon PQRST of side 6m. The vertex V of the pyramid is 12m above the centre O of the circle passing through P, Q, R, S and T. Calculate, correct to three significant figures:

(a) the angle between the sloping edge and the base;

(b) the angle between a sloping face and the base;

(c) the volume of the pyramid.

O/L MATHS NOVEMBER 1985
SECTION A

1. Of 120 cars taking roadworthiness test, 60% passed. Of the number that failed, faults in brakes, lights and steering occurred as followed;

Brakes only   14
Brakes and steering   7
Brakes and lights   10
Brakes, steering and lights   4
Steering and light only   3

The number of cars that failed because of faults in steering only equaled the number of cars that failed due to faults in lights only.

(a) Illustrate this information above in a Venn diagram.

(b) How many cars had faulty lights?

     (c)   How many cars had only one fault?

2.   (a)   Find the exact value of $\dfrac{0.05 \times 0.189}{0.0105}$.

     (b)   What is the value of x, if $110_x = 1020_4$?

3.   (a)   If $\underline{p} = \begin{pmatrix} 2 \\ 7 \end{pmatrix}$ and $\underline{q} = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$, find $2\underline{p} - 3\underline{q}$.

     (b)   Simplify $\dfrac{5.4 \times 10^8}{0.18 \times 10^{11}}$, expressing your answer in the standard form.

     (c)   If $\sqrt{3} - \dfrac{2}{\sqrt{3}} = p\sqrt{3}$, find the value of p.

4.   Using a ruler and compasses only,
     (a)   construct triangle PQR with $|PQ| = 5.5cm, |PR| = 7cm$ and
               angle $PRQ = 135°$;
     (b)   Measure $|PQ|$;
     (c)   Find, by construction, a point S within triangle PQR which is on the mediator
               of QR and $8.8cm$ from P.
     (d)   Measure $|QS|$.

5.   The expenditure of an employee of a certain company is distributed as follows:

          Food   40%
          Rent   18%
          Car Maintenance   25%
          Savings   12%
          Taxes   5%

     (a)   Show this information on a pie chart.
     (b)   Find his savings at the end of the year if his annual salary is Le 6200.00

SECTIONB

6.   A Nigerian soap factory finds that the cost of materials and labour to produce a
     certain brand of soap are in the ratio 3:5. The factory sells to a wholesaler at a profit
     of $27\frac{1}{2}\%$ and the wholesaler sells to a retailer at a profit of 25%.
     (a)   If the retailer pays ₦1530.00 each box of soap, calculate how much it costs the
               factory in
               (i)   materials   (ii)   the labour to produce a box of soap.
     (b)   The labour cost went up by 20% (with increase in the cost of materials), the
               price charged to the wholesaler. Calculate, correct to the nearest whole but the
               factory decided not to increase number, the new percentage profit the factory
               made.

7.   (a)   Copy and complete the following table of values for the relation
               $y = 2 + x - x^2$.

x	-2	-1.5	-1	-0.5	0	1	1.5	2	2.5	3
y			0	1.25	2	2	1.25			

     (b)   Draw the graph of the relation, using a scale of 2cm to 1unit on each axis.

(c) From your graph, find the greatest value of $2 + x - x^2$ and the value of x at which this occurs.

(d) Using the same axes, draw the graph of $y = 1 - x$ and use your graph to determine the truth set of the relation $1 + 2x - x^2 = 0$.

8. Mr. White started from his house at 7:30am and cycled to his office at an average speed of 12kmh⁻¹. Mrs. Roberts started from Mr. White's house at 8:00am and travelled by car in the same direction as Mr. White at an average speed of 48kmh⁻¹. After travelling 8km, Mrs. Roberts met a friend and stopped for 12 minutes. She then continued her journey at the same average speed as before.

(a) Using 2cm to 20 minutes and 2cm to 2km draw the graphs of the journey of Mr. White and Mrs. Roberts.

(b) Use your graphs to find:
   (i) when Mrs. Roberts overtook Mr. White;
   (ii) how far Mr. White was from his house when Mrs. Roberts overtook him;
   (iii) find the distance between Mr. White and Mrs. Roberts at 8:20am.

9. The table below shows the mark distribution of candidates interviewed for promotion to a senior grade in the Ghana Education Service.

Marks	44-46	47-49	50-52	53-55	56-58	59-61	62-64	65-67	68-70	71-73
Freq.	3	4	11	20	26	42	46	36	9	2

(a) Draw a cumulative frequency graphs for this distribution.
(b) From your graph, estimate the median mark.
(c) What is the probability of selecting a candidate who obtained at least 66%?

10. (a) Draw on a sheet of paper two perpendicular axes Ox and Oy for the intervals $-6 \le x \le 6$ and $-3 \le y \le 6$.

(b) Plot, indicating the coordinates of all vertices:
   (i) Triangle PQR with $P(-2, 4), Q(3, -1)$ and $R(2, 5)$.
   (ii) The image $P_1Q_1R_1$ of triangle PQR under a reflection in the line $y = x$, $P \to P_1, Q \to Q_1$ and $R \to R_1$.
   (iii) The image triangle $P_2Q_2R_2$ of triangle PQR under a clockwise rotation about the origin O through an angle of 90°, where $P \to P_2, Q \to Q_2$ and $R \to R_2$.

(c) Find the gradient and hence the equation of the line PQ.

11. $P(Lat\ 60°N,\ Long.\ 15°E), Q(Lat.\ 60°N,\ Long.\ 48°W)$ and $R(Lat.\ 38°S,\ Long.\ 48°W)$ are three places on the Earth's surface. Calculate, correct to three significant figures;

(a) the distance PQ measured along the latitude;
(b) the distance QR along the meridian,
(c) the time taken by an aircraft to cover the distance PQ and QR at an average speed of 800km/h. $[Take\ \pi = 3.142,\ Radius\ of\ the\ Earth = 6400km]$.

O/L MATHS JUNE 1986

SECTION A

1.   (a)   Consider the following statements:

   P: Abena has measles   Q: Abena is in the hospital

   If $P \Rightarrow Q$, state whether or not the following statements are valid.

   (i)   If Abena is not in the hospital, then she does not have measles.

   (ii)   If Abena is in the hospital, then she has measles.

   (iii) If Abena does not have measles, then she is not in the hospital.

   (b)   If $P = \{x: x \text{ is } factor \text{ of } 36\}$, $Q = \left\{x: \frac{1}{2}x - 3 < x - 6\right\}$ and $R = \{x: x < 10\}$
   are subsets of $U = \{integers\}$, list the elements of $P \cap Q \cap R$.

2.   (a)   If $x\cos 60° = 1.5$ and $y\sin 30° = 2$, evaluate $\sqrt{x^2 + y^2}$.

   (b)   Given that $\overrightarrow{PQ} = \binom{-4}{7}$ and $\overrightarrow{RP} = \binom{3}{-5}$.

   (i)   Find $\overrightarrow{QR}$.

   (ii)   Describe precisely the geometric relationship between $\overrightarrow{QR}$ and
   $\overrightarrow{ZM} = \binom{-3}{6}$.

3.   The following table shows the distribution of the expenses of a family in a certain year;

	Le
Food	4,500.00
Housing	1,200.00
Clothing	1,200.00
Tobacco and drinks	1,700.00
Entertainment and books	400.00

   (a)   Construct a pie char to show the distribution of expenses.

   (b)   What percentage of the total expenses was on food?

4.   (a)   Find the truth set of $\frac{1}{3}x - \frac{1}{4}(x + 2) > 3x - 1\frac{1}{3}$, where x is a real number.
   Illustrate your answer on a number line.

   (b)   Draw a table for multiplication $\otimes$ modulo 13 on the set $P = \{1, 5, 8, 12\}$. Use
   your table to find on P the truth set of

   (i) $12 \otimes n = 5$ (ii) $n \otimes n = 12$

5.   PQR is an isosceles triangle in which $|PQ| = |QR|$ and M is the midpoint of PR.

   (a)   Show that $\overrightarrow{QP} + \overrightarrow{QR} = 2\overrightarrow{QM}$

   (b)   If $\overrightarrow{PQ} = \binom{-3}{4}$ and $\overrightarrow{QR} = \binom{4}{3}$,

   (i)   express $\overrightarrow{QM}$ as a column vector.

   (ii)   calculate $|\overrightarrow{QR}|$, correct to three significant figures.

SECTION B

6.   Mr. Blain and Mr. Thomas entered into a partnership with capitals D12600.00 and D19200.00 respectively. After three months they were joined by Mr. Ceesay with a capital of D16200.00. It was agreed that the profits should be shared in proportion to their capitals. During the first three months of the year, the business made a profit of 24% of the working capital and during the remaining nine months the profit of was 32% of the working capital.

    (a)   Find the amount received by each partner as his share of the profits for the year.

    (b)   Express Mr. Blain share of the profit as a percentage of his investment.

7.   (a)   Draw on this graph, indicating the coordinates of all vertices:

        (i)   A triangle ABC with vertices $A(3, 2), B(5, 4)$ and $C(1, 4)$;

        (ii)   The image triangle DEF of triangle ABC when it is reflected in the line $y = x$, where $A \to D, B \to E$ and $C \to F$;

        (iii)   Triangle PQR, the image of triangle DEF, under an enlargement from the origin with a scale factor of -1, where $D \to P, E \to Q$ and $F \to R$.

    (b)   Find the equation of AD.

8.   (a)   Copy and complete the table for the relation $y = x^2 - 3x + 7$

x	−2.0	−1.5	−1.0	−0.5	0	0.5	1.0	2.0	3.0	4.0	4.5	5.0
y		13.75	11.00				5.00		7.00		13.75	17.00

    (b)   Using a scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graph of the relation for $-2.0 \le x \le 5.0$

    (c)   From the graph, find in the given intervals;

        (i)   the truth set of $x^2 - 3x - 4 = 0$

        (ii)   the least point on the graph

        (iv)   the equation of the line of symmetry.

9.   (a)   Find the truth set of the equation $34x + 289 = 3x^2$.

    (b)   The height of a cylinder X of a given material varies directly as the mass, and inversely as the square of the radius r. The height of X is 12cm. It is required to make another cylinder Y of the same material. If the mass of Y is $\frac{1}{4}$ the mass of X and its radius is 0.4 that of X, calculate, correct to three significant, the height of Y.

10.   The following table gives the frequency distribution of the results of an examination takes by students from two schools A and B.

Mark	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
School A	2	4	7	14	25	20	11	5	2
School B	0	2	6	10	15	28	22	9	3

    (a)   Form the cumulative frequency table for each school.

    (b)   Using scales of 2cm to 10 marks and 2cm to 10 students draw the cumulative frequency curves of the distributions.

(c)   What percentage of each school scored more than 65 marks?

O/L MATHS NOVEMBER 1986

SECTION A

1.   (a)

*	1	2	5	6
1	3	5	0	1
3	5	4		
5	0			
6		6	4	3

The operation $*$ is defined by $m * n = mn + 2$, in arithmetic modulo 7.
(i)   Copy and complete the table operation $*$ on the set $\{1, 3, 5, 6\}$.
(ii)   From the table in (i) find the truth set of
       (α) $3 * n = 3$ (β) $m * m = 4$

(b)   The following statements are true of a certain class in a school.
P: All pupils who study Mathematics also study General Science.
Q: No pupil studies both Health Science and General Science.
(i)   Using the symbol $\Rightarrow$, write the statements p and q concerning Kofi
who studies General Science in this class.
(α)   Kofi necessarily studies Mathematics
(β)   Kofi studies Health Science.

2.   (a)   Given that $125^{(x + 2)} = 5^{2y}$, find x in terms of y.
(b)   Convert 432_5 to a number in base three.

3.   (a) $M(5, 6), N(-1, 4)$ and $B(-1, 5)$ are three points in a plane. If A is the
midpoint of MN, express the $\overrightarrow{AB}$ in the form $\begin{pmatrix} x \\ y \end{pmatrix}$.

(c)   Find the truth set of $4 + \frac{3}{4}(x + 2) < \frac{3}{8}x + 1$ and illustrate the truth set on a
number line.

4.   A housewife spent the following sums of money in buying ingredients for a family
Christmas cake in 1984.
       Flour   ¢24.00
       Margarine   ¢96.00
       Sugar   ¢18.00
       Eggs   ¢60.00
       Baking Powder   ¢12.00
       Miscellaneous   ¢30.00
(a)   Represent the above information on a pie chart.
(b)   What percentage of the total sum was spent on sugar?

5.   Using a ruler and a pair of compasses only,
(a)   construct a triangle MNX with $|MX| = 12cm, |MN| = 6cm$ and $\angle 30°$.
(b)   Find the point T on MN which is equidistant from M and N and measure $|TX|$.

SECTION B

6.   The estimated cost of a house was Le 6400.00. It was made up of the cost of labour, materials and the contractors' charges in the ratio 12:15:5 respectively. During construction, as a result of inflation, the cost of labour increased by r %, the cost of materials by 2r % while the contractors' charges remained the same. If after the increases the cost of labour was third-thirds the cost of materials, find:
(a)   the value of r.   (b)   the new cost of the house.

7.   (a)   Copy and complete the table for the relation: $y = \dfrac{3x^2 - 8x}{3x + 8}, x \neq -\dfrac{8}{3}$.

x	-2	-1	0	1	2	3
y						

(b)   Using a scale of 2 cm to 1 unit on the x-axis and 2 cm to 0.5 units on y-axis, draw the graph for the relation for the interval $-2 \leq x \leq 3$.

(c)   Using the same scale and axes, draw the graph of $y = -\dfrac{1}{8}x$.

(d)   Write down, correct to one decimal place, the coordinates of the points of intersection of the two graphs.

8.   (a)   Simplify $2\sqrt{175} - \sqrt{567} + \dfrac{32}{\sqrt{7}}$, leaving your answer in surd form.

(b)   Make h the subject of the relation $a = \sqrt{h^2 + r^2}$.

(c)   (i)   For what value of x is the expression $\dfrac{x^2 + 7x - 60}{x + 1}$ not defined?

(ii)   Find the value of x for which the expression is 0.

9.   The table shows the mark distribution of candidates in an examination.

Marks%	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Freq.	3	17	41	85	97	15	101	64	21	6

(a)   Draw a cumulative frequency table for the distribution.
(b)   Using a scale of 2cm to 10 marks and 2cm to frequency of 50, draw the cumulative frequency graph for the distribution.
(c)   From your graph, estimate the median mark of the distribution.
(d)   What is the probability of selecting a candidate with a mark of at least 45%?

10.   Draw on a sheet of graph paper two perpendicular axes for $-5 \leq x \leq 5$ and $-6 \leq y \leq 6$, using a scale of 2 cm to 1 unit on both axes.
(a)   Draw on the graph sheet a quadrilateral $FGHJ$ with $F(1,1), G(3,1), H(3,3)$ and $J(1,3)$.
(b)   Draw the image $F^1G^1H^1J^1$ of $FGHJ$, where $F \rightarrow F^1, G \rightarrow G^1, H \rightarrow H^1$ and $J \rightarrow J^1$ under the mapping $\begin{pmatrix} x \\ y \end{pmatrix} \rightarrow \begin{pmatrix} x - 2y \\ y - 2x \end{pmatrix}$, showing clearly the coordinates of the vertices.
(c)   Describe precisely the slope of the image $F^1G^1H^1J^1$.
(d)   What is the ratio of the area of $FGHJ$ to the area of $F^1G^1H^1J^1$?
(e)   What two other transformations will map F onto F^1?

11. $P(Lat.\,42°N, Long.\,24°W)$ and $Q(Lat.\,42°N, Long.\,40°E)$ are two points on the Earth's surface. Assuming that the Earth's is a sphere of radius 6400km, calculate, correct to three significant figures,

(a) the radius of latitude $42°N$;

(b) the distance PQ measured along the line of latitude;

(c) the total time taken by an aeroplane to fly at an average speed of $750kmh^{-1}$ from P to Q and then along longitude $40°E$ to a point S on the equator.
($Take\ \pi = 3.142$)

O/L MATHS JUNE 1987
SECTION A

1. Two binary operations $*$ and $\oplus$ are defined as follows:
$p * q = \frac{1}{p} + \frac{1}{q}$ and $p \oplus q = \frac{1}{p} - \frac{1}{q}$, where $p \neq 0$ and $q \neq 0$

(a) If $p = \frac{3}{5}$ and $q = \frac{1}{3}$, evaluate:

(i) $p * q$ (ii) $\dfrac{p * q}{p \oplus q}$

(b) If $p * q = \dfrac{1}{p \oplus q}$, evaluate $p^2 \oplus q^2$.

2. (a) If $\underline{p} = \begin{pmatrix} 2 \\ -2 \end{pmatrix}$ and $\underline{q} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$, find $\underline{r}$ such that $\frac{1}{2}\underline{p} - \underline{q} + \underline{r} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$.

(b) A petty trader wants to buy oranges at 2.50 each and mangoes at 2.00 each. She decides to buy twice as many mangoes as oranges. Her total cost was not less than 65.00 and not more than 78.00. Taking x to be the number of oranges.

(i) Write the given information as an inequality in x.

(ii) Illustrate the truth set on the number line.

3. (a) Given that $X = \{2, 3\}$, $Y = \{2\}$, $Z = \{3\}$, $S = \{\ \}$

(i) Copy and complete the table below for the intersection of sets X, Y, S and Z.

$\cap$	X	Y	Z	S
X			Z	
Y		Y		
Z				
S				S

(ii) Use your table to find $X \cap Y \cap Z$.

(b) Consider the following statements:

P: All soldiers are men.

Q: There is no soldier who does not use a gun.

(i) If $M = \{men\}$, $S = \{soldiers\}$ and $G = \{people\ using\ guns\}$, draw a Venn diagram to illustrate P and Q.

(ii) State whether or not each of the following is a valid conclusion form P and Q.

     (α) Men who use guns are soldiers.

     (β) All men use guns.

     (γ) Men who do not use guns are not soldiers.

4. (a) Simplify $\sqrt{5}\left(\sqrt{5} + \frac{3}{2\sqrt{5}}\right)$

  (b) If $p = \frac{m}{R^2} + k$

    (i) Make R the subject of the relation.

    (ii) Find R, correct to two significant figures, given that $p = 14,\ m = 6$ and $k = 2$.

5. Using a ruler and a pair of compasses only, construct a quadrilateral ABCD in which $|AB| = 6.5cm, |BC| = 8.5cm,\ angle\ ABC = 105°, |BD| = 11.5cm$ and $|AD| = |DC|$. Measure $|AD|$.

SECTION B

6. A manufacturing company has a capital of ₦900.00. The gross annual sales are ₦375,000. The cost of materials and manufacture is 35% of the gross sales. Other costs are as follows: rent, rates and taxes ₦38,700; advertising ₦94,000; office expenses ₦13,600; Manager's salary ₦20,000 together with 1% of the gross sales.

  (a) Find, correct to one decimal place, the percentage rate of interest that can be paid on the capital.

  (b) If the cost of advertising is doubled and in consequence the gross sales increases by 40%, find the increase in the annual profit.

7. (a) Draw a graph on a sheet of graph paper, using a scale of 2cm to 2 units on both axes, for both the interval $-10 \le x \le 10$ and $-10 \le y \le 10$. Draw triangle OPQ with coordinates $P(0, -4)$ and $Q(3, 4)$ where O is the origin.

  (b) Draw the image triangle $O'P'Q'$ of triangle OPQ under rotation about $R(10, 0)$, where $O \to O'(2, 6), P \to P'$ and $Q \to Q'$. From your diagram, find:

    (i) the angle of rotation   (ii) the coordinates of Q'

  (c) Draw the image triangle $O''P''Q''$ of triangle OPQ, where $O \to O'', P \to P''$ and $Q \to Q''$ under a reflection in the line $x + 2 = 0$. State the coordinates of O'', P'' and Q''.

8. (a) Using a scale of 2cm to represent 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graph of the following relations for the interval $0 \le x \le 6$.

    (i) $y = 1 + 6x - x^2$ (ii) $y = 11 - x$

  (b) Use your graphs to find:

    (i) the greatest value of $1 + 6x - x^2$;

    (ii) the truth set of the simultaneous equations $y = 1 + 6x - x^2$ and $x + y = 11$.

9.   (a)   The cost of producing a radio component is partly constant and partly varies inversely with the number of components produced per day. If 100 components are produced per day, the cost is ₦6.00 per component; if 200 are produced, the cost is reduced to ₦4.50 per component.

        (i)   What is the cost of each component if 500 are produced per day?

        (ii)   How many components can be produced per day at a cost of ₦9.00 per component?

   (c)   Under the mapping $x \rightarrow px + qx^2$, the image of 1 is 5 and the image of 3 is 27. Find the value of p and q.

10.   In a workshop, the times taken by 12 trainees to identify a fault in a machine are shown in the table below.

Number of minutes	1	2	3	4	5	6	7	8	9	10
Number of trainees	2	3	5	10	15	30	25	15	10	5

   (a)   Draw a histogram of the distribution;

   (b)   Find the mean of the distribution;

   (c)   If a trainee is picked at random, what is the probability that the time he took to identify the fault was less than five minutes?

11.   S, the foot of a vertical pole RS, is on the same horizontal level as two observation posts P and Q. The pole RS is due North of Q and Q is 90km due east of P. At P, the angle of elevation of R is 30° and at Q the angle of elevation of R is 45°. Calculate, correct to three significant figures;

   (a)   the height of the pole RS.   (b)   the bearing of P from the pole RS.

O/L MATHS JUNE 1988
SECTION A

1.   A Science Sixth Form in a school has 12 teachers. Of these, 6 teach Mathematics, 5 teach Physics and 4 teach Chemistry. 2 teach Mathematics and Physics but no one teaches both Mathematics and Chemistry.

   (a)   Draw a Venn diagram to illustrate the above information.

   (b)   Find the number of teachers who teach;

        (i)   Chemistry and Physics

        (ii)   only Physics

2.   The operation $*$ is defined by $a * b = ab + 2$, in arithmetic modulo 5.

   (a)   Draw a table for the operation $*$ on the set $\{1, 2, 3, 4\}$;

   (b)   From your table;

        (i)   evaluate $(2 * 3) + (3 * 2)$.

        (ii)   find the truth set of the equation $n * (n * 3) = 3$.

3.   (a) $A(9, 5)$ and $B(3, 11)$ are points in the Oxy plane. If C is the midpoint of AB, find:

        (i) $\overrightarrow{OC}$

      (ii)   the value of the acute angle between $\overrightarrow{OC}$ and the x-axis, correct to the nearest degree.

    (b)   Find the truth set of $\frac{1}{2}(x+1) - 1 \leq x - \frac{1}{3}$.

4.   (a)   Simplify $311_{five} + 213_{four} - 332_{four}$, leaving your answer in base ten.

    (b)   If $p = -2$ and $q = 3$, evaluate $\dfrac{p-2q}{p+2q} - \dfrac{q-p}{q+p}$.

5.   Using a ruler and a pair of compasses only,

    (a)   construct triangle XYZ with $|YZ| = 8cm, |ZX| = 7cm$ and $\angle 135°$.

    (b)   Find the point P on XY which is equidistant from Y and Z.

    (c)   Measure $|PZ|$.

SECTION B

6.   Atiomo borrows ¢900.00 from Oppong and the same amount from Asamoah to start a business. He agrees to pay Oppong 15% of the profits of the business each year. He also agrees to pay Asamoah 10% of the annual profits in addition 3% interest on his loan each year.

    (a)   Find how much Oppong is paid in a year in which Asamoah receives ¢48,000.00.

    (b)   How much is Oppong paid in a year in which he receives ¢12,750.00 more than Asamoah?

7.   (a)   Copy and complete the table of values below for the relation $y = x^2 - 4x - 21$ for $-4 \leq x \leq 6$.

x	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8
y	11	0			-21	-24			-21	-16	-9	0	11

    (b)   Using a scale of 2 cm to 2 units on the x-axis and 2cm to 5 units on the y-axis, draw the graph of the relation.

    (c)   Use your graph to find:

        (i)   the least value of the relation $y = x^2 - 4x - 21$.

        (ii)   the equation of the axis of symmetry.

        (iii)   the truth set of the equation $x^2 - 4x - 16 = 0$.

8. P, Q and R are three ships at sea. The bearing of Q from P is $030°$ and the bearing of P from R is $300°$. If $|PQ| = 5km$ and $|PR| = 6km$, calculate to three significant figures,

    (a) $|QR|$ (b) $\angle PQR$ (c)   the bearing of R from Q

9.   The following is a record of marks obtained by a group of 50 candidates in an examination.

48	63	62	59	12	57	37	38	81	43
23	9	70	58	70	44	28	18	23	2
25	42	40	90	63	63	83	8	27	58
54	81	91	45	31	32	43	19	93	72

| 25 | 63 | 82 | 71 | 35 | 35 | 63 | 46 | 17 | 7 |

(a)   Tabulate the marks as a frequency distribution grouping in the intervals of 10 marks namely; 0-9, 10-19, 20-29 etc,

(b)   Draw a histogram for this distribution.

(c)   Find: (i)   the modal class   (ii)   the mean of the distribution

10.   (a)   Using a scale of 2cm to 1 unit on each axis, draw on a sheet of graph paper, two perpendicular axes Ox and Oy, for the intervals $-5 \le x \le 5$ and $-5 \le y \le 5$.

(b)   Draw; indicating the coordinates of all vertices:

(i)   A quadrilateral $ABCD$ with vertices $A(2, 1), B(4, 1), C(4, 3)$ and $D(2, 3)$;

(ii)   The image $A_1B_1C_1D_1$ of ABCD under an anticlockwise rotation 90° about the origin $O(0, 0)$ where $A \to A_1, B \to B_1, C \to C_1$ and $D \to D_1$.

(iii)   The image $A_2B_2C_2$ of ABCD under a translation by the vector $\begin{pmatrix} -1 \\ -3 \end{pmatrix}$, where $A \to A_2, B \to B_2, C \to C_2$ and $D \to D_2$.

(c)   Find the equation of the line AB_2.

11.   An aeroplane flies from point $Q(Lat\ 15°N, Long.\ 20°E)$ due West to T on the same latitude.

(a)   If the distance QT along the parallel of latitude of Q is 3000km, find longitude of T.

(b)   From T, the aeroplane flies due North for 5 hours to a point S on latitude 40° North. Find the speed of the aeroplane, correct to two significant figures. (Take $\pi = 3.142$ and the radius of the earth = 6400km)

O/L MATHS NOVEMBER 1988
SECTION A

1.   (a)   In an examination, every candidate took history or geography or both. Out of 500 candidates, 60% took History, while 72% took Geography. How many candidates took both subjects?

(b)   The following statements are true of a class in certain school.

P: All students suffering from malaria go to the hospital.

Q: No healthy student goes to the hospital.

(i)   Write P and Q as statements of implication using the symbol $\Rightarrow$ concerning Abena, a student in the class.

(ii)   Which of the following are valid conclusions from P and Q?

(α)   Abena is healthy, so she has gone to the hospital.

(β)   Akosua has malaria, so she is healthy.

2.   (a)   Draw: (i)   the addition $\oplus$ and   (ii)   multiplication $\otimes$ tables for the set $\{1, 5, 7, 11\}$ in arithmetic modulo 12.

(b)   Using your tables;

        (i)   Evaluate $7 \oplus (7 \otimes 11)$ (ii)   Find the truth set of $n \otimes n = 1$

3.   (a)   If $\underline{p} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}, \underline{q} = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$ and $\underline{r} = \underline{p} + \frac{1}{2}(\underline{p} - \underline{q})$, find: (i) $\underline{r}$ (ii) $|\underline{r}|$

     (b)   Simplify $\sqrt{3}\left(\sqrt{12} - \frac{3}{\sqrt{12}}\right)$

4.   (a)   In the diagram, PR is perpendicular to QS. Angle $QPS = 60°$, angle $PSR = 30°$ and $|PQ| = 8cm$. Calculate $|SR|$, calculate to 2 significant figures.

     (b)   Given that x is a real number, find the truth set of $\frac{1}{3}(2x - 1) \geq 4$.

5.   The table below shows the percentage allocation of funds for a development in a village.

Agriculture	30%
Small Industries	10%
Power	20%
Social Services	15%
Transport	20%
Miscellaneous	5%

     (a)   Illustrate the above information on a pie chart.

     (b)   If the total amount to be spent is ₦400,000, find how much is allocated for Power.

SECTION B

6.   (a)   A retailer bought 600 copies of a book at ₦4.50 each. He sold 500 copies at ₦6.00 each, but gave a discount of 5K in the naira. He sold the remainder of the books half the selling price, but without discount. Calculate the retailer's percentage gain, correct to three significant figures.

     (b)   A labourer who is paid by the hour, worked 40 hours in a certain week for a basic weekly wage of ₦60.00. If worked 6 hours overtime and half, 4 hours overtime at double time, calculate:

     (i)   His basic hourly rate;   (ii)   His total overtime pay for week;

     (iii)   His gross pay for the week.

7.   (a)   Copy and complete the following table for the relation $y = \frac{1}{2}(2x - 1)(x + 2)$.

x	-3.5	-3	-2	-1	-0.5	0	1	2
y	6	3.5	0					6

     (b)   Using a scale of 2 cm to 1 unit on each axis, draw the graph of the relation. $y = \frac{1}{2}(2x - 1)(x + 2)$ for $-3.5 \leq x \leq 2$.

     (c)   Use your graph to find:

     (i)   The values of x for which y is negative;

     (ii)   The values of x for which y is least;

     (iii)   The truth set of $y = \frac{1}{2}(2x - 1)(x + 2) = 4$.

8.   Mr. Appiah leaves his home at 8:00 am to walk to a village 10km away, at an average speed of 5kmh^{-1}. He stops at the village for 30 minutes for refreshment before walking back home at an average speed of 4kmh^{-1}. At 9:30 am his wife sets out from this home walking at an average speed of 3kmh^{-1} to meet him. After meeting, Mr. Appiah and his wife get a lift in cart which brings them home at 12 noon.

(a)   Using a scale of 2cm to 30 minutes and 2cm to 2km, draw the travel graphs of Mr. Appiah and his wife and the cart.

(b)   Use your graph to find;
  (i)   When Mr. Appiah reaches the village;
  (ii)   When and where Mr. Appiah met his wife;
  (iii)   The average speed of the cart.

9.   The following table shows the frequency distribution of the masses, to the nearest kg of 100 men.

Mass	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	100-104
Freq.	2	6	9	23	25	13	10	6	5	1

(a)   Make a cumulative frequency table for the distribution.

(b)   Use your table to draw a cumulative frequency curve.

(c)   Use your curve to estimate:
  (i)   the median of the distribution.
  (ii)   the probability of picking from the group a man whose mass is at least 78kg.

10.   (a)   Using a scale of 2cm to 2 units on each axis, draw on a sheet of graph paper, two perpendicular axes Ox and Oy, for the intervals $-10 \leq x \leq 10$ and $-10 \leq y \leq 10$.

(b)   Draw:
  (i)   Triangle ABC with vertices $A(2,9), B(5,9)$ and $C(2,4)$.
  (ii)   the image triangle $A_1B_1C_1$ of triangle ABC under a reflection in the line $y + x = 0$, where $A \rightarrow A_1, B \rightarrow B_1$ and $C \rightarrow C_1$.
  (iii)   The image triangle $A_2B_2C_2$ of triangle $A_1B_1C_1$ under translation by the vector $T = \begin{pmatrix} 6 \\ 2 \end{pmatrix}$, where $A_1 \rightarrow A_2, B_1 \rightarrow B_2$ and $C_1 \rightarrow C_2$.

(c)   Describe the precisely the two transformations that will map triangle $A_2B_2C_2$ onto triangle ABC, where $A_2 \rightarrow A, B_2 \rightarrow B$ and $C_2 \rightarrow C$.

11.   A triangle pyramid ABCD is such that when it rest with the base ABC on a horizontal plane, D is vertically above A. Given that $|AB| = |AC| = 30cm$, angle $ABC = 55°$ and angle $ABD = 37°$, calculate, correct to three significant figures;

(a) $|BD|$ (b) $|AD|$
(c)   The angle which the plane DBC makes with the horizontal.

O/L MATHS JUNE 1989

SECTION A

1. (a) The following statements are true of a certain school.

P: There is no left-handed boy in the football team.

Q: All the good students in Mathematics are in the football team.

If $L = \{left - handed\ boys\}, T = \{football\ team\}$ and

$R = \{Good\ Mathematics\ students\}$

(i) Draw your Venn diagram to illustrate P and Q.

(ii) Using your Venn diagram, state whether or not each of the following is a valid deduction from P and Q.

(α) Fosu is not a good student of Mathematics therefore he is not in the football team.

(β) Opare is left-handed so he is not a good student of Mathematics.

(b) If $P = \{factors\ of\ 42\}$ and $Q = \{factors\ of\ 54\}$, find

(i) $P \cap Q$ (ii) the H.C.F of 42 and 54.

2. The operation $*$ defined on the set of real numbers by $m * n = \frac{m-n}{n}, n \neq 0$.

(a) Evaluate $3 * (5 * 2)$

(b) Find the truth set of: (i) $8 * k = 12 * 3$ (ii) $k * 8 = 12 * 3$

3. (a) If x varies directly as y and inversely as z, write an equation connecting x, y and z. Given that $x = 8$ when $y = 5$ and $z = 3$, find the y when $x = 12$ and $z = 4$.

(b) Find the truth set of $x^2 - 7x + 12 = 0$.

4. (a) If $\underline{p} = \binom{2}{1}, \underline{q} = \binom{1}{1}, \underline{r} = \binom{13}{7}$ and $k\underline{p} + m\underline{q} = \underline{r}$, calculate the values of k and m.

(b) Express $\sqrt{15}\left(\sqrt{27} - \frac{2}{\sqrt{3}}\right)$ in form $\left(p\sqrt{q}\right)$, where p and q are real numbers.

5. The following data gives the monthly budget of a family.

Food	₦60.00
Clothing	₦10.00
House Rent	₦50.00
Fuel and light	₦15.00
Miscellaneous	₦35.00
Savings	₦30.00

(a) Represent the information on a pie chart.

(b) What percentage of the family budget is for House Rent?

SECTION B

6.   A man has a wife and 6 children and his total income in 1985 was ₦8500.00. He was allowed the following free of tax.

Personal	₦1200
Wife	₦300
Each Child	₦250 for a maximum of 4
Dependent relatives	₦400
Insurance	₦250

The rest of the taxes were as follows:
  The first ₦2000 at 10%
  The next ₦2000 at 15%
  The next ₦2000 at 20%
  The next ₦2000 at 25%

Calculate:

(a)   His tax free pay;

(b)   His taxable income;

(c)   His monthly tax;

(d)   His net monthly pay.

7.   (a)   Copy and complete the table of values for the relation $y = 4 + \frac{1}{2}x - \frac{1}{3}x^2$, for $-3 \le x \le 4$.

x	-3	-2	-1	0	1	2	3	4
y		1.7	3.2		4.2	3.7		0.7

(b)   Using a scale of 2cm to 1 unit on each axis, draw the graph of the relation for the given interval.

(c)   From your graph, find:

  (i)   the value of k for which $x = 2.3$ and is a member of the truth set of the equation $4 + \frac{1}{2}x - \frac{1}{3}x^2 = k$;

  (ii)   the equation of the axis of symmetry of the curve;

  (iii)   the truth set of the equation $12 + 3x - 2x^2 = 0$.

8.   With the aid of a pair of compasses and a ruler only, construct a parallelogram $ABCD$ such that $|AB| = 8cm$, angle $BAC = 45°$ and angle $ABC = 60°$. Measure $|BC|$. Locate a point P inside triangle ABC such that $|PA| = |PB|$ and $|PC| = 4cm$. Measure $|PD|$.

9.   (a)   Draw:

  (i)   Triangle XYZ with vertices $X(2, 9), Y(5, 9)$ and $Z(2, 4)$;

  (ii)   The image triangle $X_1Y_1Z_1$ of triangle XYZ under a reflection in the y axis, where $X \to X_1$, $Y \to Y_1$ and $Z \to Z_1$.

  (iii)   The image triangle $X_2Y_2Z_2$ of triangle $X_1Y_1Z_1$ under an anticlockwise rotation of $90°$ about the origin, where $X_1 \to X_2$, $Y_1 \to Y_2$ and $Z_1 \to Z_2$.

      (iv)   The image triangle $X_3Y_3Z_3$ of triangle XYZ under an enlargement from the origin with scale factor -1, where $X \to X_3$, $Y \to Y_3$ and $Z \to Z_3$.

    (b)   Describe precisely the single transformation that will map triangle $X_2Y_2Z_2$ onto triangle $X_1Y_1Z_1$ where $X_2 \to X_1$, $Y_2 \to Y_1$ and $Z_2 \to Z_1$.

10.   The following is the record of marks of 40 candidates in an examination.

65	84	91	58	43	86	73	33	76	80
57	33	53	29	40	27	72	19	51	67
37	14	18	92	13	45	61	39	23	22
22	41	27	51	63	47	19	35	39	76

    (a)   Using class intervals of 11-20, 21-30, etc., prepare for the distribution:
      (i)   A frequency table;
      (ii)   A cumulative frequency table.

    (b)   Draw a cumulative frequency curve and use it to find:
      (i)   the media   (ii)   the lower quartile

11.   A sector of angle $120°$ is removed from a thin circular metal sheet of radius 14cm. The remaining portion is then folded, with the straight edge coinciding to form a right circular cone.

    (a)   Calculate, correct to three significant figures:
      (i)   The outer surface area, A cm^2;   (ii)   The height, h cm;
      (iii)   The volume V cm^3, of the cone.

    (b)   Find the cost of painting the outer surface area of the cone at 25K per 10 cm^2. (Take π to be 3.142)

O/L MATHS JUNE 1990

SECTION A

1.   Draw an addition $\oplus$ table for arithmetic modulo 5. Using your table,
    (i)   Evaluate $(2 \oplus 4) \oplus (3 \oplus 4)$;   (ii)   Find the truth set of $3 \oplus n = 2$.

2.   (a)   What is x if three times 14_x is equal to 45_x.
    (b)   The following statements are true of a certain society:
      P: All my friends are intelligent.
      Q: No intelligent person is consecutive.
      Draw a Venn diagram to illustrate the above information.
    (c)   Using your Venn diagram, complete the following statements.
      (i)   Kweku who is not my friend.
      (ii)   (ii)   Ama who is not conservative.
      (iii)   John who is intelligent.

3.   In a class of 35 students, it is known that 24 of them do Arts, 20 do Chemistry and 22 do Biology. All the students do at least one of the three subjects. Three do all the three subjects while 7 do Arts and Biology. Six do Arts and Chemistry but not Biology and 8 do Chemistry and Biology. How many of them do Chemistry only or Biology only or Art only?

4. (a) Without using tables simplify $\left(\dfrac{16d^8}{81}\right)^{\frac{3}{4}}$.

    (b) Find the truth set of $\dfrac{1}{2}x - \dfrac{1}{3}(x + 4) > 2x + \dfrac{3}{2}$, where x is a real number.

5. The electrical resistant R ohms, of a wire varies directly as the length Lcm and inversely as the square of the diameter d cm.

    (a) Express d in terms of L, R and the constant of variation k.

    (b) Find the value of d, correct to 2 decimal places, where L = 15cm, R = 0.23 ohms and $k = 1.25 \times 10^{-3}$.

SECTION B

6. A manufacturer finds that the cost of materials and labour to make a certain article are in the ratio 3:5. The manufacturer sells to a retailer at a profit of $27\dfrac{1}{2}$ and the retailer sells to a customer at a profit of 25%. If the customer pays ¢6,375.00, calculate how much the article cost the manufacturer for materials and for labour. If there is a 20% rise in labour cost but no increase in the cost of materials and the manufacturer decides not to increase the price charged to the retailer, calculate the percentage profit which the manufacturer then makes.

7. (a) Copy and complete the following table for the relation $y = x^2 - 3x - 4$ for $-1.5 \le x \le 4.5$.

x	-1.5	-1	0	1	2	3	4	4.5
y				-6.0			0	2.8

    (b) Using a scale of 2 cm to 1 unit on the x-axis and 2 cm to 2 units on the y-axis, draw the graph of $y = x^2 - 3x - 4$ for $-1.5 \le x \le 4.5$.

    (c) From the graph, obtain, correct to one decimal place:
    (i)   the truth set of $x^2 - 3x = 5$;
    (ii) the minimum value of $y = x^2 - 3x - 4$

8. The following is the frequency distribution table of marks scored by candidates in an examination.

Marks	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-9
Freq.	2	7	8	13	24	30	6	5	3	2

    (a) Make a cumulative frequency table and use it to draw the cumulative frequency curve for the distribution.

    (c) Use your to estimate:
    (i)   the median mark;   (ii)   the lower quartile
    (iii) the pass mark if 40% of the candidates passed.

9. (a) Express $\dfrac{\sqrt{2} + \sqrt{5}}{\sqrt{10}}$ in the form $a\sqrt{5} + b\sqrt{2}$, where $a, b \in R$.

    (b) Using a ruler and a pair of compasses only, construct triangle PQR which has $|PQ| = 9cm, |QR| = 6cm$ and angle $PQR = 135°$.

        (i)   Measure $|PR|$

        (ii)   Locate a point K equidistant from P, Q and R.

        (iii)   Measure $|KP|$.

10.   Draw on a graph paper, two perpendicular axes Ox and Oy for $-10 \le x \le 10$ and $-10 \le y \le 10$, using a scale of 2 cm to 2 units on both axes. Given point $A(1, 2)$ and the $\overrightarrow{AB} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}, \overrightarrow{BC} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}$ and $\overrightarrow{CD} = \begin{pmatrix} -2 \\ -2 \end{pmatrix}$.

    (a)   Draw on the same graph paper, showing clearly the coordinates of all vertices.

        (i)   The quadrilateral ABCD;

        (ii)   The image $A_1 B_1 C_1 D_1$ of $ABCD$ under a clockwise rotation of $90°$ about the origin where $A \to A_1, B \to B_1, C \to C_1$ and $D \to D_1$.

        (iii)   The image $A_2 B_2 C_2 D_2$ of $A_1 B_1 C_1 D_1$ under a reflection in the line $y = x$, where $A_1 \to A_2, B_1 \to B_2, C_1 \to C_2$ and $D_1 \to D_2$.

    (b)   (i)   Describe precisely the single transformation which maps $ABCD$ onto $A_2 B_2 C_2 D_2$.

        (ii)   Determine the length of $A_2 B_2$.

11.   The Universal Set U is the set of all integers A, B and C are subset of U defined as follows: $A = \{..., -6, -4, -2, 0, 2, 4, 6, ...\}, B = \{x: 0 \le x \le 9\}$ and $C = \{x: -4 \le x \le 0\}$.

    (a)   Write down the set A', where A' is the complement of A with respect to U.

    (b)   Find $B \cap C$.

    (c)   Find the members of the sets $B \cup C, A \cap B$ and $A \cap C$ and show that $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$.

O/L MATHS NOVEMBER 1990

SECTION A

1.   (a)   Draw a table for multiplication $\otimes$ modulo 12 on the set $P = \{1, 4, 9, 11\}$. Use your table to find on P, the truth set of:

        (i) $9 \otimes m = 0$ (ii) $n \otimes n = 1$

    (b)   Without using mathematical tables, evaluate $32^{2/5}$.

2.   X: All Junior Secondary Pupils wear uniform.

     Y: Most Junior Secondary Pupils are well behaved.

    (a)   Draw a Venn diagram to illustrate the above information.

    (b)   Using your Venn diagram or otherwise, determine which of the following implications are valid deductions from X and Y.

        (i)   Osei wears uniform $\Rightarrow$ Osei is a Junior Secondary Pupil.

        (ii)   Kofi is a Junior Secondary Pupil $\Rightarrow$ He is well behaved.

        (iii)   Kwesi does not wear unform $\Rightarrow$ He is not a Junior Secondary Pupil.

3.   (a)   Simplify $\dfrac{\sqrt{50} \times \sqrt{45}}{\sqrt{200} \times \sqrt{75}}$, leaving your answer in the form $a\sqrt{b}$, where a is a rational and b is a positive integers.

(c)   Find the truth set of $7\frac{2}{5} - \frac{3}{10}x \geq 6 - \frac{3}{5}x$, where x is a real number.
       Illustrate your answer on the number line.

4.   (a)   Find the solution sets of the simultaneous equations
              $3a - 2b = 8$ and $\frac{a}{2} - \frac{b}{2} = \frac{5}{4}$
      (b)   Find the truth set of $2x^2 + 5x = -2$.

5.   Three quantities P, Q and R are connected so that P varies directly as R and inversely
      as the square root of Q. If $P = 6$ when $R = 12$ and $Q = 25$, find:
      (a)   the expression for P in terms of Q and R.
      (b)   the value of Q when $P = 30$ and $R = 9$.

SECTION B

6.   Alex and Jimmy entered into a business partnership in January 1985. The total capital
      was ¢27,000.00 which they agree to contribute in the ratio 2:1 respectively. The
      annual profit for 1985 was shared as follows: Alex was paid $5\frac{1}{2}\%$ of the total profit
      for his services as a manager. The remainder of the profit was then shared between
      them in the ratio of their contributions to the capital. If Alex received a sum of
      ¢6,850.00 out of the total profit, calculate:
      (a)   (i)   the total profit for the year.
             (ii)   Jimmy's share of the profit as a percentage of his initial contribution to
                    the capital.
      (b)   If Alex had to pay tax at 30% on the amount he received, how much did he
             pay?

7.   Using a ruler and a pair of compasses only,
      (a)   construct triangle ABC such that $|AB| = 6cm, |AC| = 8.5cm$ and
             angle $BAC = 120°$
      (b)   construct the locus L_1, of points equidistant from points A and B;
      (c)   construct the locus L_2, of points equidistant from AB and AC;
      (d)   Find the point of intersection, P_1 and P_2 of L_1 and L_2 and measure $|P_1P_2|$.

8.   (a)   Copy and complete the table for the relation $y = 2 + 2x - x^2$ for $-1 \leq x \leq 3$

x	-1	-0.5	0	0.5	1	1.5	2	2.5	3
y	-1	0.75	2						

      (b)   Using a scale of 4cm to 1 unit on both axes, draw the graph of the relation.
      (c)   Draw on the same axes, the graph of $x + y = 3$
      (d)   Using your graphs;
             (i)   Solve the equation $2 + 2x - x^2 = 3 - x$.
             (ii)   Find the truth set of $2 + 2x - x^2 = 1$.

9.   A pyramid with vertex O stands on a square base ABCD and
      $|CA| = |CD| = |OC| = |OD| = |AB| = 5cm$. Calculate
      (a)   the height of the pyramid.

(b)   the volume of the pyramid.

(c)   the angle between the plane OAB and the base.

(d)   the total surface area of the triangular faces.

10.   The table below shows the percentage mark distribution of a number of candidates in a Physics Examination.

Mark	0-19	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-80	90-99
Freq.	2	5	11	20	34	17	6	3	1	1

(a)   Make a cumulative frequency table and use it to draw a cumulative frequency curve.

(b)   From your graph, estimate;

    (i)   the median mark

    (ii)   (ii)   the number of candidates that passed if the pass mark was 45%.

(c)   What is the probability that a person chosen at random from the candidates passed the examination?

11.   Draw on a sheet of graph paper, two perpendicular axes Ox and Oy for $-8 \leq x \leq 8$ and $-10 \leq y \leq 10$, using a scale of 2cm to 2 units on both axes.

(a)   Plot the points $A(6, 2), B(2, 2)$ and $C(2, 6)$. Describe the triangle ABC.

(b)   Find the equation of AC;

(c)   Draw triangle PQR, which is the reflection of triangle ABC in the y-axis, where $A \to P, B \to Q$ and $C \to R$. Indicate clearly the coordinates of triangle PQR.

(d)   Draw triangle MNS, which is the image of triangle ABC under a clockwise rotation through $90°$ about the origin $O(0, 0)$ where $A \to M, B \to N$ and $C \to S$. Indicate clearly the coordinates of triangle MNS.

(e)   What single transformation maps triangle PQR into triangle MNS, where $P \to M, Q \to N$ and $R \to S$.

O/L MATHS JUNE 1991
SECTION A

1.   50 students showed which of the following sports they liked: football, volley ball and hockey. 24 liked football, 21 liked volley ball and 18 liked hockey. 9 liked football only, 3 volley ball only and 2 hockey ball only. 5 liked all three sports but 6 liked football and volley ball only.

(a)   Draw a Venn diagram to illustrate this information.

(b)   Use your diagram to find the number of students who like:

    (i)   exactly two sports;   (b)   none of the three sports.

2.   The operation $*$ is defined on the set R of real numbers by

(a)   (i)   Evaluate $\sqrt{3} * \frac{1}{\sqrt{12}}$ and $\frac{1}{\sqrt{12}} * \sqrt{3}$

    (ii)   Use your results in (i) to evaluate $\left(\sqrt{3} * \frac{1}{\sqrt{12}}\right) * \left(\sqrt{3} * \frac{1}{\sqrt{12}}\right)$.

(c)   Find the truth set of the relation $2 * a = 9$

3.
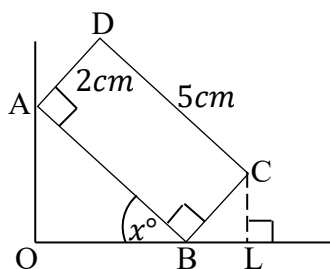
In the diagram, ABCD is a rectangle and OA is perpendicular to OB. $|BC| = 2cm, |CD| = 5cm$ and $\tan x = \frac{3}{4}$. Without using mathematical tables, find the values of $\sin x$ and $\cos x$. Find also the length of OL.

4. $M(9, 7)$ and $N(7, 2)$ are points in the OXY plane.
(a)   Find the coordinates of the point R such that $\overrightarrow{OR} = \overrightarrow{OM} + \frac{1}{2}\overrightarrow{MN}$.
(b)   Calculate:
(i) $|OR|$
(ii)   correct to the nearest degree, the angle that OR makes with the x-axis.

5.   (a) P varies directly as the square of S and inversely as R. When $S = 6$ and $R = 3, P = 48$. Find The value of P when $S = 10$ and $R = 5$.
(b)   Convert the binary number 10111101_2 to a number in base eight.

SECTION B

6.   The following is an incomplete table for the relation $y = (x + 1)(3 - x)$ for $-2 \leq x \leq 3.5$.

x	-2	-1	0	1	1.5	2	2.5	3	3.5
y	-5	0	3				1.75		-2.25

(a)   Copy and complete the table.
(b)   Taking 2 cm to 1 unit on both axes, draw the graph of the relation for the given interval.
(c)   Use your graph to find:
(i)   the truth set of $(x + 1)(3 - x) = -1$;
(ii)   the greatest value of y;
(iii)   the value of x for which y is the greatest;
(iv)   in the given range the values of x for which y decreases as x increases.

7.   A company director married with six children is on an annual salary of ₦10,000.00. His tax free allowances are as follows:

Personal   ₦1,200.00 plus 10% of excess of his salary over
Allowance   ₦10,000.00
Wife allowance   ₦600.00
Children allowance   ₦250.00 per child for the first four children
Dependent relatives   ₦550.00

On the taxable income, the rates of tax are as follows:
10K in the N on the first ₦2,000.00
15K in the ₦ on the next ₦4000.00

$22\frac{1}{2}$ K in the ₦ on the next ₦5,000.00

$30\frac{1}{2}$ K in the ₦ on the next ₦10,000.00

$37\frac{1}{2}$ K in the ₦ on the rest.

Calculate:
(a)   the director's taxable income;
(b)   the average monthly tax he pays, to the nearest kobo;
(c)   the percentage of his monthly salary he pays as tax, correct to one decimal place.

9.   (a)   Construct triangle ABC with $|AB| = 6cm, |AC| = 8cm$ and $B\hat{A}C = 75°$.
        (i)   The locus L_1, of points equidistant from AB and AC;
        (ii)   The locus L_2, of points equidistant from A and B;
        (iii)   The locus L_3, of points 4.5cm from B.
      (b)   Locate:
        (i)   the point of intersection P_1 of L_1 and L_2;
        (ii)   the point of intersection P_2 of L_1 and L_3 inside the triangle;
        (iii)   the point of intersection P_3 of L_2 and L_3 inside the triangle;
      (c)   Measure: (i) $|P_1P_2|$ (ii)   angle $P_2P_1P_3$

10.   The marks obtained by 30 pupils in an examination are as follows:

71	65	83	78	74	63	73	87	78	80
93	78	88	76	80	68	77	68	70	84
90	69	75	61	66	90	95	85	77	76

      (a)   Arrange these marks in a group frequency table using class intervals of 61-65, 66-70, 71-75, etc
      (b)   (i)   Draw a histogram of the distribution.
        (ii)   Use your histogram to estimate the mode.
        (iv)   Calculate the mean of the distribution.

11.
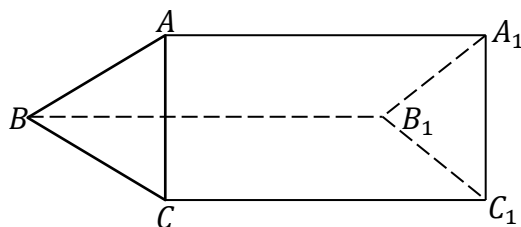
The diagram represents a trough made from a thin sheet of metal plate in the form of a triangular prism, with a capacity of 600 litres. Each triangle has a dimensions 50cm, 120cm and 130cm. If the face AA^1CC^1 of the trough is open, calculate:
(a)   the length, in metres, of the trough;
(b)   the surface are, in square metres, of the sheet of the metal used;
(c)   correct to the nearest degree, the angle between AB^1 and B^1B.

O/L MATHS NOVEMBER 1991

SECTION A

1. (a) If U is the universal set $\{7, 9, 10, 11\}, A = \{7, 11\}$ and $B = \{10, 11\}$, find
   (i) $(A \cap B)'$ (ii) $A' \cup B'$
   State the relationship between (i) and (ii).

   (b) Let $D(n)$ denote the set of all factors on the natural number n. For example $D(10) = \{1, 2, 5, 10\}$
   (i) List the elements of $D(12), D(20)$ and $D(12) \cap D(20)$;
   (ii) State the least value of r such that $D(12) \cup D(20) \le D(r)$.

2. An operation ∇ is defined on the set of real numbers by $a\nabla b = a + b + 2ab$, where $a, b \in R$.
   (i) (a) Calculate $2\nabla 3$ and hence find $(2\nabla 3)\nabla 5$;
        (b) Find the truth set of $a\nabla 7 = (a\nabla 5) + (a\nabla 2)$.

3. (a) If $\underline{k} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}, \underline{i} = \begin{pmatrix} 10 \\ 27 \end{pmatrix}$ and $\underline{r} = \frac{3}{8}(\underline{i} - \underline{k})$, find: (i) $\underline{r}$ (ii) $|\underline{r}|$

   (b) Simplify $\dfrac{5.4 \times 10^5}{0.06 \times 10^{15}}$, leaving your answer in the form $b \times 10^n$, where $1 \le b \le 10$ and n an integer.

4. (a) Find the truth set of $1.414 sinp = 1$, where $0° < p < 90°$.

   (b) Given that $siny = \frac{7}{8}$, where $0° < y < 90°$, find $tany$. Hence find the truth set of $cosx = 1 - tany$, giving your answer, correct to the nearest degree.

5. (a) If $\dfrac{12}{x-3} = 4$ is in base six, find the value of x.
   (b) If $2Q4_7 = 15Q_{nine}$, find the value of Q.

SECTION B

6. (a) Form a table of values for the relation $y = 3x^2 - 2x - 8$, taking values of x from -3 to 3.
   (b) Using a scale of 2cm to represent 5 units on the y axis and 2cm to represent 1 unit on the x axis, draw the graph of the relation in (a).
   (c) Use your graph to find:
   (i) the truth set of the equation $3x^2 - 2x - 8 = 0$;
   (ii) the least value of y and the corresponding value of x;
   (iii) the range of values of x for which y is negative.

7. A man's annual salary is ¢36,900.00. He is entitled to $^2/_9$ of this amount free of tax, and to a further tax free allowance of ¢7,700.00. On his remaining income after these deductions, he pays 10p in the cedi on the first ¢6,000.00, 40p in the cedi on the next ¢4,500.00 and 70p in the cedi on the balance, if any.
   (a) How much tax does he pay?
   (b) If his salary is increased by ¢4,5000.00, find the net increase in his income.

8.   (a)   Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper, two perpendicular axes, Ox and Oy for the interval $-10 \leq x \leq 10$ and $-12 \leq y \leq 12$.

   (b)   Draw, indicating the coordinates of all vertices:
   (i)   The triangle PQR with vertices $P(-1, 5), Q(3, 6)$ and $R(4, 0)$;
   (ii)   The image $P_1 Q_1 R_1$ of PQR under a reflection in the line $y + x = 0$, where $P \rightarrow P_1, Q \rightarrow Q_1$ and $R \rightarrow R_1$.
   (iii)   The image $P_2 Q_2 R_2$ of PQR under an enlargement from the origin with scale factor -2, where $P \rightarrow P_2, Q \rightarrow Q_2$ and $R \rightarrow R_2$.

9.   Using a ruler and a pair of compasses only, construct triangle ABC, with $|BC| = 6.5cm$, angle $ABC = 75°$ and angle $ACB = 45°$.
   (i)   Find, by construction, a point D inside the triangle which is equidistant from B and C and 3.5cm from A. Measure $|BD|$.
   (ii)   Construct a line through D parallel to BC to meet AC at E. Measure $|EC|$.

10.   The heights of 40 citrus plants in a school farm recorded, to the nearest centimetre as follows:

103	116	127	101	118	125	119	127
114	117	120	117	114	128	112	118
119	129	125	130	117	110	121	109
115	118	113	126	123	131	109	117
105	122	124	114	124	121	123	115

   (a)   Form a grouped frequency table using the intervals 100-104, 105-109, etc.
   (b)   Calculate the mean height of the plant.
   (c)   (i)   Form a cumulative frequency table.
   (ii)   Draw the ogive;
   (iii)   Use your graph to estimate the median height of the citrus plants.

11.   The feet A and C, of two vertical poles AP and CR, are on the same horizontal plane as the foot B of a vertical flag-pole, $QB = 5m$ high. A is 10m East and C 10m South of B. The heights of the poles are $|AP| = 6cm$ and $|CR| = 5m$.
   Calculate: (i) $|AR|$
   (ii)   The angle CP makes with the horizontal, correct to the nearest degree.
   (iii)   The angle the plane ACQ makes with the horizontal, correct to the nearest degree.

O/L MATHS JUNE 1992

SECTION A

1. A group of 22 travellers were each required to obtain a passport, a health certificate and a convertible currency equivalent of $50.00. 12 had the passport, 14 the health certificate and 11 the currency. 6 had both passports and currency, 6 had passports and certificates and 7 health certificates and currency. Each traveller had at least one of the requirements.
    (a) Draw a Venn diagram to illustrate the given information.
    (b) Find the number who had: (i)   all three requirements;
    (ii)   exactly two of the requirements.

2. (a) Draw: (i)   the addition $\oplus$ (ii)   the multiplication $\otimes$, for the set $K = \{3, 6, 9, 12\}$ in arithmetic modulo 15.
    (b) From the tables,
    (i)   Evaluate $(3 \otimes 3) \oplus (6 \otimes 9)$.
    (ii)   Find the truth set of the equation $n \otimes (n \oplus 3) = 3$.

3. (a) $P(-1, 2)$ and $Q(x, y)$ are points in the Oxy plane such that $\overrightarrow{PQ} = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$. Find:
    (i)   The coordinates of Q.
    (ii)   The bearing of P from Q, to the nearest degree.
    (b) If $1.5\cos x = 0.75$, find the value of x if $0° \leq x \leq 90°$.

4. (a) Make u the subject of the relation $fx = \frac{w(v - u)}{2g}$.
    (b) Find the value of u in (a) above, correct to two significant figures when $f = 48, x = 32, v = 10, w = 1000$ and $g = 9.8$.

5. (a) A point Z is in the same plane as a fixed line segment XY. What is the locus of the point Z if it moves in the plane such that angle $XZY = 90°$?
    (b) Using a ruler and a pair of compasses only, construct $\angle XYZ$ in which $|XY| = 10cm, |XZ| = 7cm$ and $\angle XZY = 90°$. Measure $|YZ|$.

SECTION B

6. The price of an article is Le 6,000.00. It is made up as follows:
    Cost of materials   20%
    Cost of manufacture   50%
    And the rest is profit.
    If the cost of materials falls by 10% and the cost manufacture increases by 10% but the price remains the same,
    (a) Find: (i)   the new profit   (ii)   the percentage change in profit.
    (b) Find the new price of the article if the original profit is maintained.

7. (a) Copy and complete the following table of values for the relation $y = x^2 - 4x + 5$ for the interval $-2 \leq x \leq 6$.

x	-2	-1	0	1	2	3	4	5	6
y			5		1		5	10	17

(b)   Using a scale of 2cm to 1 units on the x-axis and 2cm to 2 units on the y-axis, draw the graph of the relation.

(c)   Using the same scale and axes, draw also the graph of $y = x + 3$.

(d)   Use your graphs to find:

(i)   the equation of the axis of symmetry of the graph of $y = x^2 - 4x + 5$ and $y - 3 = x$.

(ii)   the truth set of the simultaneous equations $y = x^2 - 4x + 5$ and $y - 3 = x$.

8.   A ship X sailing with velocity $(21kmh^{-1}, 052°)$ observes a light house due North. The bearing of the lighthouse from the ship, 20 minutes later, is found to be $312°$. Calculate, correct to three significant figures:

(i)   The original distance, in km, of the lighthouse from the ship.

(ii)   The time, in minutes, when the lighthouse is due West of the ship from the time when it is due when it is due North of the ship.

(iii) The distance, in km, of the ship from the lighthouse when the lighthouse is due West of the ship.

9.   The following is the frequency distribution of the marks scored by candidates in an examination.

Marks	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Freq.	4	16	20	16	120	304	80	48	24	8

(a)   Make a cumulative frequency table and use it to draw a cumulative frequency curve for the distribution.

(b)   Use your curve to find:

(i)   the median mark

(ii)   the mark for a scholarship award for the best 10% of the candidates.

10.   Using a scale of 2cm to 1 unit on each axis, draw on a sheet of graph paper two perpendicular axes Ox and Oy, for the intervals $-5 \le x \le 5$ and $-5 \le y \le 5$.

(a)   Draw, indicating the coordinates of all vertices:

(i)   the quadrilateral $OABC$ with O, the origin $A(-2, 1), B(-2, -2)$ and $C(0, 2)$.

(ii)   The image $O_1A_1B_1C_1$ of $OABC$ under the mapping $\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} x \\ 2x + y \end{pmatrix}$ where $A \to A_1, B \to B_1$ and $C \to C_1$.

(iii) The image of $O_2A_2B_2C_2$ of $OABC$ under an enlargement about O with scale factor -2, where $A \to A_2, B \to B_2$ and $C \to C_2$.

11. V is the vertex of a right pyramid on a square base $ABCD$ of side $16cm$. If the volume of the pyramid is $1,200cm^3$, calculate:

(a)   its height;

(b)   the angle, to the nearest degree, between the base $ABCD$ and:

(i)   a sloping face;   (ii)   a slanting edge, of the pyramid.

(c)   The area of a sloping face of the pyramid, correct to three significant figures.

O/L MATHS NOVEMBER 1992

SECTION A

1. (a) If $A = \{x : x \text{ is a factor of } 54\}$, $B = \left\{x : 4 - \frac{1}{3}x \leq 2x - 3\right\}$ and
   $C = \{x : x \leq 15\}$, where x is an integer. Find $A \cap B \cap C$.

   (b) Use a Venn diagram to illustrate the statement.
   "All good Mathematics students are in the Science class"
   Hence, determine whether or not the following are valid conclusions from the given statement.
   (i) Vivian is in the Science class therefore she is a good Mathematics student.
   (ii) David is not a good Mathematics student therefore he is not in the Science class.
   (iii) Mathias is not in the Science class therefore he is not a good Mathematics student.

2. (a) Copy and complete the table for the operation $*$ and $\oplus$ which are defined in modulo 5 by: $m * n = m + n + 2mn$, and $m \oplus n = mn + 2$, where $m, n \in P$ and $P = \{0, 1, 2, 3, 4\}$.

   (b) Use your tables to evaluate the following:
   (i) $2 \oplus (3 * 4)$; (ii) $(2 \oplus 3) * (2 \oplus 4)$.

$*$	0	1	2	3	4
0	0	1	2	3	4
1	1		2		3
2	2	2		2	2
3	3	0		4	
4	4	1	3	1	0

$\oplus$	0	1	2	3	4
0	2	2	2	2	2
1	2		4		1
2	2	4		3	0
3	2		3	1	
4	2	1	0		3

3. In a certain country, annual income tax is calculated as follows:

Taxable Pay	
On the first $1,000	4c in the $
On the next $2,000	8c in the $
On the next $4,000	20c in the $
On the next $6,000	32c in the $
On the remainder	48c in the $

   Calculate the tax payable by an employee whose taxable pay is $16,400.00 per annum.

4. (a) In triangle ABC, Q is the midpoint of BC. Show that $\overrightarrow{AB} + \overrightarrow{AC} = 2\overrightarrow{AQ}$.

   (b) The formula shows the resulting resistance R, when two electrical resistances R_1 and R_2 are wired in parallel $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$. Make R_2 the subject of the formula. Hence, find the value of R_2 given that $R = 24$ and $R_1 = 30$ ohms

5. (a) Convert 232_{five} to a number in base seven.

   (b) Simplify $\frac{2\sqrt{3}}{3\sqrt{2}}$, leaving your answer in the form $a\sqrt{b}$ where a is a rational

number and b a positive integer.

SECTION B

6.   Two friends, Ansana and Fremaso entered into a business partnership. Ansana contributed ¢2,800,000.00 and Fremaso contributed ¢5,200,000.00. At the end of the year they made a profit of 70% of their contribution. 5% of the profit was paid as an educational levy and 20% of the remaining profit was paid into a reserved fund. If they share the remaining profit in the ratio of their contributions, find;

    a.   the amount paid as educational levy;

    b.   the amount received by each partner as his share of the profit;

    c.   Ansana's share as a percentage of his contribution of 2% on all her sales. If her sales in a particular month amounted to ¢1.5 million, calculate her gross income for that month.

7.   a.   Copy and complete the following table for the relation $y = x^2 - 5x + 3$ for $0 \leq x \leq 5$.

x	0	0.5	1	1.5	2	2.5	3	4	4.5	5
y	3		-1				-3		0.75	3

    b.   Using a scale of 2cm to represent 1 unit on both axes, draw the graph of the relations:

        i. $y = x^2 - 5x + 3$ ii. $y - 1 = \frac{1}{4}x$

    c.   From your graphs, find;

        i.   the truth set of $x^2 - 5x + 3 = \frac{1}{4}x + 1$;

        ii.   the least point on the graph of the relation $y = x^2 - 5x + 3$.

        ii.   the equation of the line of symmetry of the equation $y = x^2 - 5x + 3$.

8.   The following table shows the distribution of the marks scored by 200 candidates in an examination.

Marks %	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Freq.	2	18	20	22	34	50	26	16	10	2

    a.   Construct a cumulative frequency table and use it to draw a cumulative frequency curve.

    b.   Use the cumulative frequency curve to estimate:

        i.   the median mark;

        ii.   the probability that a candidate passed, if the pass mark was 42.

        iii.   the lowest mark for the distinction if 12% of the candidates passed with distinction.

9.   Using a ruler and a pair of compasses only,

    a.   Construct a parallelogram WXYZ such that $|XY| = 8.4cm, |YZ| = 6.7cm$ and $\angle XYZ = 105°$.

    b. Locate a point P inside WXYZ such that it is equidistant from WZ, WX and XY.

    c. Construct a circle to touch WZ, WX and XY.

    d. Measure $|XP|$ and the radius of the circle.

10. Using a scale of 2cm to 2 units on each axis, draw on a sheet of graph paper two perpendicular axes, Ox and Oy, for the intervals $-10 \leq x \leq 10$ and $-10 \leq y \leq 10$.

    a. Draw, indicating the coordinates of all vertices:

       i. Triangle ABC with A$(4, 2)$, B$(0, 2)$ and C$(0, 8)$.

       ii. The image $A_1B_1C_1$ of ABC under the anticlockwise rotation of $90°$ about the point Q$(10, 0)$ where $A \rightarrow A_1$, $B \rightarrow B_1$ and $C \rightarrow C_1$.

       iii. The image of $A_1B_1C_1$ of $A_2B_2C_2$ under a translation by the vector $\begin{pmatrix} -10 \\ 14 \end{pmatrix}$, where $A_1 \rightarrow A_2$, $B_1 \rightarrow B_2$ and $C_1 \rightarrow C_2$.

       iv. The image $A_2B_2C_2$ of $A_3B_3C_3$ under a reflection in the line $y = 2$, where $A_2 \rightarrow A_3$, $B_2 \rightarrow B_3$ and $C_2 \rightarrow C_3$.

    b. Describe precisely the single transformation that maps ABC onto $A_3B_3C_3$ where $A \rightarrow A_3$, $B \rightarrow B_3$ and $C \rightarrow C_3$.

11. P$(28°N, 27°E)$ and Q$(28°N, 33°W)$ are two points on the surface of the Earth. Assuming the earth to be a sphere of radius 6,400km, calculate:

    a. the radius of circle of latitude;

    b. the shortest distance between P and Q along the line of latitude;

    c. the shortest distance of P from the North Pole along a circle of longitude. (Take $\pi = 3.142$).

O/L MATHS JUNE, 1993

SECTION A

1.   a. Construct:

       i. the multiplication $\otimes$ and

       ii. addition $\oplus$ for the set $\{2, 3, 5, 7\}$ in arithmetic modulo 8.

    b. From the tables;

       i. evaluate $(7 \otimes 5) \oplus 7$ ii. find the truth set of $n \oplus n = 6$.

2.   a. Consider the following statement: "Not all bullies are strong people"

    Let $E = \{all\ bullies\}$; $S = \{all\ strong\ people\}$.

       i. Illustrate these sets on a Venn diagram and indicate by shading strong people who are bullies.

       ii. Deduce whether the following arguments (α) and (β) are valid or not.

         (α)   Nwanda is strong $\Rightarrow$ Nwanda is a bully.

         (β)   Ifowa is not strong $\Rightarrow$ Ifowa is not a bully.

    b. Find the truth set of $1 + \frac{3}{8}x \geq \frac{3}{4}(x - 2) + 4$ and illustrate your answer on the number line.

11. A solid right pyramid with vertex O has a square base PQRS. The volume of the pyramid $5,292cm^3$ and its height is $27cm$. Calculate;

    a. the length of the side of a base;

    b.   the slant height, correct to one decimal place;

    c.   the angle between OP and QR, correct to the nearest degree.

    d.   The area of a sloping face, correct to the one decimal place.

O/L MATHS NOVEMBER 1993

SECTION A

1. $P = \{1, 2, 3, 4\}$ and $Q = \{1, 3, 5, 7\}$ are subsets of $U = \{1, 2, 3, 4, 5, 6, 7, 8\}$.

    a.   Draw a Venn diagram to illustrate the given information.

    b.   Find:

        i. $(P \cap Q') \cup (P' \cap Q')$;   ii. $(P \cup Q)$.

2.   a.   Draw a table for multiplication $\otimes$ modulo 8 on the set $\{1, 3, 5, 7\}$.

    b.   Use your table to find the truth set of:

        i. $3 \otimes n = 7$;   ii. $n \otimes n = 1$.

3.   The height, h metres, of what above the sea level at the entrance to a dock is given by $h = 6 + 4\cos(15p)°$, where $0 < p < 6$. Find:

    a.   the value of h when $p = 4$;

    b.   the value of p, correct to two significant figures, when $h = 9$ metres.

4.   a.   Using a ruler and a pair of compasses only, construct:

        i.   Triangle PQR such that $|PQ| = 10cm$, $|QR| = 12cm$ and $\angle PQR = 60°$;

        ii.   The locus L, of the set of points equidistant from RP and RQ;

        iii.   The perpendicular from P to QR.

    c.   X is the intersection of L with the perpendicular P to QR. Measure $|RX|$.

5.

Form	S1	S2	S3	S4	S5	S6
No. on Roll	219	189	189	183	141	159

The table shows the distribution of students in a secondary school in September 1985.

    a.   Construct a pie chart to illustrate the distribution.

    b.   If a student is selected at random from this school, find, correct to one decimal place, the probability that the student is in S1.

SECTION B

6.   A bicycle agent allows a discount of 25% of his advertised prices and still makes a profit of 20% on his cost price. Calculate:

    a.   the advertised price of a bicycle on which

        i.   he makes a profit of ₦60.00;

        ii.   his cost price ₦380.00.

    c.   His profit if the advertised price is ₦500.00.

7.   a.   Copy and complete the tables of values below for the relations;

        i. $y = -3 - x^2$.

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-28	-19	-12		-4	-3		-7	-12	-19	-28

ii. $y = x^2 - 4x + 10$

x	-3	-2	-1	0	1	2	3	4	5	6	7
y	31	22		10	7	6		10	15	22	31

b.   Using the same axes and a scale of 2cm to 2 units on the x-axis and 1cm to 5 units on the y-axis, draw the graphs of $y = -3 - x^2$ and $y = x^2 - 4x + 10$.

c.   Use your graph to find:

  i.   the equation of the line joining the minimum point of $y = x^2 - 4x + 10$ the maximum point of $y = -3 - x^2$;

  ii.   the truth set of $x^2 - 4x + 10 = 0$;

  iii.   the truth set of $x^2 - 4x - 5 = 0$.

8. a.   Using a scale of 2cm to 2 units on each axis, draw on a graph sheet two perpendicular axes Ox and Oy for the interval $-10 \leq x \leq 10$ and $-10 \leq y \leq 10$.

  b.   Draw on this graph sheet, indicating the coordinates of all vertices:

  i. $\triangle ABC$ with $A(3, 2)$, $\overrightarrow{AB} = \begin{pmatrix} -4 \\ 3 \end{pmatrix}$ and $\overrightarrow{BC} = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$.

  ii.   The image $\triangle A_1 B_1 C_1$ of $\triangle ABC$ under an anticlockwise rotation of $90°$ about the origin of $O(0, 0)$, where $A \rightarrow A_1$, $B \rightarrow B_1$ and $C \rightarrow C_1$;

  iii.   The image $\triangle A_1 B_1 C_1$ of $\triangle A_2 B_2 C_2$ under a reflection in the line $y - x = 0$, where $A_1 \rightarrow A_2$, $B_1 \rightarrow B_2$ and $C_1 \rightarrow C_2$;

  c. i.   Describe precisely the single transformation that maps $\triangle ABC$ onto $\triangle A_2 B_2 C_2$, where $A \rightarrow A_2$, $B \rightarrow B_2$ and $C \rightarrow C_2$;

  ii.   Find $|A_1 A_2|$, leaving your answer in the form $p\sqrt{q}$, where p and q are whole numbers.

9.   The following data represents the number of visitors to a museum for 50 days:

41	52	46	42	46	36	4	68	58	44
49	48	48	65	52	50	45	72	45	43
63	49	57	44	48	49	45	47	48	43
45	56	61	54	51	47	42	53	41	45
58	55	43	63	38	42	43	46	49	47

a.   Copy and complete the table below using this data:

Classes	Tally	Frequency (f)	Class Mark (x)	$d = x - 47$	fd
$35 - 39$					
$40 - 44$					
$45 - 49$					
$50 - 54$					
$55 - 59$					

$60 - 64$					
$65 - 69$					
$70 - 74$					

    b.   i.   Find the mean $\bar{d}$, of the values.

           ii.   Deduce the mean $\bar{x}$, of the data from this relation $\bar{x} - \bar{d} - 47 = 0$.

    c.   Draw the histogram for the distribution.

10.   Two ships, A and B, start sailing from a port P at the same time. Ship A sailing at 35km/hr is on a bearing of 335° and Ship B, sailing at 22km/hr on a bearing of 065°.

    a.   Find, after three hours:

         i.   the distance between the two ships;

         ii.   the bearing of A from B.

    b.   After covering a distance of 120km from the port, Ship A reaches a point D. It then turns and sails parallel to the track of Ship B. How long will it take Ship A to reach a point E due north of P?

11.   O is the vertex of a right pyramid on a rectangular base PQRS. OM is the height of the pyramid. $|PQ| = 11m$, $|PS| = 16m$ and $|OQ| = 24m$. Calculate, correct to three significant figures:

    a. $|QS|$ b. $|OM|$ c.   angle OQS

    d.   the volume of the pyramid

SSCE MATHS NOVEMBER 1993

SECTION A

1.   Without using tables or calculator, evaluate:

    a. $\dfrac{20.3}{3.5 \times 0.58}$ b. $53.8^2 - 46.2^2$ c. $\dfrac{2\frac{7}{8} \times 1\frac{1}{5}}{8 - 2\frac{1}{4}}$

2.   In a Senior Secondary School, there are 174 students in Form 2. Of these 86 play table tennis, 84 play football and 94 play volleyball, 30 play table tennis and volleyball, 34 play volleyball and football and 42 play table tennis and football. Each student plays at least one of the three games and x students play all three games.

    a.   Display these facts in a Venn diagram;

    b.   Write down an equation in x and hence find the value of x;

    c.   If a student is chosen at random Form 2, what is the probability that he plays only two games?

3.   The cost (C) of producing a motor car in a certain factory partly constant and partly varies inversely as the number (n) of cars produced per day. The cost of producing 4 cars per day is $1,600 and that of producing 5 cars per day is $1,420. Find the relation between C and n.

4. A$(4, 7)$ is the vertex of triangle ABC. $\overrightarrow{BA} = \begin{pmatrix} 5 \\ 3 \end{pmatrix}$ and $\overrightarrow{AC} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$.

     a.   Find the coordinates of B and C.

     b.   If M is the midpoint of the line BC, find $\overrightarrow{AM}$.

5.
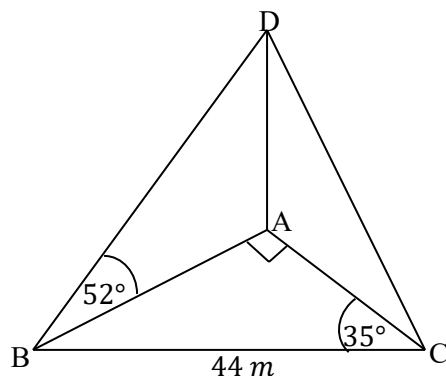
In the diagram, ABC is a right angled triangle on a horizontal ground. AD is a vertical tower. $\angle BAC = 90°$, $\angle ACB = 3°5$, $\angle ABD = 52°$ and $|BC| = 44m$. Find:

     a.   the height of the tower;

     b.   the angle of elevation of the top of the tower from C.

SECTION B

6. Using a ruler and a pair of compasses only for the following constructions:

     a.   Construct triangle ABC in which $|AB| = 10cm$, $|BC| = 6cm$ and $\angle ABC = 45°$;

     b.   Locate the point D inside the triangle ABC such that D is equidistant from AB and AC, and $5cm$ from B.

     c.   Construct a straight line through D to cut AB at X and AC at Y such that $AX = AY$.

     d.   Measure $|AY|$.

7. a.   Use logarithm tables to calculate $\sqrt[3]{0.4276}$;

     b.   The development budget of a District Council includes expenditure on feeder roads, schools and water supply. The expenditure on roads, schools and water supply are in the ratio 7:15:2. If the expenditure on road is ¢28 million, find the expenditure on:

         i.   Schools   ii.   Water supply

     c.   What is the total budget for these three projects?

     d.   The cost of maintaining libraries is ¢900,000.00 and this met from the expenditure on schools. What percentage, correct to 3 significant figures, of the expenditure on schools is spent on maintaining libraries?

8. The relation for the volume y of a tray of depth x cm is given by $y = x(12 - x)(8 - x)\ cm^3$.

     a.   Copy and complete the table of values for the relation $y = x(12 - x)(8 - x)$.

x	0	1	2	3	4	5	6	7	8
$12 - x$	12	11		9	8		6		4
$8 - x$	8	7	6	5		3		1	0
$x(12 - x)(8 - x)$	0	77		135					0

b. Use the values to draw the graph of $y = x(12 - x)(8 - x)$ from $x = 0$ to $x = 8$, taking 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis.

c. Find the values of x if the volume of the tray is $100cm^3$.

d. What value of x gives the maximum volume of the tray?

9.
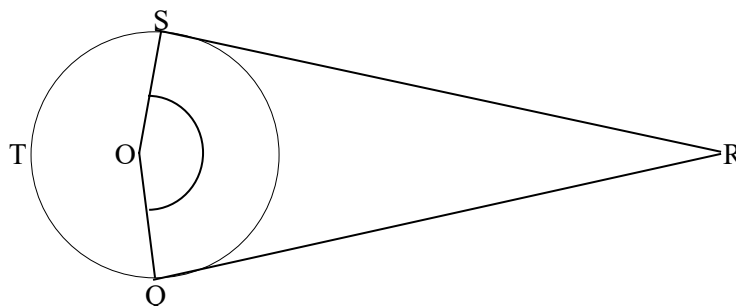
The diagram shows a belt QRST round a shaft R (of negligible radius) and pulley of radius $0.6m$. O is the centre of the pulley, $|OR| = 1.5m$ and the straight portions QR and RS of the belt are tangents at Q and S to the pulley. Calculate:

a. the angle QOS, correct to the nearest degree;

b. the total length of the belt QRST to the nearest metre. (Take $\pi = 3.142$)

10. Using a scale of 2cm to 2 units on each axis, draw on a sheet of graph paper, two perpendicular axes Ox and Oy, for the intervals $-10 \le x \le 10$ and $-10 \le y \le 10$.

a. Draw $\triangle ABC$ with coordinates A$(6, 8)$, B$(2, 5)$ and C$(7, 2)$.

b. Draw the image $\triangle A^1 B^1 C^1$ of $\triangle ABC$ under an enlargement with scale factor -1 from the origin, where $A \to A^1$, $B \to B^1$ and $C \to C^1$. Label vertices and coordinates clearly.

c. Draw the image $\triangle A^{11} B^{11} C^{11}$ of $\triangle ABC$ under a clockwise rotation of $270°$, about the origin where $A \to A^1$, $A \to A^1$ and $A \to A^1$. Label vertices and coordinates clearly.

d. i. What transformation maps $\triangle A^1 B^1 C^1$ onto $\triangle A^{11} B^{11} C^{11}$?
   ii. What is the equation of BB^1?

11. The table gives the distribution of the ages (in years) of all persons (to the nearest thousand) in a town, who were under the ages of 40 years on 30th June, 1990.

Age	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39
No. of persons								

a. Using the table, calculate:
   i. the total number of persons under 20 years;
   ii. the total number of persons between 15 and 30 years.

b. i. Prepare a cumulative frequency table and use it to draw the cumulative curve.

ii.   Use the curve to find the median age for the distribution.

12.   A sector of area $427cm^2$ is cut out from a thin circular metal of radius $17cm$. It is then folded with the straight edges coinciding to form a cone. Calculate, correct to three significant figures:
     a.   the angle of the sector;   b.   the length of the arc of the sector;
     c.   the height of the right circular cone. (Take $\pi = 3.142$)

O/L MATHS JUNE 1994
SECTION A

1.   a.   If $\mu = \{0, 1, 2\}$, list all the subsets of μ.
    b.   An expression is defined on the set of integers, Z, by $x * y = x + y + 3xy$, where x and $y \in Z$.
       i.   Construct a table for this operation on the set $S = \{-1, 0, 1, 2\}$.
       ii.   Find, from your table, a number $b \in S$, such that $c * b = c$ for all $c \in S$.

2.   The pie chart shows how a worker spends his monthly salary.
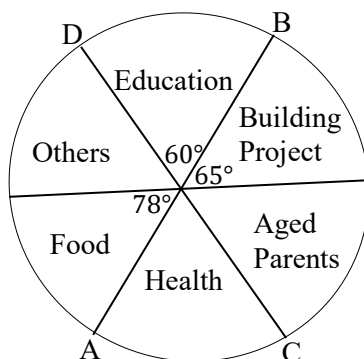
The lines AB and CD are diameters. If he spends ¢11,000.00 on his aged parents, find:
    a.   how much he earns in a month;
    b.   how much he spends on OTHERS;
    c.   What percentage of his salary is spend on HEALTH and FOOD?

3.   A$(-1, 5)$, B$(5, 3)$, C$(3, -3)$ and D$(-3, -1)$ are four points in the plane.
    a.   Determine the relationship between the following pairs of vectors:
       i. $\overrightarrow{AC}$ and $\overrightarrow{BD}$ ii. $\overrightarrow{AD}$ and $\overrightarrow{BC}$

4.   Using a ruler and a pair of compasses only, construct:
    i.   a square ABCD of side $6cm$;
    ii.   a circle through the four vertices of the square. Measure the radius of the circle.

5.   a.   Simplify $\dfrac{(2^3)^2 \times 2^3}{(2^{-2})^3}$, leaving your answer in the index form.
    b.   Solve $-\dfrac{1}{2}(3x - 4) > 3x - 7$.

SECTION B

6. a. A trader bought some goods whose marked price was ¢10,000.00 at a discount of 2.5%. After selling the goods the trader is required to pay tax at a rate of 20% on the profit she makes in excess of ¢10,000.00. How much should she sell the goods so that after tax she would make a net profit of ¢20,000.00?

    b. Find the number base (n), for which $122_n = 1212_3$.

7. a. Copy and complete the table of values below for the relation: $y = 4 - \frac{3}{2}x^2$, for $-4 \leq x \leq 4$.

    b. Using a scale of 2cm to 1 unit on the x-axis and 2cm to 5 units on the y-axis, draw the graphs of the relations:

    i. $y = 4 - \frac{3}{2}x^2$ ii. $y = 2x - 5$

    c. Use your graph to find:

    i. the maximum value on the graph of the relation $2y = 8 - 3x^2$;

    ii. the range of values of x for which $y = 4 - \frac{3}{2}x^2$ is negative.

    iii. the truth set of the equation $3x^2 + 4x - 18 = 0$.

8. The marks obtained by some candidates in an examination are:

27	36	40	48	50	35	69
58	57	60	61	63	61	63
65	68	65	68	67	70	55
71	69	73	72	75	76	78
76	80	81	83	88	89	90

    a. Form a grouped frequency table for this data, using the class intervals $20 - 29$, $30 - 39, 40 - 49, \dots 90 - 99$.

    b. State the modal class.

    c. Using the table, find the mean mark, correct to one decimal place.

    d. Draw a histogram for the data.

    e. If a candidate is picked at random, what is the probability that he is in a class of frequency 5?

9. $A(36°N, \ 80°E)$ and $B(36°N, 25°E)$ are two points on the Earth surface.

    a. Calculate the shortest distance between A and B along their parallel of latitude, correct to three significant figures;

    b. What percentage of the equator is the parallel of latitude 36°, correct to the nearest whole number?

    c. P is a point due south of B. The distance along the great circle through B and P is 12,500km. Calculate, correct to the nearest degree, the latitude of P. (Assume that the Earth is a sphere of radius 6,400km and $\pi = 3.142$)

10. Two friends, Kojo and Yaw, travelled the same route from town A to town B. a distance of 53km. Kojo started at 6:30am and for the first one and half hours, he moved at a constant speed and covered 28km. He stopped for 10 minutes and continued his journey at 12.5km/h to reach town B. Yaw started from town A at

9:00am and overtook Kojo 30 minutes later Yaw continued with the same speed till he got to town B.

    a.   Using a scale of 2cm to 30 minutes and 2cm to 5km, draw the distance time graph for these friends.

    b.   Use your graph to find:

        i.   when Kojo reached town B.

        ii.   Yaw's speed.

11.   a.   In the diagram, the angles BAD and ADC are right angles and AX is parallel to BC. If $|AB| = |BC| = 5cm$ and $|DC| = 8cm$. Calculate the area of ABCX.
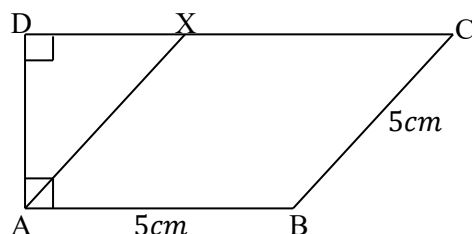
    b.   A container in the form of a cube of size 22cm is three-quarters full of water. Calculate the volume of water in the container.

A stone is placed in the water and the level of the water rises by 2cm. Calculate the volume of the stone.

    c.   A spherical steel ball of volume $726cm^3$ is lowered into the water. Calculate,

        i.   the rise in the water level.

        ii.   the radius of the ball, correct to two significant figures.

        (Take $\pi = \frac{22}{7}$).

SSSCE NOVEMBER 1994

SECTION A

1.   Without using calculators:

    a.   Evaluate $\frac{2x - y}{z} + \frac{z + 2y}{x}$, $x = 2, y = -3$ and $z = 4$;

    b.   Find the value of Q if $3Q + 13^2 = 16^2$.

2.   a.   Multiply 2102_3 by 122_3 and leave the answer in base three.

    b.   i.   Copy and complete the following table for multiplication modulo 7 on the set $\{1, 2, 3, 6\}$

        ii.   Use the table to find the truth set of $n \otimes n \otimes 6 = 5$.

$\otimes$	1	2	3	6
1	1	2	3	6
2	2	4	6	
3	3		2	4
6	6	5		

3.   a.   The universal set $U = \{2, 3, 5, 7\}, P = \{2, 5\}$ and $Q = \{5, 7\}$. Find:

i. $(P \cap Q)'$ ii. $P' \cup Q'$

State the relationship between (i) and (ii).

b. In class of 50 students, 30 offer Economics, 17 offer Government and 7 offer neither Economics nor Government. How many students offer both subjects?

4. a. Evaluate $\sqrt{7}\left(3\sqrt{7} + \frac{6}{\sqrt{7}}\right)$.

  b. Find the truth set of the simultaneous equations:

   $\frac{5}{6}x - \frac{3}{4}y = 2;$ $\frac{1}{2}x - \frac{2}{3}y = \frac{5}{2}$

5. X, Y and Z are such that X varies directly as Z and inversely as the cube root of Y. If $X = 8,\ Y = 27$ and $Z = 4$, find:

  a. an expression for X in terms of Y and Z;

  b. the value of Y when $X = 12$ and $Z = 10$.

SECTION B

6. OABCD is right square pyramid with vertex O, such that $|OA| = |OB| = |OC| = |OD| = 30m$ and $|AB| = 25m$. Calculate:

  a. the height of the pyramid;

  b. the volume of the pyramid;

  c. the angle between OA and AC;

  d. the total surface area of the pyramid, excluding the base.

7. The marks obtained by 40 students in an examination are as follows:

63	76	87	6	78	85	77	87	74	77
80	77	74	88	72	78	79	89	85	90
77	70	81	69	75	78	73	86	83	91
69	96	65	88	84	74	84	81	83	75

  a. Copy and complete the table below using the data above.

Class Boundary	Tally	Frequency (f)	Class Midpoint	fx
$59.5 - 64.5$			62	
$64.5 - 69.5$			67	
$69.5 - 74.5$				
$74.5 - 79.5$				
$79.5 - 84.5$				
$84.5 - 89.5$				
$89.5 - 94.5$				
$94.5 - 99.5$		1	97	97
Total		40		

  b. i. Using the relation $\bar{x} = \frac{\Sigma fx}{\Sigma f}$ or otherwise, find the mean, $\bar{x}$.

    ii. Calculate the probability that a student chosen at random obtained at least 75 marks.

    c.   Draw a histogram using the frequency table.

8.   a.   Using a scale of 2cm to 2 units on each axis, draw on a graph sheet two perpendicular axes Ox and Oy for the interval $-10 \le x \le 10$ and $-10 \le y \le 10$.

    b.   Draw on this graph sheet, indicating the coordinates of all vertices:

        i. ΔPQR with P(2, 2), $\overrightarrow{PQ} = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$ and $\overrightarrow{QR} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$

        ii.   The image $\Delta P^1 Q^1 R^1$ of ΔPQR under a reflection in the line $x = 0$ where $P \to P^1$, $Q \to Q^1$ and $R \to R^1$.

        iii.   The image $\Delta P^{11} Q^{11} R^{11}$ of $\Delta P^1 Q^1 R^1$ under rotation of $180°$ about the origin where $P^1 \to P^{11}$, $Q^1 \to Q^{11}$ and $R^1 \to R^{11}$.

    c.   i.   Describe precisely the single transformation that maps $\Delta P^1 Q^1 R^1$ onto $\Delta P^{11} Q^{11} R^{11}$, where $P^1 \to P^{11}$, $Q^1 \to Q^{11}$ and $R^1 \to R^{11}$.

        ii.   Find $|P^1 R^1|$.

9.   Using a pair of compasses and a ruler only:

    a.   Construct ΔPQR such that $|PQ| = 9cm, \angle PQR = 75°$ and $\angle QPR = 60°$;

    b.   Locate a point T, inside ΔPQR such that it is equidistant from RQ, RP and PQ;

    c.   Construct the circle which touches the three sides of ΔPQR and measure its radius.

10.   Kofi and Yaw entered into a business partnership with a total capital of ¢81m. They agreed to contribute the capital in the ratio 2:1 respectively. The profit was shared as follows: Kofi was paid 5% of the total profit for his services as the manager. Each partner was paid 3% of the capital he invested. The remainder of the profit was then shared between them in the ratio of their contributions to the capital. Kofi's share of the total profit was ¢7.5m, calculate:

    a.   the total profit for the year to the nearest thousand cedis;

    b.   Yaw's share of the profit as a percentage of his contribution to the capital.

11.   a.   Copy and complete the table for the relation $y = 3 + 2x - x^2$ for $-2 \le x \le 4$

x	-2	-1	0	1	1.5	2	2.5	3	3.5	4
y		0	3				1.75			-5

    b.   Taking 2cm to 1 unit on both axes draw the graph of the relation for the given interval.

    c.   Draw on the same axes the graph of $x - y = 0$.

    d.   Using your graphs,

        i.   solve the equation $3 + 2x - x^2 = x$;

        ii.   find the values of x for which $3 + 2x - x^2 = 2$.

12.   a.   A village P is 10km from a lorry station Q, on a bearing of $065°$. Another village R, is 8km from Q, on a bearing of $155°$. Calculate:

        i.   the bearing of R from P, to the nearest kilometre.

        ii.   The bearing of R from P, to the nearest degree.

    b.   M is a village on PR such that QM is perpendicular to PR. Find the distance of

M from P, to the nearest kilometre.

O/L MATHS NOVEMBER 1994

SECTION A

1. a.   A, B and C are three intersecting sets. Seven regions of the Venn diagram are p, q, r, s, t, u and v.
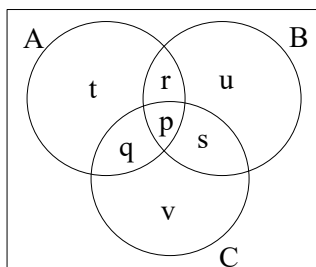
Find: i. $A \cap B'$ ii. $A \cap (B \cup C)$

iii. $(A \cup B) \cap (A \cup C)$

  b.   Write an expression for each of the regions in terms of A, B and C.

   i.   p   ii.   q   iii.   t

2. a. Copy and complete the addition $\oplus$,   multiplication $\otimes$ table for modulo 7

$\oplus$	0	1	2	3	4	5	6
0	0	1	2			5	
1	1	2	3	4	5	6	0
2		3		5	6	0	
3	3	4		6	0		2
4	4	5		0		2	
5		6		1	2	3	4
6	6		1		3		5

$\otimes$	0	1	2	3	4	5	6
0	0	0	0	0	0	0	0
1	0	1			4	5	6
2		2		6	1	3	
3	0	3	6	2	5	1	4
4	0		1			6	
5	0	5	3	1		4	
6	0		5		3	2	1

  b.   Use your tables to solve for x in the following.

   i. $x \oplus 3 = 6$ ii. $3 \oplus x = 1$ iii. $(2 \otimes x) \oplus 5 = 2$

3. a.   The vector V translates the point $P(5, 4)$ onto the point $P'(8, -2)$. Find:

   i.   the vector V;

   ii.   the coordinates of the point R which maps onto the point $R^1(3, 2)$ under V.

  b.   Find the truth set of the inequality $\frac{2(5 - x)}{3} + 3 < \frac{-3(x - 2)}{2}$, illustrate the answer on a number line.

4.   In the diagram CF is perpendicular from C to AB, $|AC| = 32cm$, $|AF| = 24.5cm$ and $\angle FCB = 22°$.
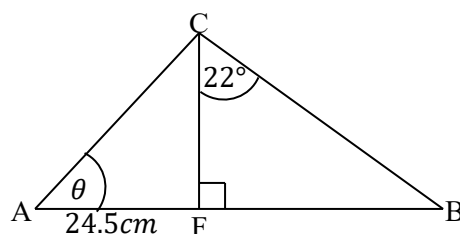
Find:

a. the angle of triangle ABC, correct to the nearest degree;

b. the length of CF, correct to three significant figures.

5. a. If $3d(d + 1) = 7$, find, correct to two decimal places, the positive value of d. Hence, deduce the positive value of x if $9x(3x + 1) = 7$.

b. Factorize $(5x - 2)^2 - (4y + 3)^2$.

SECTION B

6. The cost (C) of running a training course is partly constant and partly varies as the number of candidates (n) and the number of weeks (w) that the course lasts. When 110 candidates attended a course for 10 weeks, the running cost was ₦120,000.00 and when 150 candidates attended the course for 6 weeks, the running cost was ₦100,000.00.

a. Find:

i. the equation connecting c, n and w;

ii. the cost of running the course for 100 candidates for 12 weeks.

c. The organizers wish to make a profit of 20% on the cost of running the course for 160 candidates for 7 weeks. How much should each of the 160 candidates pay?

7. a. Copy and complete the table for the relation $y = (x - 2)^2 + 4$.

x	-2	-1	0	1	2	3	4	5	6
y		13		5		5			20

b. Using a scale of 2cm to 1 unit on the x-axis and 4cm to 5 units on the y-axis, draw the graph of the relation.

c. Draw on the same axes the line $y = 2x + 4$.

d. Use your graph to find the truth set of;

i. $(x - 2)^2 + 4 = 2x + 4$ ii. $(x - 2)^2 - 6 = 0$

8. The following table shows the frequency distribution of marks obtained by 100 candidates.

Marks	$10 - 14$	$15 - 19$	$20 - 24$	$25 - 29$	$30 - 34$
No. of candidates	1	6	18	21	27

$35 - 39$	$40 - 44$	$45 - 49$	$50 - 54$	$55 - 59$
15	5	4	2	1

a. Construct a cumulative frequency table for the distribution;

b. Draw the cumulative frequency curve;

c. Use your graph to determine:

i. the minimum mark required to earn a prize if the best 3 candidates are to be awarded prizes;

ii. the percentage of candidates with marks between 30.5 and 40.5.

9. a. Using a ruler and a pair of compasses only, construct;
       i. $\triangle ABC$ such that $|AB| = 10cm$, $\angle ABC = 30°$ and $\angle BAC = 45°$;
       ii. the locus L_1 of points which are equidistant from B and C;
       iii. the locus L_2 through C, of points equidistant from AB.
    b. L_1 and L_2 intersect at D. Measure: i. $\angle CDB$ ii. $|AC|$;
    c. Locate the point E on AB such that CE is perpendicular to AB.

10. a. Using a scale of 2cm to 2 units on both axes, draw on sheet of graph two
        perpendicular axes Ox and Oy for $-12 \leq x \leq 12$ and $-10 \leq y \leq 10$.
    b. Draw on the same graph, indicating clearly the coordinates of all vertices,
       i.   the triangle OAB with O(0,0), A(-2, 3) and B(-5, 3);
       ii. the image of triangle $O_1 A_1 B_1$ of triangle OAB under an enlargement
            from point (2, 6) with scale factor 2, where $O \rightarrow O_1$, $A \rightarrow A_1$ and
            $B \rightarrow B_1$.
       iii. the image of triangle $O_2 A_2 B_2$ of triangle $O_1 A_1 B_1$ under a reduction
            from the point (2, 6) with scale factor $^1/_2$, where $A_1 \rightarrow A_2$, $B_1 \rightarrow B_2$
            and $C_1 \rightarrow C_2$.
    c. Describe the single transformation which takes OAB onto $O_2 A_2 B_2$.
    d. Calculate the area of the quadrilateral $ABB_1 A_1$.

11. A right pyramid has a square base. The volume of the pyramid is $24cm^3$ and a
    diagonal of its base is $2\sqrt{3}m$.
    a. Calculate:
       i.   the height of the pyramid;
       ii. the area of the sloping face, correct to one decimal place.
    b. If smaller pyramid of height 3m is cut off from the top of the pyramid,
        calculate the volume of the remaining solid.

O/L MATHS NOVEMBER 1995
SECTION A

1. $A = \{1, 3, 5, 7, 9, 11\}$, $B = \{2, 3, 5, 7, 11, 13\}$, $C = \{3, 6, 9, 12, 15\}$ are subsets of
    $U = \{1, 2, 3, \dots, 15\}$.
    a. Draw a Venn diagram to illustrate the given information.
    b. Use your diagram to find:
       i. $C \cup A^1$
       ii. the probability of selecting a number in the set $A^1 \cup (B \cap C)$.

2. a. Draw a table for multiplication $\otimes$ in modulo 12 on the set $\{1, 5, 7, 11\}$.
    b. Using the table,
       i.   State with reason whether or not the operation $\otimes$ is commutative;
       ii. Evaluate $5 \otimes (7 \otimes 11)$;   iii.   Find the truth set of $n \otimes n = 1$.

3. a. $8^x = \frac{1}{2}$, find the value of x.
    b. A trader sold 1,750 articles for ¢525,000.00 at a profit of 20%.

      i.   Calculate the cost price of each article;

      ii.   If he had wanted 45% profit on the cost price, how much should he have sold each of the article?

4.   The following information gives the proportion in which Yoro spends annual salary.

Food	30%
Income Tax	20%
Rent	15%
Savings	5%
Transport	7.5%
Miscellaneous	22.5%

    a.   Draw a pie chart to illustrate the above information.

    b.   If Yoro's annual salary is D8,000.00, calculate the amount he spends on food.

5.   a.   Solve the simultaneous equations:

$3x - y = 7$ $2x + 3y = 12$

    b.   Two points P and Q are 41km apart is on a bearing of $064°$ from P. A point T is on a bearing of $029°$ from P and $334°$ from Q. Calculate, to nearest kilometre, the distance of T from P.

SECTION B

6.   a.   If $\log_x 3 = 0.5283$ and $\log_x 7 = 0.9358$, find logarithm to base of;

      i.   27;   ii. $\sqrt{7}$

    b.   A piece of wire of length L, is bent into shape of a rectangle. The area enclosed by the rectangle is $7\frac{1}{2}\ cm^2$.

      i.   If the length of the side of a rectangle is $x\ cm$, find an expression for L.

      ii.   If the length of the wire is 13cm, find the length of the sides of the rectangle.

7.   a.   Copy and complete the table of values for the relation $y = x^2 + 2x - 3$ for the interval $-4 \le x \le 2$.

    b.

x	-4	-3	-2	-1	0	1	2
y		0	-3		-3	0	

Using a scale of 2cm to 1 unit on each axis, draw the graph of the relation for the given interval.

    c.   Using the same axes and scale, draw the graph of the relation $2x + 3y = 6$.

    d.   From your graphs, find:

      i.   the equation of the axis of symmetry of the curve;

      ii.   the solution of $x^2 + 2x - 3 = 2 - \frac{2}{3}x$;

      iii.   the coordinates of the least value of $y = x^2 + 2x - 3$.

8.   Using a ruler and a pair of compasses only, construct:

      i.   a quadrilateral ABCD with $|AB| = 9cm$, $|AD| = 7.5cm$,

$|BC| = 10cm$, $\angle BAD = 135°$ and $\angle ABC = 75°$;

ii. the bisectors of $\angle BCD$ and $\angle ABC$ and mark their point of intersection O;

iii. the line OR from O to meet AB at right angles at R;

iv. Measure $|OR|$.

9. a. P, Q, R and T are points in the Cartesian plane. The coordinates of P and Q are $(4, 1)$ and $(-3, 2)$ respectively. $\overrightarrow{PT} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}$ and $\overrightarrow{QR} = \begin{pmatrix} -2 \\ -3 \end{pmatrix}$. Find $\overrightarrow{TR}$.

b. ABCD is a parallelogram whose vertices are A(p, q), B$(5, 7)$, C$(4, 3)$ and D$(1, 2)$.

i. Find $\overrightarrow{AB}$ and $\overrightarrow{DC}$ are hence find the values of p and q;

ii. Calculate the magnitude of $\overrightarrow{AC}$.

10. The table below shows the distribution of the masses of 50 bags of kola nuts exported in October, 1991.

Mass (kg)	110-114	115-119	120-124	125-129	130-134	135-139	140-144	145-149
No. of bags	1	4	8					

a. Construct a cumulative frequency table for the distribution;

b. Draw the cumulative frequency curve.

c. Use your graph to determine:

i. the median mass;

ii. the inter-quartile range of the distribution;

iii. the probability that a bag chosen at random has a mass less than 127kg.

11. Assuming the earth to be a sphere of radius 6,400km, find, correct to the nearest kilometre:

a. the circumference of parallel of latitude of 51°N;

b. the distance between two places on this latitude whose longitudes differ by 54°;

c. the distance of the North Pole from any point on the latitude 51°N measured along a line of longitude.

SSSCE NOVEMBER 1995

SECTION A

1. Without using calculators or tables, evaluate;

a. $\frac{0.0048 \times 0.81}{0.0027 \times 0.004}$, leaving your answer in standard form.

b. $2\sqrt{5}(6 - 2\sqrt{5})$, if $\sqrt{5} = 2.236$

2. a. Copy and complete the addition $\oplus$, multiplication $\otimes$ table for the arithmetic modulo 5

$\oplus$	0	1	2	3	4
0	0	1	2	3	4
1	1	2	3	4	
2	2		4		1
3	3	4	0	1	
4	4	0	1	2	

$\otimes$	0	1	2	3	4
0	0	0	0	0	0
1	0	1	2	3	4
2	0	2	4		
3	0	3	1		2
4	0	4		2	

    b.   From the tables, find:

          i. $(2 \otimes 4) \oplus 4$ ii. $(4 \oplus 4) \otimes 2$

3. In a class of 32, 18 offer Chemistry, 16 offer Physics and 22 offer Mathematics, 6 offer all three subjects, 3 offer Chemistry and Physics only and 5 offer Physics only. Each student offers at least one subject. Find the number of students who offer;
    a.   Chemistry only   b.   only one subject
    c.   only two subjects

4. A man deposited ¢80,000.00 in a bank at 12% compound interest per annum. Find his total amount at the end of the third year.

5. A ship sails from port R on a bearing 065° to a port S a distance of 54km. It then sails on a bearing of 155° from port S to port Q, a distance of 80km. Find, correct to one decimal place,
    a.   the distance between R and Q;   b.   the bearing of Q from R.

SECTION B

6. Jones bought a car for ¢6,800,000.00. He later put for sale at ¢8,800,000.00. He agreed to sell it to Ruby under the following hire purchase terms: an initial payment of 20% of the price and the balance paid at 15% simple interest per annum in twelve monthly equal installments. Calculate:
    a.   the amount paid every month;
    b.   the total amount Rudy paid for the car;
    c.   the percentage profit Jones made on the cost of the car.

7.   a.   Using a ruler and a pair of compasses only, construct;
        i.   triangle ABC, where $|AB| = 7cm$, $|AC| = 8cm$ and $\angle A = 105°$;
        ii.   X, the locus of points $6cm$ from C;
        iii.   Y, the locus of points equidistant from $\overline{AB}$ and $\overline{BC}$ to X in P and R.
    b.   Measure: i. $|BC|$ ii. $|PR|$.

8.   a.   The resistance R, of the motion of a car is partly constant and partly varies as the square of the speed, V. When the car is moving at 30km/h, the resistance is 630N and at 5km/h, the resistance is 950N. Find;
        i.   an expression for R in terms of V;
        ii.   the resistance at 80km/h.
    b.   Solve for x in $3\log_{10} x + \log_{10} 3 = \log_{10} 81$.

9. a. The coordinates of the vertices of a parallelogram QRST are Q(1, 6), R(2, 2), S(5, 4) and T(x, y).

   i. Find $\overrightarrow{QR}$ and $\overrightarrow{TS}$ and hence determine the values of x and y.

   ii. Calculate the magnitude of $\overrightarrow{RS}$;

   iii. Express $\overrightarrow{RS}$ in the form (k, θ), where k is the magnitude and θ, the bearing.

   b. Find the values of x and y in the equation $\begin{pmatrix} x+3 \\ 2 \end{pmatrix} - \begin{pmatrix} y \\ x+y \end{pmatrix} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$

10. Using a scale of 2cm to 2 units on each axis, draw on a sheet of graph paper two perpendicular axes Ox and Oy, for the intervals $-8 \le x \le 12$ and $-12 \le y \le 12$.

    a. Draw the triangle ABC with coordinates A(5, 7), B(3, 4) and C(7, 3).

    b. Draw the image triangle $A^1B^1C^1$ of triangle ABC under the translation by the vector $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$, where $A \to A^1$, $B \to B^1$ and $C \to C^1$.

    c. Draw the image triangle $A^{11}B^{11}C^{11}$ of triangle ABC under a reflection in the line $y = -2$, where $A \to A^{11}$, $B \to B^{11}$ and $C \to C^{11}$.

    d. Draw the image triangle $A^{111}B^{111}C^{111}$ of triangle ABC under a rotation through 90° anticlockwise about the origin, $A \to A^{111}$, $B \to B^{111}$ and $C \to C^{111}$.

    e. Find the gradient of the line B^1B^{11}.

11. The table below shows the distribution of marks of candidates in an examination.

Mark	Frequency	Marks less than	Cumulative Frequency
$0 - 9$	4		
$10 - 19$	7		
$20 - 29$	5		
$30 - 39$	10		
$40 - 49$	13		
$50 - 59$	20		
$60 - 69$	15		
$70 - 79$	13		
$80 - 89$	5		
$90 - 99$	1		

    a. Copy and complete the table.

    b. Draw the cumulative frequency curve for the distribution.

    c. Use your curve to estimate:

       i. the median;

       ii. the probability that a student chosen at random obtained at least 75 marks.

12. a. The diagram shows a circle PQRS with centre O. The reflex angle at O is $\angle 204°$, angle ORS $= 54°$ and angle OPS $= x$. Find the value of x.
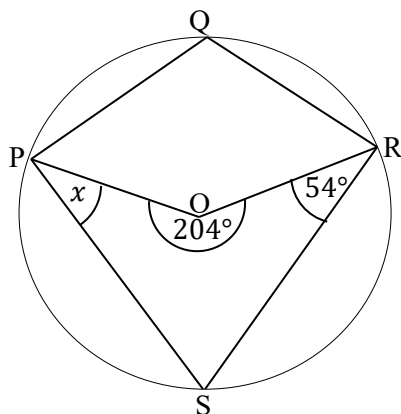
b. A solid cube of side 8cm was melted to form a solid circular cone. Base radius of the cone is 4cm. Calculate, correct to one decimal place, the height of the cone. $[\ Take\ \pi = \frac{22}{7}]$

O/L MATHS JUNE 1996

SECTION A

1. a. $A = \{1, 2, 3, 4, 5\}$ and $B = \{3, 6, 9\}$ are subsets of $E = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$.
   i. Illustrate the given information on a Venn diagram.
   ii. State the number of subsets of A;
   iii. List all elements of $A \cap B$ and $A \cup B$.

   b. Evaluate $\left(49^{1/2} + 125^{1/3}\right)^2$.

2. a. Draw a table for multiplication $\otimes$ modulo 6 on the set $S = \{2, 3, 4, 5\}$.
   b. Use your table to find:
   i. $(4 \otimes 2) \otimes (4 \otimes 5)$; ii. the truth set of $n \otimes n = n$.

3. a. Make r the subject of $a - b = \sqrt{\frac{b}{r} + b^2}$ and simplify the expression.

   b. Solve the inequality $2(9 - 3x) < 3 - x$ and illustrate it on the number line.

4. The following table shows the expenditure distribution essential services by a district council.

Item	Expenditure (million cedis)
Health	84
Primary Education	90
Secondary Education	54
Transport	72
Police	54
Housing	78

   a. Draw a pie chart to illustrate the information.
   b. Find the percentage of total expenditure allocated to education.

5. y varies inversely as the square of x. When $x = 3$, $y = 100$. Find:
        a.   the equation connecting x and y;
        b.   the value of x when $y = 25$;
        c.   the value of y when $x = 15$.

SECTION B

6.   a.   A manufacturer makes a wireless set at a cost of Le 6,000.00 and sold it to a wholesaler at a profit of 10%. The wholesaler sold it to a retailer at profit of 25%. Find:
                i.   the cost to the wholesaler;
                ii.   the selling price of the wholesaler;
                iii.   the marked price of the retailer;
                iv.   If a customer who paid cash had the price reduced to Le 12,200.00, find the percentage discount allowed on the marked price to the customer.
        b.   A motorist estimated that to travel a certain distance, he would need 90 litres of petrol and 1 litre of oil at a cost of ¢37,400.00. He actually used 80 litres of petrol and 2 litres of oil at a cost of ¢34,800.00. Find the cost of:
                i.   petrol per litre;   ii.   oil per litre.

7.

x	-3	-2	-1	0	0.5	1	1.5	2	3	4	5
y			0	-5						15	

        a.   Copy and complete the table for the relation $y = 2x^2 - 3x - 5$ for $-3 \le x \le 5$.
        b.   Using a scale of 2cm to 1 unit on the x-axis and 2cm to 5 units on the y-axis, draw the graph of the relation $y = 2x^2 - 3x - 5$ for the given interval.
        c.   Use your graph to solve:
                i. $2x^2 - 3x - 5 = 0$ ii. $2x^2 - 3x - 15 = 0$

8.   a.   Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper two perpendicular axes Ox and Oy for the intervals $-10 \le x \le 10$ and $-10 \le y \le 10$.
        b.   Draw on the same graph, indicating clearly the coordinates of all vertices,
                i.   triangle ABC with A$(-2, 8)$, B$(5, 10)$ and C$(5, 2)$;
                ii.   the image triangle $A_1 B_1 C_1$ of triangle ABC under an anticlockwise rotation of 90° about the origin, where $A \to A_1$, $B \to B_1$ and $C \to C_1$.
                iii.   the image triangle $A_2 B_2 C_2$ of triangle ABC under a reflection in the line $y = 0$, where $A \to A_2$, $B \to B_2$ and $C \to C_2$.
        c.   What single transformation maps triangle $A_1 B_1 C_1$ onto triangle $A_2 B_2 C_2$ where $A_1 \to A_2$, $B_1 \to B_2$ and $C_1 \to C_2$.
        d.   Find the gradient of $A_1 A_2$.

9.   The vertices of triangle PQR are P$(1, -3)$, Q$(7, 5)$ and R$(-3, 5)$.
   a.   Express $\overrightarrow{PQ}$, $\overrightarrow{QR}$ and $\overrightarrow{PR}$ as column vectors.
   b.   Show that triangle PQR is isosceles.
   c.   Find:
      i.   the equation of PQ;
      ii.   the coordinates of the midpoint of $\overline{PR}$.

10.   The marks scored in Mathematics by 80 students in an examination are recorded below.

93	88	85	62	68	84	73	81	90	68
75	59	53	71	73	79	57	73	60	93
72	78	71	95	61	65	97	67	74	62
60	74	83	68	66	78	61	89	94	77
71	79	68	60	96	78	76	82	75	95
75	65	63	76	79	62	87	75	78	85
74	76	85	62	65	80	73	88	88	78
77	75	76	76	86	67	82	75	72	68

   a.   Using the class intervals 50-54, 55-59, etc, construct a cumulative frequency table for the distribution.
   b.   Draw the cumulative frequency curve;
   c.   Use your graph to estimate;
      i.   the median mark;   ii.   the lower quartile;
      iii.   the probability that a student selected at random scored a mark between 80 and 89.

11.   A solid right pyramid has a square base ABCD with vertex V. The volume of the pyramid is $2601cm^3$ and the height $27cm$. Calculate:
   a.   the length of a side of a base;
   b.   the angle between one of the sloping surfaces and the base, correct to the nearest degree;
   c.   the total surface area of the solid, correct to four significant figures.

SSSCE NOVEMBER 1996
SECTION A
1.   Mathematics, English and Life Skills books were distributed to 50 students in a class. 22 had Mathematics books, 21 English books and 25 Life Skills books. 7 had Mathematics and English books, 6 Mathematics and Life Skills books and 9 English and Life Skills books. Find the number of students who had:
   a.   all three books   b.   exactly two of the books
   c.   only Life Skills books

2.   The following table below shows the number of students who offer certain subjects in a school.

Subjects	Number of students
Mathematics	45
Physics	39
Chemistry	28
Biology	14
Economics	36
History	18

3.
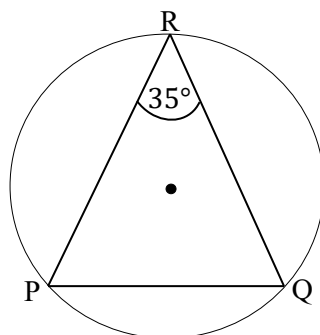
In the diagram, P, Q, R are points on a circle with centre O and diameter 14cm. Angle PRQ = 35°. Find, correct to one decimal place;

a.   the length of the minor arc PQ;

b.   the length of the chord PQ.   [$Take\ \pi = 3.142$]

4.   The force of attraction, F, between two bodies varies directly as the product of their masses, M, and m, and varies inversely as the square of the distance, d, between them. Given that $F = 20$ when $M = 25$kg, $m = 10$kg and $d = 5m$, find:

a.   an expression for F in terms of M, m and d;

b.   the distance d when $M = 7.5$kg, $m = 4$kg and $F = 30$N.

5.   a.   Find θ, if $\cos(\theta + 60°) = 0.0872$, where $0° \leq \theta \leq 90°$.

b.   A vertical pole AB is erected on a level ground. A man 1.7m tall stands at C, 24m away from the foot B, of the pole. The angle of elevation of the top A of the pole from the man is 54°. Calculate, correct to one decimal place, the height of the pole.

SECTION B

6.   a.   The value of a printing machine depreciated each year by 8% of its value at the beginning of that year. If the value of the new machine is 54 million cedis, find its value at the end of the third year.

b.   Three friends, Ako, Oko and Edem entered into a business partnership. They contributed 3.0 million, 2.4 million and 3.6 million cedis respectively. It was agreed that profits will be shared in proportion to their contributions. After one year of operation the profit made was 2.7 million cedis.

i.   Find the amount received by each partner as his share of the profit;

ii.   Express Edem's share of the profit as a percentage of his investment.

7.   a.   Copy and complete the table for the relation $y = x^2 + x - 6$ in the interval $-5 \leq x \leq 4$.

x	-5	-4	-3	-2	-1	0	1	2	3	4
y		6		4			-4		6	

   b.   Using a scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graph of the relation for $-5 \leq x \leq 4$.

   c.   Use your graph to find;
   i.   the equation of the line symmetry;
   ii.   the truth set of $x^2 + x = 8$;
   iii.   the coordinates of the minimum point.

8.   a.   If $\underline{a} = \begin{pmatrix} 1 \\ -3 \end{pmatrix}$, $\underline{b} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ and $\underline{c} = \begin{pmatrix} 8 \\ 3 \end{pmatrix}$, find:
   i. m and n such that $\underline{c} = m\underline{a} + n\underline{b}$, where m and n are scalars;
   ii. $|\underline{d}|$, if $\underline{d} = \underline{c} - 2\underline{a}$.

   b.   Find the image of $(3, -7)$ under the transformation $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 2x + y \\ y - 3x \end{pmatrix}$.

9.   a.   i.   Express $\dfrac{\sqrt{2} + \sqrt{5}}{\sqrt{10}}$ in the form $a\sqrt{2} + b\sqrt{b}$ where a and b are rational numbers.

   ii.   Simplify $\left(6 + 3\sqrt{5}\right)\left(3 - \dfrac{2}{\sqrt{5}}\right)$.

   b.   Find three consecutive odd integers such that the sum of the last two is 15 less than 5 times the first.

10.   a.   Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper, two perpendicular axes Ox and Oy for $-10 \leq x \leq 10$ and $10 \leq y \leq 10$.

   b.   Draw on the same graph indicating clearly, the coordinates of all vertices;
   i.   the quadrilateral ABCD with $A(2, 2)$, $B(6, 2)$, $C(8, 8)$ and $D(4, 8)$.
   ii.   the image $A_1B_1C_1D_1$ of ABCD under a reflection in the line $x = 0$, where $A \to A_1$, $B \to B_1$, $C \to C_1$ and $D \to D_1$.
   iii.   the image $A_2B_2C_2D_2$ of ABCD under a rotation through 180° about the origin, where $A \to A_2$, $B \to B_2$, $C \to C_2$ and $D \to D_2$.
   iv.   the image $A_3B_3C_3D_3$ of ABCD under a reflection in the line $y = 2$, where $A \to A_3$, $B \to B_3$, $C \to C_3$ and $D \to D_3$.

   c.   Find the equation of the line DD_1.

11.   The table below shows the distribution of marks obtained by students in an examination.

Marks	Frequency
$11 - 20$	5
$21 - 30$	21
$31 - 40$	15
$41 - 50$	43
$51 - 60$	10

61 − 70	14
71 − 80	7
81 − 90	3
91 − 100	2

    a.   Draw a histogram to represent the data;

    b.   Use the histogram to estimate the mode;

    c.   Find the class that contains the median mark;

    d.   If a student is chosen at random, find the probability that he obtains a mark between 41 and 90.

12.   A circle has a radius of 7.5cm. A sector with an angle of 240° is cut out from the circle.

    a.   Find the length of the arc of the sector.

    b.   If the sector is folded to form a cone, find, correct to one decimal place;

        i.   the height of the cone;   ii.   the volume of the cone.

$\left[Take\ \pi = \frac{22}{7}\right]$

GCE JUNE 1997

SECTION A

1.
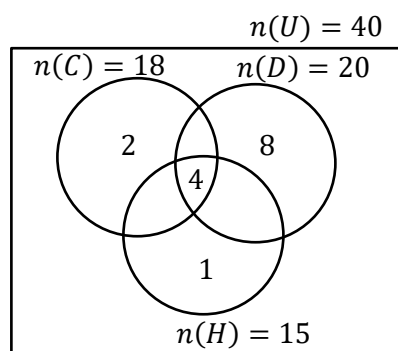
The Venn diagram shows choices of vocations by 40 students. 18 chose Catering (C), 20 chose Dressmaking (D) and 15 chose Hairdressing (H). 2 chose Catering only, 8 chose Dressmaking only and 1 chose Hairdressing only, 4 chose all the three vocations. Find the number of students who chose:

    a.   Dressmaking and Catering only;   b.   None of the vocations.

2.   a.   Simplify $\sqrt{50{,}000} - 25\sqrt{125} + 5\sqrt{5}(\sqrt{5} - 5)$, leaving your answer in the form $a + b\sqrt{5}$, where $a, b \in R$.

    b.   Simplify $\dfrac{(42000 \times 10^{36})(5000 \times 10^{-10})}{(0.0007 \times 10^{21})(0.0006 \times 10^{-14})}$, leaving your answer in the standard form.

3.   a.   Express 216 as a product of prime factors and hence evaluate $(216)^{2/3}$.

b. i. Solve for x in the inequality $\frac{1}{2}(x + 1) \geq \frac{1}{3}(2x + 2)$, where x is a real number line.

ii. Illustrate your answer on the number line.

4. Draw a table for multiplication $\otimes$ modulo on the set $P = \{1, 5, 9, 10\}$. Use your table to:

a. find the truth set of the equation:

i. $10 \otimes a = 2$; ii. $a \otimes a = 4$;

b. Evaluate $5 \otimes (9 \otimes 10)$.

5. In an election, the number of votes won by five political parties A, B, C, D and E in a village are as follows:

Party	A	B	C	D	E
No. of votes	140	110	190	520	240

a. Draw a pie chart to illustrate this information.

b. What percentage of the total vote did the winner obtain?

SECTION B

6. Yaw starts a company with ¢2,400,000. After 6 months, he is joined by Esi who contributes ¢3,000,000. Two months later, Yaw and Esi were joined by Kwesi who contributes ¢3,300,000. They agreed to share the profit as follows: 20% to Yaw as manager of the company and 4% to Kwesi as assistant manager. The rest of the profits will then be shared in the ratio of the product of their capitals in the company and the time since each of them joined the company. If the profit at the end of the year after Yaw had started the company is ¢1,005,000, calculate the total amount received by each of the three partners of the company.

7. a. Copy and complete the table of values for the relation $y = x^2 + x - 2$ for the interval $-4 \leq x \leq 3$.

x	-4	-3	-2	-1	0	1	2	3
y	10				-2			

b. Using a scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graph of the relation $y = x^2 + x - 2$ for $-4 \leq x \leq 3$.

c. Use your graph to solve:

i. $x^2 + x - 2 = 0$ ii. $x^2 - x - 5 = 0$.

8. Using a ruler and a pair of compasses only,

a. Construct:

i. triangle ABC with $|AB| = 8cm$, $\angle ABC = 30°$ and $\angle BAC = 120°$;

ii. the locus L_1, of point equidistant from A and C;

iii. the locus L_2, of points equidistant from AB and AC.

b. Locate the point of intersection D, of L_2 and BC.

c. i. Construct locus L_3 of points $2.5cm$ from D.

ii.   Locate E and F, the points of intersection of L_1 and L_3 and measure $|EF|$.

9.   a.   Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper two perpendicular axes Ox and Oy for the intervals $-10 \leq x \leq 10$ and $-10 \leq y \leq 10$.

    b.   Draw on the same graph, indicating clearly the coordinates of all vertices,

        i.   Quadrilateral PQRS with P(2, 1), $\overrightarrow{PQ} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ and $\overrightarrow{RS} = \begin{pmatrix} -2 \\ -2 \end{pmatrix}$.

        ii.   The image quadrilateral $P_1Q_1R_1S_1$ of PQRS under an anticlockwise rotation of 270° about the origin, where $P \rightarrow P_1, Q \rightarrow Q_1, R \rightarrow R_1$ and $S \rightarrow S_1$.

        iii.   The image of quadrilateral $P_2Q_2R_2S_2$ of PQRS under a reflection in the line $y = -x$, where $P \rightarrow P_2, Q \rightarrow Q_2, R \rightarrow R_2$ and $S \rightarrow S_2$.

    c.   Express $\overrightarrow{P_1P_2}$ as a column vector.

10.   The following data shows marks obtained by students in a Mathematics test.

6	9	5	9	5	3	7	5	5	2
7	10	2	9	8	0	6	2	6	6
5	6	9	7	7	4	1	6	6	8

    a.   Construct a frequency table for the data.

    b.   i.   State the mode of the distribution.

        ii.   If a student is chosen at random, what is the probability that he had more than 5 marks?

    c.   Calculate the mean of the distribution.

11. $P(40°N, 20°W)$ and $Q(40°N, 36°W)$ are two points on the surface of the earth. Assuming the earth is a sphere of radius 6400km, calculate:

    a.   the distance PQ along the line of latitude, correct to one decimal place;

    b.   correct to two decimal places, the time taken for an aircraft to fly average speed of $540 kmh^{-1}$ from P to Q along the line of latitude;

    c.   the shortest distance along the earth between P and Q, correct to two significant figures. $[Take\ \pi = 3.142]$

SSSCE NOVEMBER 1997

SECTION A

1.   The sets $A = \{..., -6, -4, -2, 0, 2, 4, 6, ...\}$, $B = \{x: 0 \leq x \leq 9\}$, $C = \{x: -4 \leq x \leq 0\}$ are subsets of Z, the set of integers.

    a.   i.   Describe the members of the set A', where A' is the complement of A.

        ii.   Find $A' \cap B$.

    b.   Represent the sets B and C on a Venn diagram.

2.   Without using calculator or tables,

    a.   simplify $\left(1\frac{2}{7} - \frac{1}{3}\right) \times 1\frac{3}{4}$;   b.   evaluate $\dfrac{7.25 \times (0.16)^2}{0.004}$

3. $P'(8, -2)$ is the image of the point $P(5, 2)$ by the translation vector **V**. Find:
    a. the vector **V**;
    b. the coordinates of the point Q which maps onto the point $Q(5, -2)$ under V;
    c. $\overrightarrow{P'Q'}$;   d. $\left|\overrightarrow{P'Q'}\right|$.

4. If $3^m \times 3^n = 243$ and $3^m \div 3^{2n} = 9$, write down two equations connecting m and n.

5. Using a ruler and a pair of compasses only, construct triangle ABC in which angle A is 45°, $|AB| = 7cm$ and $|AC| = 9cm$. Locate a point P, inside the triangle ABC, $5cm$ from A and equidistant from B and C. Find $|PB|$.

SECTION B

6. a.
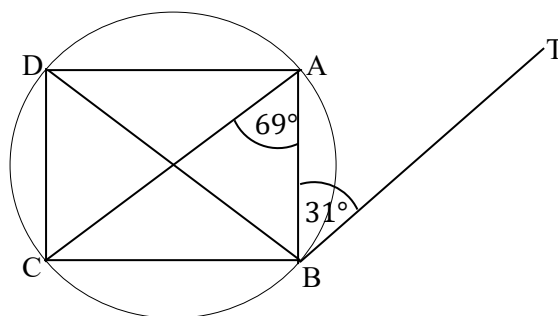
In the diagram, TB touches the circle at B and BD is a diameter.
Angle $TBA = 31°$ and angle $BAC = 69°$. Calculate:
    i.   Angle ADC   ii.   Angle ABC
    iii. Angle CAD

b. In triangle ABC, $|AB| = 5cm$, $|BC| = 8cm$ and $|AC| = 6cm$. P is a point on AB such that $|AP| = 2cm$. The line through P parallel to BC meets AC at Q. Calculate;
    i. $|PQ|$;   ii. $|QC|$.

7. a. The cost of a packet of sugar is x cedis and the cost of a tin of milk is y cedis. If 3 packets of sugar and 4 tins of milk cost ¢635.00 and 4 packets of sugar and three tins of milk cost ¢695.00, write two equations connecting x and y. Hence find the values of x and y.

b. The cost of production of a wireless set was ¢40,000.00. The manufacturer sold it to a wholesaler at a profit of 20%. The wholesaler also sold it to a retailer at a profit of 25%. The retailer marked the set to be sold at a price 50% above what he paid for it.
    i.   Find the marked price;
    ii.   To a customer who paid cash, the retailer reduced the price to ¢75,000.00. Find the percentage discount.

8. a. Without using tables or calculators, evaluate $3\sqrt{7}\left(7 - 2\sqrt{7}\right)$ if $\sqrt{7} = 2.646$.
    b. The cost of producing a motor car in a certain factory is partly constant and partly varies inversely as the number of cars produced per day. If the cost of producing each car is $1,600 when 4 cars are produced per day and $1,420

when 5 cars are produced per day, find the rate of production necessary to bring the cost down to $1,150 per car.

9. The table below shows the heights measured to the nearest metre of 300 trees.

Height (m)	2	3	4	5	6	7	8	9
No. of tress	14	21	42	83	118	12	7	3

  a. Draw a histogram to represent the data;

  b. Calculate the mean mark of the distribution, correct to the nearest metre.

  c. If a tree is selected at random, find the probability that it is at least 6 metres tall.

10. a. Copy and complete the following table of values for the relation; $y = \frac{2x(x-1)}{x+3}$ for the interval $-1 \le x \le 6$.

x	−1	0	0.5	1	2	3	4	5	6
$2x(x-1)$		0	−0.5	0	4		24	40	60
$x+3$			3.5	4		6	7		9
$y = \dfrac{2x(x-1)}{x+3}$			−0.1	0			3.43		6.67

  b. Using a scale of 2cm to 1 unit on both axes, draw the graph of $y = \frac{2x(x-1)}{x+3}$ for the given interval.

  c. Use your graph;

    i. to find the range of values of x for which y is negative;

    ii. to estimate, correct to one decimal place, the value of x for which $2x(x-1) = x + 3$.

11. a. Using a scale of 2cm to 2 units on both axes, draw on a graph sheet two perpendicular axes Ox and Oy for $-10 \le x \le 10$ and $-10 \le y \le 10$.

  b. Draw, labelling clearly all the vertices together with their coordinates;

    i. triangle ABC with vertices $A(4, 8)$, $B(1, 7)$ and $C(3, 4)$;

    ii. the image $\Delta A_1 B_1 C_1$ of ΔABC under a reflection in the line $y = 3$, where $A \to A_1$, $B \to B_1$ and $C \to C_1$.

    iii. the image $\Delta A_2 B_2 C_2$ of ΔABC under an anticlockwise rotation through $90°$ about the origin, where $A \to A_2$, $B \to B_2$ and $C \to C_2$.

    iv. the image $\Delta A_3 B_3 C_3$ of ΔABC under an enlargement with scale factor -1 from the origin, where $A \to A_3$, $B \to B_3$ and $C \to C_3$.

  c. What single transformation maps $\Delta A_2 B_2 C_2$ onto $\Delta A_3 B_3 C_3$?

12. The model below shows a pyramid EFGHV on a cuboid ABCDEFGH. The volume of the model is $132 cm^3$. Find, correct to the nearest whole number,

  a. the height of the pyramid;

  b. the length of the slant edge, VG;

  c. the angle between the face VFG and the base EFGH.
    $[Take\ \pi = 3.142]$
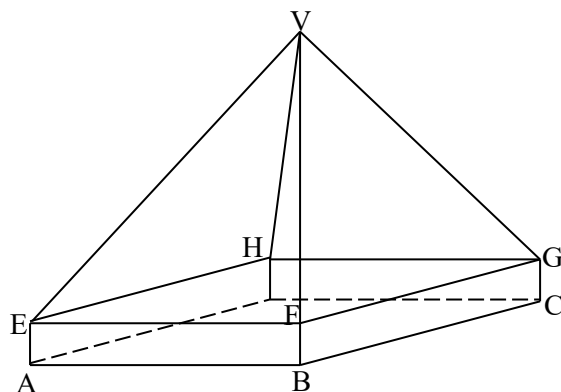
SSSCE NOVEMBER 1998

SECTION A

Answer all the questions in this section. All questions carry equal marks.

1.   a.   Consider the following statements:

S: All students with measles stay in the sick bay.

T: All students in the sick bay do not do homework.

Which of the following is/are valid deductions from the two statements?

i.   Kofi does not have measles so Kofi does his homework.

ii. George has done his homework therefore he does not stay in the sick bay.

iii. Jane does not have measles so she does not stay in the sick bay

b.   Solve the equation $243_x = 73$.

2.   a.   Simplify $\left(\frac{27}{64}\right)^{-\frac{2}{3}}$

b.   Solve the inequality $4x + 3 \geq 3(2x - 1)$. Illustrate your answer on the number line.

3.   a.   If $C = 216K$, find the least positive integral value of K that will make C a perfect square.

b.
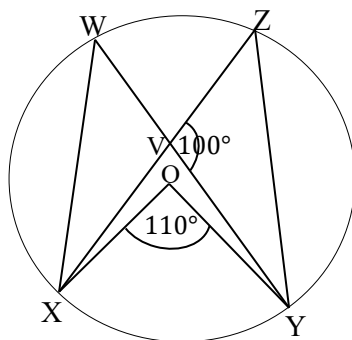
Not drawn to scale

In the diagram, WYXZ is a circle with centre O, XZ and WY intersect at V, $\angle XOY = 110°$ and $\angle YVZ = 100°$. Calculate:

i. $\angle XZY$;   ii. $\angle WXZ$.

4. If $t = \sqrt{\dfrac{p-r}{p+r}}$, find

   a. r in terms of p and t;   b. the value of r when $t = 3$ and $p = 10$.

5.

20m

2m

18m

Not drawn to scale

2m
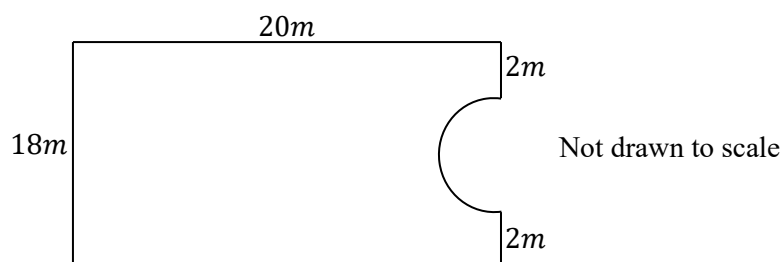
The diagram above represents a rectangular compound 20m by 18m with a semicircular portion cut off. $\left[Take\ \pi = \dfrac{22}{7}\right]$. Calculate:

   a. the perimeter of the compound;   b. the area of the compound.

SECTION B

Answer four questions only from this section. All questions carry equal marks.

6. a. $3x - 4 = 2(y - 2)$. Find $\dfrac{x}{y}$, where $y \neq 0$.

   b. Use logarithm tables to evaluate $\dfrac{86.19 \times (0.0462)^2}{\sqrt{0.846}}$.

7.
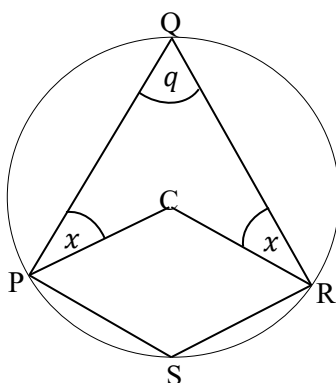
The diagram above shows a circle PQRS with centre C. Quadrilateral CPSR is a rhombus. $\angle QPC = \angle CRQ = x$ and $\angle PQR = q$.

   a. Find:

   i. q ii. x iii. $\angle QRS$

   b. Show that triangle PQR is an equilateral triangle.

8. The table below shows the expenditure pattern of a family in 1993. The net income of the family was 1.8 million cedis.

Item	Percentage
Food	60
Clothing and footwear	22
Rent, transport and household equipment	7
Education, entertainment and recreation	7
Miscellaneous goods and services	4

    a.   Calculate the amount the family spent on
        i.   Food;
        ii.   Miscellaneous goods and services.

    b.   The family income for 1994 increased 35%. At the same time expenditure for food recorded an increase of 25% while all the other items recorded an increase of 20%. Find the amount the family saved at the end of 1994.

9.   a.   Using a ruler and a pair of compasses only, construct;
        i.   a quadrilateral ABCD, where $|AB| = 8cm$, $|AD| = 6cm$, $|BC| = 10cm$, $\angle BAD = 60°$ and $\angle ADC = 135°$;
        ii.   the locus L_1, of points equidistant from BC and CD;
        iii.   the line L_2, from B perpendicular to L_1.

    b.   i.   Locate E, the point of intersection of L_1 and L_2.
        ii.   Measure $|DE|$.

10.   a.   Copy and complete the following table of the relation $y = 10 + 6x - 3x^2$ for $-3 \le x \le 5$.

x	-3	-2	-1	0	1	2	3	4	5
y				10	13		1	-14	

    b.   Using a scale of 2cm to 1 unit on the x-axis and 2cm to 5 units on the y-axis, draw the graph of the relation for the given interval.

    c.   From your graph, solve the equation:
        i. $10 + 6x - 3x^2 = 0$;   ii. $5 + 2x - x^2 = 0$.

    d.   Find the equation of the line symmetry.

11.   a.   A ship sails due north from a point P to a point Q, 4km away. It then sails on a bearing of 090° to a point R, 3km from Q. Find the distance between P and R.

    b.   Two points A and C on opposite sides of a vertical pole, are on the same level ground as the foot of the pole, B. The angles of elevation of the top of the pole, D from A and C are 30° and 48° respectively. If the distance between the A and C is 50m. Find $|BD|$, the length of the pole.

12.   Two fair dice, A and B, each with faces numbered 1 to 6 are thrown together.
    a.   Construct a table showing all the 36 equally likely outcomes;
    b.   From your table, list the pair of numbers on the two dice for which the sum is
        i.   5;   ii.   more than 10.
    c.   Find the probability that the sum of the numbers on the two dice is
        i.   5;   ii.   more than 10.

SSSCE NOVEMBER 1999

SECTION A
[40 marks]
Answer all the questions in this section. All questions carry equal marks

1.   a.   Consider the following two statements:

        P: All students are hardworking.

        Q: No hardworking student is careless.

        i.   Draw a Venn diagram to illustrate the above statements.

        ii.   Which of the following statements are valid or not valid conclusions from P and Q?

            α.   Ama is a student $\Rightarrow$ Ama is not careless.

            β.   Kwame is hardworking $\Rightarrow$ Kwame is a student.

            γ.   Esi is careless $\Rightarrow$ Esi is not a student.

    b. $A = \{1, 2, 3, 4, 6\}$ and $B = \{1, 2, 3, 6, 9, 18\}$ are subsets of the universal set $\mu = \{1, 2, 3, 4, 6, 9, 12, 18, 36\}$.

        List the elements of: i. $A' \cap B$ ii. $(A' \cap B)'$

2.   a.   If $\dfrac{3m - n}{5m - n} = \dfrac{p}{q}$, express m in terms of p, q and n.

    b.   Without using tables or calculators, express $\dfrac{(0.00042 \times 10^{-8})(15,000)}{(5000 \times 10^7)(0.0021 \times 10^{14})}$ in the form $a \times 10^n$, where n is an integer.

3.   a.   Copy and complete the multiplication, $\otimes$, for modulo 8 on the set $\{2, 3, 4, 5, 6, 7\}$.

$\otimes$	2	3	4	5	6	7
2	4	6	0	2	4	6
3	6		4		2	5
4	0	4		4	0	4
5		7	4	1		3
6	4	2	0	6	4	
7	6		4		2	1

    b.   From your table find:

        i.   the truth set of the equation $n \otimes n = 1$;

        ii.   the value of $(3 \otimes 5) \otimes 6$.

4. $A(-2, 3), B(2, -1), C(5, 0)$ and $D(x, y)$ are the vertices of the parallelogram ABCD.

    a.   Find $\overrightarrow{AB}$ and $\overrightarrow{DC}$. Hence find the coordinates of D.

    b.   Calculate, correct to one decimal place, $|\overrightarrow{DB}|$.

5.   a.   Using a ruler and a pair of compasses only, construct;

        i.   triangle ABC with $|AB| = 6.0cm$, $|BC| = 8.0cm$ and angle ABC $= 90°$.

        ii.   A point D on AC, which is equidistant from B and C.

        iii.   Measure $|BD|$.

SECTION B

[60 marks]

Answer four questions only from this section. All questions carry equal marks.

6.   a.   Simplify $3\sqrt{27} - 2\sqrt{3}(4\sqrt{3} - 5\sqrt{12})$, leaving your answer in the surd form.

        b.   A variable y is partly constant and partly varies as the square of x. When $x = 2, y = 6$ and when $x = 3, y = 10$.

            i.   Find the equation connecting x and y.

            ii.   What is the value of y when $x = 4$?

            iii.   Find the value of x when $y = 5$.

7.   a.
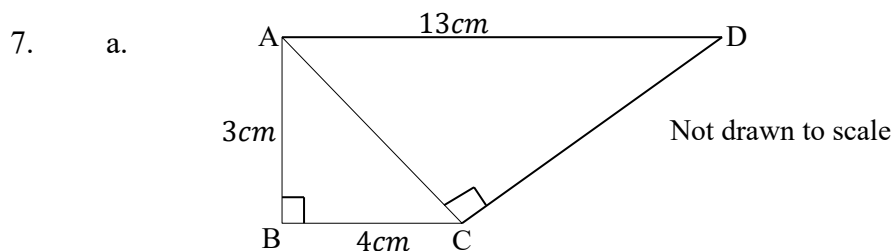
            In the diagram, ABCD is a quadrilateral. $\angle ABC = \angle 90°$, $|AB| = 3cm$, $|BC| = 4cm$ and $|AD| = 13cm$. Find the area of the quadrilateral.

        b.
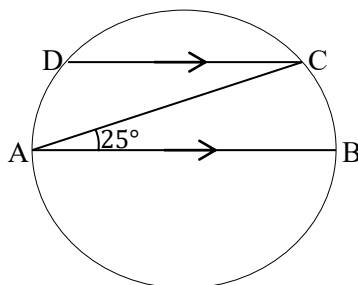
            In the diagram AB is a diameter of the circle ABCD. DC is parallel to AB and $\angle BAC = 25°$. Calculate:

            i. $\angle ADC$;   ii. $\angle CAD$.

8.   In a certain country, the annual income tax payable by an individual is as follows.

Amount	Rate of Tax
First ¢140,700	Free
Next ¢100,000	5%
Next ¢150,000	15%
Next ¢200,000	25%
Next ¢300,000	35%
Next ¢350,000	45%
Next ¢400,000	55%

Mr. Hamosa's annual salary is ¢1,390,700. Calculate:

    a.   his taxable income;

b.   his annual income;

c.   the percentage of his income that went into tax, correct to two significant figures.

9.   a.   Copy and complete the table of values for the relation $y = x^2 - 2x - 3$ for the interval $-2 \leq x \leq 4$.

x	-2	-1.5	-1	0	1	2	2.5	3	3.5	4
y	5		0	-3				0		

b.   Using a scale of 2cm to 1 unit on both axes, draw the graph of the relation $y = x^2 - 2x - 3$ for the interval.

c.   Use your graph to find:

     i.   the solution of $x^2 - 2x - 3 = 0$;

     ii.   the equation of the line of symmetry;

     ii.   the range of values of x for which y is negative.

10.   A, B, X and Y are four points in a horizontal plane. B is on a bearing 090° from A. X is 7.5m due north of B and on a bearing 052° from A. Y is due north of A and on a bearing 340° from B. Calculate, correct to three significant figures,

a. $|AB|$;

b. $|AY|$.

c.   the components of $\overrightarrow{XY}$.

d.   the distance and bearing of Y from X.

11.   The table below shows the height, in millimetres, of a sample of 250 seedlings on an experimental farm.

Height of seedlings (mm)	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39
No. of seedlings	40	45	60	40	30	20	10	5

a.   Construct a cumulative frequency table and use it to draw a cumulative frequency curve for the sample.

b.   Using your cumulative frequency curve, find:

     i.   the first and third quartiles;

     ii.   the percentage of the sample of seedlings whose heights are above 22mm.

12.

2m

3.5m

2.5m

Not drawn to scale
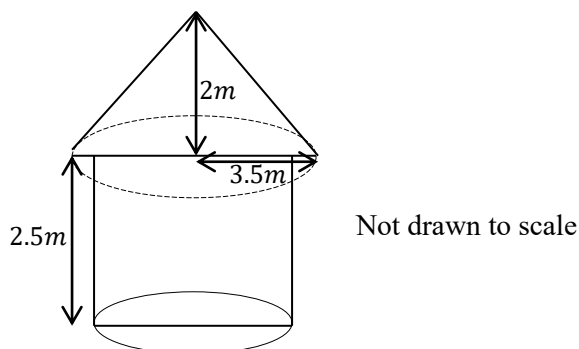
The diagram above shows a hut made up of a conical roof and a cylindrical wall. The height of the roof is 2m and its base radius is 3.5m. The cylindrical wall has a height of 2.5m and base area of $28.26m^2$. $[\pi = 3.14]$

a. Calculate, correct to 3 significant figures
   i. the slant height of the conical roof;
   ii. the surface area of the conical roof;
   iii. the external surface area of the wall.

b. If the cost of painting a square metre of surface is ¢450.00, calculate the total cost of painting the outer area of the wall and the roof of the hut.

SSSCE NOVEMBER 2000
SECTION A
[40 marks]
Answer all the questions in this section. All questions carry equal marks.

1. The set $P = \{multiples\ of\ 3\}$, $Q = \{factors\ of\ 72\}$ and $R = \{even\ numbers\}$ are subsets of $\mu = \{18 \le x \le 36\}$.
   a. List the elements of P, Q and R.
   b. Find: i. $P \cap Q$;   ii. $Q \cap R$;   iii. $P \cap R$.
   c. What is the relationship between $P \cap Q$ and $Q \cap R$?

2. a. Find R, if $5(R)^2 + (22.55)^2 = (27.45)^2$.
   b. Evaluate $\sqrt{1500} + 3\sqrt{3} \times 5\sqrt{5} + 2\sqrt{15}(\sqrt{15} - 3)$ in the form $q\sqrt{15}$ where p and q are integers.

3. a. Solve the equation $\log(5x - 4) = \log(x + 1) + \log 4$.
   b.
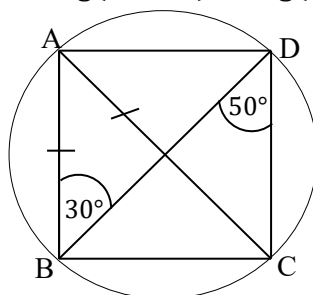
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In the diagram above, A, B, C and D are points on a circle $|AB| = |AC|$;

$\angle BDC = 50°$ and $\angle ABD = 30°$. Calculate the value of $\angle CAD$.

4. Given that $T = \dfrac{37V}{6V - 54M}$
   a. Make V the subject;
   b. If $T = 4.5$ and $M = 7 \times 10^7$, calculate the value of V, leaving your answer in standard form.

5. The table shows the number of cars sold by a company from January to June, 1990.

January	February	March	April	May	June
7,100	7,668	10,366	9,940	8,236	7,810

a. Draw a pie chart to illustrate the information.
b. What is the percentage of cars sold in February?

SECTION B

Answer four questions only from this section. All questions carry equal marks.

6. a. Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper two perpendicular axes Ox and Oy, for the interval $-10 \leq x \leq 10$ and $-12 \leq y \leq 12$.
   b. Draw on the same graph sheet indicating clearly the coordinates of all vertices.
      i. The square PQRS with coordinates $P(2, 2)$, $Q(6, 2)$, $R(6, 6)$ and $S(2, 6)$;
      ii. The image $P_1Q_1R_1S_1$ of the square PQRS under a reflection in the y axis, where $P \rightarrow P_1$, $Q \rightarrow Q_1$, $R \rightarrow R_1$ and $S \rightarrow S_1$;
   iii. The image $P_2Q_2R_2S_2$ of the square PQRS under a translation by the vector $\begin{pmatrix} 4 \\ -8 \end{pmatrix}$ where $P \rightarrow P_2$, $Q \rightarrow Q_2$, $R \rightarrow R_2$ and $S \rightarrow S_2$;
      iv. The image $P_3Q_3R_3S_3$ of the square PQRS under a rotation through $180°$ about the origin, where $P \rightarrow P_3$, $Q \rightarrow Q_3$, $R \rightarrow R_3$ and $S \rightarrow S_3$;
   c. Find $\overrightarrow{P_2P_3}$.

7. a. The simple interest on ¢600,000.00 for $3\frac{1}{4}$ years is ¢56,250.00. Find the rate percent per annum.
   b. Mr. Amos bought a car for 2.5 million cedis in 1985. He paid 40% of the cost and paid the rest in equal monthly installments. He took eight years to make full payment for the car. Interest was charged at 18% simple interest. Calculate:
      i. the monthly installment;
      ii. the total amount he paid for the car;
      iii. the percentage increase in the cost of the car.

8. a. The cost, C, of manning a household is partly constant and partly varies as the number of people, n, in the house. For 8 people, the cost is ¢ 70,000 and for 10 people, the cost is ¢90,000. Find:
      i. an expression for C in terms of n;
      ii. the weekly cost for 12 people.
   b. Two passengers trains, A and B, 300km apart, start towards each other at the same time. They meet after 2 hours. If train B travels $\frac{8}{7}$ as fast as train A, what is the speed of each other at the same time?

9. Using a ruler and a pair of compasses only,
   a. construct:
      i. triangle ABC such that $|AB| = 8cm$, $\angle BAC = 105°$ and $\angle ABC = 30°$;
      ii. the locus l_1, of points equidistant from A and B;
      iii. the locus l_2, of points equidistant from B and C;
   b. Locate P, the point of intersection of l_1 and l_2.

     c.   Using PC as a radius, draw a circle.

     d.   Measure;   i. $|BC|$;   ii.   the radius of the circle.

10.   a.   The annual rent of a rectangular plot of land is ¢1,024,000.00 at a rate of ¢320.00 per square metre if the length is 80m find the width of the plot.

     b.   A flower bed is in the form a rectangle with semi-circular ends. The straight sides are 25m long and the flower bed is 14m wide.

          i.   Find the area of the flower bed;

          ii.   If the cost of the black soil is ¢955.75 per square metre and the cost of labour is ¢800.00 per square metre, find the cost of covering the flower bed with black soil. $\left[Take\ \pi = \frac{22}{7}\right]$.

11.   The data below shows the distribution of marks obtained by 50 students in a test.

10	73	19	78	24	78	34	34	35	35
37	59	41	63	41	65	45	55	55	58
48	49	49	53	53	55	45	55	65	67
58	38	59	43	61	44	48	68	79	83
70	14	74	29	76	31	48	68	85	90

     a.   Using class intervals 10-19, 20-29 etc, construct a frequency table for the distribution.

     b.   i.   Draw a histogram for the distribution.

          ii.   Use your histogram to estimate the mode.

     c.   Calculate the mean mark for the distribution.

12.   a.   Four angles of a hexagon are $130°, 160°, 112°$ and $80°$. If the remaining angles are equal, find the size of each of them.

     b.   A ship sails from a point A in a direction 065° to point B, 24km away from B, the ship then sails 18km due east to a point C. From C, the ship then sails 30km due north to a point D. Calculate the bearing of D from A.

SSSCE JULY 2001

<div align="center">

SECTION A

[40 marks]

</div>

Answer all the questions in this section. All questions carry equal marks.

1.   a.   If $P = \{1, 2, 3, 4\}$, write down all the subsets of P which have exactly two elements.

     b. $A = \{prime\ numbers\ less\ than\ 15\}, B = \{even\ numbers\ less\ than\ 15\}$ and $C = \{x : 3 \leq x \leq 12, where\ x\ is\ an\ integer\}$.

     List the elements of:

          i. $A \cap C$ ii. $B \cap C$ iii. $(A \cup B)' \cap C$

2.   a.   If $\sqrt{7} = 2.646$, find without using a calculator, the value of $\sqrt{0.0007}$.

     b.   Copy and complete the table below for addition in base eight.

$\oplus$	1	3	5	7
1	2	4	6	
3		6	10	12
5	6			
7		12	14	16

Use your table to solve the following:

     i. $3 \oplus x = 12$ ii. $n \oplus n = 6$

3.   a.   If $x^5 = 1024$, find the value of x.

     b.   Given that $\log_{10} 7 = 0.8451$ and $\log_{10} 3 = 0.4771$. Find without using calculator, $\log_{10}\left(\frac{9}{7}\right)$.

4.   a.   Express 441_{five} as a number in base four.

     b.   Solve the inequality $\frac{1}{3}x - \frac{1}{5}(2 + x) \geq x + \frac{7}{3}$.

5.   A group of 300 mathematics teachers were classified as follows:

     University Graduates   120

     Diplomats   90

     Specialists   50

     Others y

     a.   Calculate the value of y.

     b.   Draw a pie chart to illustrate the above information.

SECTION B

Answer four questions from this section. All questions carry equal marks.

6.   a. $S = \frac{n}{2}[2a + (n - 1)d]$, where $n > 0$. Find the value of n, if $a = 3, d = 4$ and $S = 210$.

     b.   Tickets for a film show were sold at ¢4,000 per adult and ¢2,000 per child. The total amount raised from the tickets sold was ¢1,6000,000.

          i.   Find the number of:

               α.   adults who bought the tickets for the show.

               β.   children who bought the tickets for the show.

          ii.   If 12% of the amount realised was paid as tax and 2% of the amount realised paid to the ticket sellers. Find the amount paid;

               α.   as tax;   β.   to the tickets sellers.

7.   a.   Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper, two perpendicular axes Ox and Oy for $-10 \leq x \leq 10$ and $-12 \leq y \leq 12$.

     b.   Draw on the same graph sheet, showing clearly the coordinates of all vertices.

          i.   The triangle PQR with $P(4, 8)$, $\overrightarrow{QP} = \begin{pmatrix} -2 \\ 2 \end{pmatrix}$ and $\overrightarrow{RP} = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$;

          ii.   The image $\Delta P_1 Q_1 R_1$ of ΔPQR under a reflection in the line $y = -2$, where $P \to P_1, Q \to Q_1$ and $R \to R_1$;

    iii.   The image of $\Delta P_2 Q_2 R_2$ of ΔPQR under a translation by the vector $\begin{pmatrix} -8 \\ 2 \end{pmatrix}$, where $P \to P_2$, $Q \to Q_2$ and $R \to R_2$;

    iv.   The image $\Delta P_3 Q_3 R_3$ of ΔPQR under a rotation through 180° about the origin, where $P \to P_3$, $Q \to Q_3$ and $R \to R_3$;

    v.   Find $\overrightarrow{Q_2 Q_3}$.

8.

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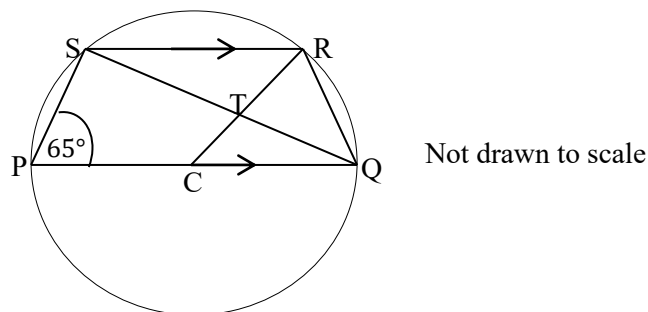
In the diagram C is the centre of the circle PQRS, STQ and PCQ are straight lines and RS is parallel to QP. Angle $SPC = 65°$.

a.   Show that triangle CQT and RST are similar.

b.   Find:

    i. $\angle RSQ$ ii. $\angle CRQ$.

9.   a.   Using ruler and a pair of compasses only, construct

    i. ΔGBC with angle $GBC = 30°$, $|BC| = 9.5cm$ and $|BG| = 12cm$;

    ii. L_1, the locus of points 6cm from C;

    iii. L_2, the perpendicular from C to BG;

    b.   i.   Locate A and D, the intersection of L_1 and BG;

    ii.   Measure $|AD|$ and $\angle ACD$;

    iii.   Calculate, correct to two significant figures, the area of the minor sector ACD. $[Take\ \pi = 3.142]$

10.   The marks obtained in a test by 40 pupils are as follows;

78	60	78	66	33	81	67	84	72	60
54	42	27	33	24	66	27	63	18	30
39	44	30	30	33	45	39	33	30	45
27	36	42	18	42	36	60	72	72	63

a.   Construct a frequency table, using class intervals 10-19, 20-29, 30-39, etc.

b.   Draw a histogram for the distribution taking 2cm for the width of each bar and 2cm to represent 2 pupils.

c.   i.   Use your histogram to estimate the mode.

    ii.   Calculate the mean of the distribution.

11.   The diagram below represents a field with a circular pond of diameter 14m. PTS and QUR are semicircles, PQRS is a rectangle with $|PQ| = 112m$ and $|QR| = 56m$.
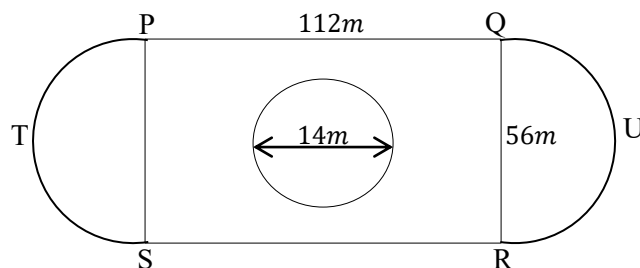
Not drawn to scale

Find:

a.   the distance round the field;

b.   the area of the field excluding the pond. $\left[Take\ \pi = \frac{22}{7}\right]$

12. a.   If $\sin \theta = \frac{3}{5}$, find the value of $\tan \theta$.

b.   A ladder 5m long leans against a vertical wall at angle of $70°$ to the ground. The ladder slips down the wall 2m. Find, correct to two significant figures,

i.   the new angle which the ladder makes with the ground.

ii.   The distance the ladder has slipped back on the ground from the original position.

SSCE NOVEMBER 2001

SECTION A

1.   Some students were interviewed to find out which of the following three sports they liked; football, boxing and volleyball. 70% of the students liked football, 60% boxing and 45% volleyball. 45% liked football and boxing, 15% boxing and volleyball, 25% football and volleyball and 5% liked all three sports.

a.   Draw a Venn diagram to illustrate this information.

b.   Use your diagram to find the percentage of students who liked:

i.   football and boxing but not volleyball;

ii.   exactly two sports;

iii. none of the three sports.

2.   Without using mathematical tables or calculators,

a.   find the value of y, if $13y = 187^2 - 174^2$;

b.   evaluate $\sqrt{\dfrac{0.0048 \times 0.81 \times 10^{-7}}{0.027 \times 0.04 \times 10^{6}}}$ leaving your answer in standard form.

3.   a.   Copy and complete the multiplication $\otimes$ and addition $\oplus$ tables for modulo 7 below.

⊕	1	2	3	4	5	6
1	2	3	4	5	6	0
2	3	4	5		0	1
3	4		6	0	1	
4	5	6	0	1	2	3
5	6	0		2	3	4
6	0	1	2	3	4	

⊗	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	4	6	1	3	5
3	3	6		5	1	4
4	4		5		6	3
5	5	3	1	6		2
6	6	5		3	2	1

b.   From the tables;

       i.   find the value of n if $n \otimes (n \oplus n) = 1$;

       ii.   evaluate $(4 \oplus 5) \otimes 3$.

4.   Using ruler and a pair of compasses only construct;

    a.   i. ΔPQR with $|PQ| = 5.5cm, |PR| = 6.5cm$ and $\angle QPR = 120°$;

       ii.   a point S on QR such that it is equidistant from $|PQ|$ and $|PR|$;

    b.   Measure $|PS|$.

5.   The table shows the scores obtained by 20 students in test.

Score	4	5	6	7	8
Frequency	3	2	5	4	6

    a.   Calculate the mean score for the test.

    b.   Draw a bar chart for the distribution.

6.   a.   The vectors $a = \begin{pmatrix} -1 \\ 4 \end{pmatrix}, b = \begin{pmatrix} x \\ y \end{pmatrix}$ and $c = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ are in the same plane.

       If $3a - 2b = c$, find

       i.   the vector b;

       ii. $|d|$ and express your answer in the form $p\sqrt{q}$, where p and q are integers and $d = b - c$.

    b.   The point P, Q and R are in the same plane. $\overrightarrow{PQ} = (xkm, 030°)$, $\overrightarrow{RP} = (12km, 300°)$ and $|QR| = 20km$.

       i.   Find the value of x;

       ii.   If the point S is on PR such that $\angle PQS = 45°$, find $|QS|$ in the form $p\sqrt{q}$, where p and q are integers.

7.   In the diagram, ABC are points on a circle with centre O, AT is the tangent to the circle at A. The line DOE is perpendicular to AB, $|AB| = |AC| = \angle TAC = 72°$.

Not drawn to scale
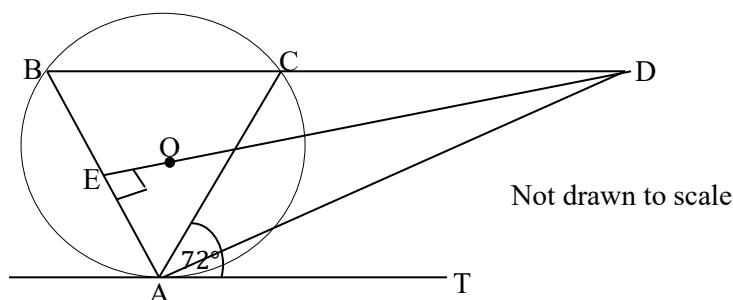
a. Calculate:
   i. $\angle BCA$; ii. $\angle CAD$; iii. $\angle CDA$.

b. Use your result in (a) to show that
   i. AD bisects angle TAC;
   ii. $|CD| = |CA|$.

8. Mr. Ansu's salary was ¢3,450,000.00 per annum. He contributed 5% of his salary per annum to Social Security Fund on which he did not pay any tax. In addition, he was allowed ¢240,000.00 per annum free of tax. After these deductions, Mr. Ansu paid tax at 17.5% on the first 70% of his taxable income. He also paid tax at the rate of 45% on the remaining 30% of his taxable income. Calculate

   a. Mr. Ansu's annual contribution to the Social Security Fund;
   b. the annual amount on which he pays tax;
   c. the percentage of income tax that went into tax, correct to three significant figures.

9. a. Copy and complete the table for the relation $y = 7 + 3x - x^2$ for intervals $-3 \le x \le 6$.

x	-3	-2	-1	0	1	2	3	4	5	6
y	-11			7				3		-11

   b. Using a scale of 2cm to 1 unit on the x-axis, draw the graph of the relation $y = 7 + 3x - x^2$ for the given interval.

   c. Use your graph to find:
      i. the solution of $7 + 3x - x^2 = 0$;
      ii. the solution of $5 + 3x - x^2 = 0$;
      iii. the maximum value of y.

SSSCE JULY 2002

SECTION A

[40 marks]

Answer all the questions in this section. All questions carry equal marks

1. a. Without using calculators, simplify $\dfrac{\frac{3}{4}\left(3\frac{3}{8} + 1\frac{5}{6}\right)}{2\frac{1}{8} - 1\frac{1}{2}}$.

   b. Find the truth set of the inequality $7x + 4 < \frac{1}{2}(4x + 3)$. Illustrate your answer on the number line.

2. Consider the following statements:
   P: If students work hard they will pass their examinations.
   Q: If students pass their examinations then they do not sleep in class.
   a. Draw a Venn diagram to represent the statements P and Q.
   b. Deduce whether the following conclusions are valid or not.
      i. Nana does not sleep in class so she is hard working.
      ii. Nii does not pass his examination so he sleeps in class.

        iii.   Naa works hard so she does not sleep in class.

3.   a.   If $(3.64)^2 - (1.54)^2 = 10x$, find the value of x.

        b.   Find the truth set of the equation $5x^2 = (x + 2)(x + 3)$.

4.   Tickets for a film show were sold at ¢4,500.00 to the general public and ¢3,750.00 to the students. 400 people attended the show and ¢1,680,000.00 were collected in the ticket sales.

        a.   How many tickets were sold to the students?

        b.   Mr. Mensah was issued with 25 tickets to be sold to the general public and 20 tickets to be sold to students. How much did Mr. Mensah collect after selling all the tickets issued to him?

5.   a.   Using a ruler and a pair of compasses only,

            i.   construct triangle ABC with $|AB| = 10cm$, angle $ABC = 30°$ and angle $BAC = 45°$;

            ii.   a perpendicular from C to meet AB at D.

        b.   Measure $|CD|$.

SECTION B
[60 marks]
Answer four questions only from this section. All questions carry equal marks

6.   A woman bought 130kg of tomato for ¢52,000.00. She sold half of them at a profit of 30%. The rest of the tomatoes began to go bad, she then reduced the selling price per kg by 12%. Calculate:

        a.   the selling price per kg;

        b.   the percentage profit on the whole transaction if she threw away 5kg of bad tomatoes.

7.   a.   The points P, Q, R and S are vertices of a parallelogram in the Cartesian plane. The coordinates of P and R are $(-8, 2)$ and $(5, -2)$ respectively and $\overrightarrow{QR} = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$. Find:

            i.   the coordinates of Q and S;   ii.   the magnitude of $\overrightarrow{PR}$.

        b. $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$ and $d = u + v$.

            i.   Express d in terms of f and u.

            ii.   Find the value of d, when $f = 6$ and $u = 6.5$.

8.   a.   Copy and complete the following table for the relation $y = 7 + 4x - 3x^2$, for the interval $-3 \le x \le 4$.

x	-3	-2	-1	0	0.5	1	1.5	2	2.5	3	3.5	4
y	-32			7	8.25			3		-8	-15.5	

        b.   Taking 2cm to 1 unit on the x-axis and 2cm to 5 units on the y-axis, draw the graph of $y = 7 + 4x - 3x^2$ for the given interval.

        c.   Draw on the same graph sheet the graph of the relation $y + 2x + 2 = 0$.

    d.   Using your graphs,
        i.   solve the equation $9 + 6x - 3x^2 = 0$;
        ii.   find the values of x for which $17 + 4x - 3x^2 = 0$.

9.   The table below shows the frequency distribution of marks scored by 80 candidates in an examination.

Marks	$0-9$	$10-19$	$20-29$	$30-39$	$40-49$	$50-59$	$60-69$
Frequency	2	5	8	18	20	15	5

$70-79$	$80-89$	90 - 99
4	2	1

    a.   Draw the cumulative frequency curve for the distribution.
    b.   Use your graph to estimate:
        i.   the median mark;   ii.   the 60th percentile mark.
    c.   If the mark for distribution was 70%, what percentage of students passed with distinction?

10.   a.   A chord PQ of a circle of radius 5cm subtends an angle of 70° at the centre, O. Find, correct to 3 significant figures,
        i.   the length of the chord PQ;
        ii.   the length of the arc PQ;
        iii.   the area of the sector POQ;
        iv.   the area of the minor segment cut off by PQ.
    b.   A right circular cone has base radius 5cm and height 12cm. Calculate:
        i.   its volume;   ii.   its total surface area.

11.   a.   The sum of two numbers is 8 and their product is -33. Find the numbers.
    b.   Two given points S and T which are at opposite sides of a tower are 20m apart. S, T and the foot of the tower are in the same straight line. The angle of elevation of the top of the tower from S and T are 32° and 45° respectively. Find, correct to one decimal place, the height of the tower.
    d.   A clerk spends $\frac{1}{5}, \frac{1}{3}$ and $\frac{1}{8}$ of his annual salary on rent, transport and entertainment respectively. If after all these expenses he had ₦820.00 left, find how much he earns per annum.

12.   a.   Using a scale of 2cm to 2 units on each axis, draw on a sheet of graph paper two perpendicular axes Ox and Oy for the interval $-10 \le x \le 10$ and $-10 \le y \le 10$.
    b.   Draw on this graph sheet indicating the coordinates of all vertices,
        i. ΔUVW with $U(3, 7)$, $V(6, 7)$ and $W(3, 3)$;
        ii.   the image $\Delta U_1 V_1 W_1$ of ΔUVW under a reflection in the x-axis, where $U \to U_1, V \to V_1$ and $W \to W_1$.
        iii.   the image $\Delta U_2 V_2 W_2$ of $\Delta U_1 V_1 W_1$ under mapping, $\begin{pmatrix} x \\ y \end{pmatrix} \to \begin{pmatrix} x + y \\ x \end{pmatrix}$, where $U_1 \to U_2, V_1 \to V_2$ and $W_1 \to W_2$.
    c.   i.   Find the equation of the line joining points V_1 and U.

    ii.   Calculate $|WW_1|$.

SSSCE NOVEMBER 2002
SECTION A
[40 marks]

Answer all the questions in this section. All questions carry equal marks.

1.   a.   M and N are two intersecting sets. If $n(M) = 20, n(N) = 30$ and
$n(M \cup N) = 40$, find $n(M \cap N)$.

    b. x varies directly as the square root of t and inversely as s. When $x = 4, t = 9$
and $s = 18$.

        i.   Express x in terms of s and t.

        ii.   Find the value of x when $t = 81$ and $s = 27$.

2.   a.   Write the equation of the line to the straight line $y = \frac{3}{2}x + 5$ and passing
through the point $(2, 3)$.

    b.   If $223_x = 87_{ten}$, find the value of x.

3.   a.   An amount of ¢300,000.00 was shared among Ama, Kojo and Esi. Ama
received ¢60,000.00. Kojo received $\frac{5}{12}$ of the remainder, while the rest went to
Esi. In what ratio was the money shared?

    b.   If $\frac{1}{m} + \frac{1}{n} = \frac{1}{p}$,

        i.   express m in terms of n and p;

        ii.   calculate m correct to one decimal place, when $n = 17.24$ and
$p = 16.41$.

4.   a.   The average petrol consumption of a car is 1 gallon per 35km. The cost of 1
litre of petrol is ¢747.00. Find the cost of petrol for a journey of 280km to the
nearest cedi.   [$Take\ 1\ gallon = 4.55\ litres$]

    b.   Solve the simultaneous equation: $2p - 3q = 4$ and $3p + 2q = 19$.

5.   Consider the following two statements:

W: Some students are hard working

Z: Some hardworking students are not carless

    a.   Draw a Venn diagram to illustrate the above statements.

    b.   State whether the following conclusions are valid or not valid from the
statements W and Z.

        i.   Jacob is careless $\Rightarrow$ Jacob is hard working.

        ii.   Zenzen is hard working $\Rightarrow$ Zenzen is careless.

        iii.   Owusu is not a student $\Rightarrow$ Owusu is not careless.

SECTION B

[60 marks]

Answer four questions only from this section. All questions carry equal marks

6. In a certain country, the annual tax payable by the individual in 1997 was assessed at the following rates:

For the first $200.00	Nil
For the next $300.00	10%
For the next $500.00	15%
For the next $800.00	20%
The remaining amount	30%

  a. Calculate the income tax payable by Mr. Vonda whose annual income is $2,800.00.

  b. If Miss Nyenge paid a monthly tax of $29.00, calculate her annual income.

7. a. Using ruler and a pair of compasses only;

  i. construct $\triangle ABC$ such that $|AB| = 8cm$, angle $BAC = 60°$ and angle $ABC = 75°$;

  ii. locate the point, O, inside $\triangle ABC$ equidistant from A, B and C;

  iii. construct the circle with centre O, which passes through A.

  b. Measure:

  i. $|OA|$; ii. angle ACB.

8. a. The vector $\boldsymbol{p} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$, $\boldsymbol{q} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$ and $\boldsymbol{r} = \frac{1}{2}(\boldsymbol{q} - \boldsymbol{p})$.

  i. Find the vector $\boldsymbol{r}$;

  ii. If $m\boldsymbol{p} + n\boldsymbol{q} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$, find the values of m and n, where m and n are scalars.

  b. $\overrightarrow{AB} = \begin{pmatrix} 4 \\ -2 \end{pmatrix}$ and $\overrightarrow{AC} = \begin{pmatrix} -1 \\ 6 \end{pmatrix}$ are vectors in the same plane. A is the point $(1, 2)$.

  i. Find the coordinates of B and C.

  ii. If D is the mid-point of BC, show that $\overrightarrow{AB} + \overrightarrow{AC} = 2\overrightarrow{AD}$.

9. The marks obtained by 40 students in an examination are as follows:

51	46	38	68	21	51	58	64	72	33
86	48	67	93	71	63	44	50	22	91
78	66	52	81	43	64	53	82	45	58
57	72	62	77	61	74	88	35	43	56

  a. Using class intervals of $20 - 29$, $30 - 39$, $40 - 49$, etc., construct a frequency distribution table for the data.

  b. Draw a cumulative curve for the distribution.

  c. Use your curve to estimate:

  i. the upper quartile; ii. the pass mark, if 31 students passed.

10.   a.   Solve the equation $\frac{y-5}{y} = \frac{5}{3y} - \frac{1}{5}$.

        b.

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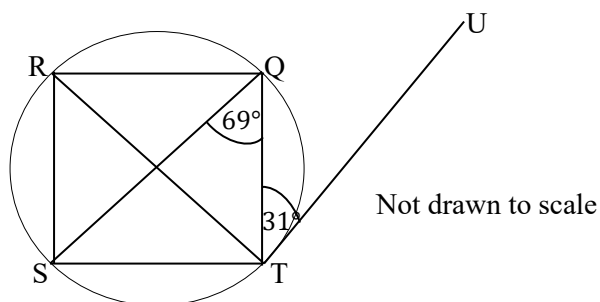
        In the diagram TU touches the circle at T and RT is a diameter. Angle $UTQ = 31°$ and angle $TQS = 69°$. Calculate:

        i.   angle QRS;   ii.   angle QTS;   iii.   angle SQR.

11.   a.   Copy and complete the table of values for the relation $y = 3 - 2x - x^2$, for the interval $-5 \le x \le 3$.

x	-5	-4	-3	-2	-1	0	1	2	3
y	-12		0			3			

        b.   Using a scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw on the same graph sheet the graph of the relations,

        i. $y = 3 - 2x - x^2$;   ii. $y + 2x + 4 = 0$.

        c.   From your graphs find:

        i.   the equation of the line of symmetry for the curve;

        ii.   the solution set of the equation $x^2 - 7 = 0$;

        iii.   the values of x for which the relation $y = 3 - 2x - x^2$ is greater than zero.

12.   ABCV is a right pyramid with base AB which is an equilateral triangle of side 18.0cm. Each sloping edge of the pyramid is 13.0cm. G is the centre of symmetry of triangle ABC. If $|AG| = 10.4cm$, calculate:

        a.   the angle between AV and the base ABC;

        b.   correct to one decimal place, the height VG of the pyramid;

        c.   correct to the nearest whole number, the volume of the pyramid;

        d.   the angle between the face BCV and the base ABC.

SSSCE JULY 2003

SECTION A
[40 marks]
Answer all the questions in this section. All questions carry equal marks.

1.   a.   Without using mathematical tables or calculators evaluate $\frac{0.0125 \times 0.00576}{0.0015 \times 0.32}$

        leaving your answer in standard form.

(All rough workings must be shown, including rough work)

b.   i.   Simplify $2\sqrt{3}(2 - \sqrt{3}) + 3\sqrt{2}(\sqrt{2} - 1)$.

     ii.   Hence evaluate your answer in (i) correct to 2 decimal places, given
that $\sqrt{2} = 1.414$ and $\sqrt{3} = 1.732$.

2.   If $A = \left\{x: \frac{2x-1}{3} < \frac{x+3}{5}\right\}$ and $B = \left\{x: \frac{2x}{3} - 5 < 3x + 2\right\}$.

    a. $A \cap B$;   b.   Illustrate your answer in (a) on a number line.

3.   a.   A trader sold 1,750 articles for ¢525,000.00 and made profit of 20%.

        i.   Calculate the cost price of each article.

        ii.   If he wanted 45% profit on the cost price, how much should he have
sold each of the articles?

    b.   Factorize completely $2xy - 6mn - 3my + 4nx$.

4.   P varies inversely as the square of $(Q + 1)$ and P is 2 and Q is 3.

    a.   Write an equation connecting P and Q.

    b.   Find the possible values of Q, when $P = 8$.

5.   Two vectors $\boldsymbol{p}$ and $\boldsymbol{q}$ are defined by $\boldsymbol{p} = \begin{pmatrix} 5\cos x \\ 5\sin x \end{pmatrix}$ and $\boldsymbol{q} = \begin{pmatrix} 2\cos x \\ 2\sin x \end{pmatrix}$.

    a.   If $\boldsymbol{p} + \boldsymbol{q} = \begin{pmatrix} 4.690 \\ 5.208 \end{pmatrix}$, find the nearest whole number the value of x, x is acute.

    b.   Find the value of vector $\boldsymbol{c}$, if $\boldsymbol{c} = 2\boldsymbol{p} + \boldsymbol{q}$.

SECTION B
[60 marks]

Answer four questions only from this section. All questions carry equal marks

6.   100 members of a community were asked to state the activities they undertake during
the day. 38 go to School. 54 go for Fishing. 50 engage in Trading. 10 go to School
and also Fish. 18 go to School and also Trade. 22 go for Fishing and also Trade. Each
of these members undertakes at least one of the activities. The number of people who
go to School only is same as the number who engage in Trading only. Use the
information to find the number who:

    a.   undertake all the three activities;   b.   go to School only.

7.   The marks scored by 15 pupils in a test are as follows;

14, 14, 11, 13, 17, 14, 11, 13, 20, 19, 17, 11, 20, 14, 17

Find:

    a.   the mean mark;

    b.   the standard deviation, correct to 2 decimal places.

8.   a.   Copy and complete the table of values for the relation $y = \frac{10}{x+3} + 3x - 3$ for
the interval $-2.25 \le x \le 1.5$.

x	-2.25	-2.0	-1.5	-1.0	-0.5	0	0.5	1.0	1.5
y	3.58	1	-0.83	-1.0	-0.5	0.33	1.36	2.5	3.72

b. Using a scale of 4cm to 1 unit on the x-axis and 2cm to 1 unit on the y-axis, draw a graph for the relation.

c. Estimate from your graph,
   i. the solution of the equation $(3x - 3)(x + 3) + 10 = 0$;
   ii. the values of x for which $y = 1$.

9. a. Solve for x if $\log_{10}(8x + 1) - \log_{10}(2x + 1) = \log_{10}(x + 2)$.

   b.

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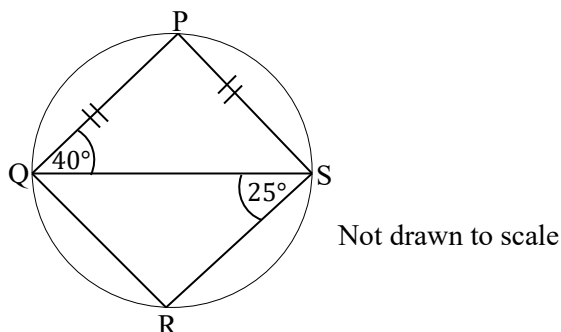
In the diagram, P, Q, R and S are points on a circle. $|PQ| = |PS|$, $\angle PQS = 40°$ and $\angle QSR = 25°$. Calculate the value of:
   i. $\angle QPS$ ii. $\angle RQS$

10. a. The diagonals of a rhombus are 8cm and 10cm long. Calculate, correct to 1 decimal place, the length of a side of the rhombus.

   b. A hollow right circular cone stands with its base on a horizontal table. It is 100cm high with a base radius of 20cm. It is filled with water through the vertex up to a depth of 25cm. Calculate,
      i.   the radius of the circle formed by the water surface;
      ii.   correct to the nearest whole number, the volume of water inside the cone. $\left[Take\ \pi = \frac{22}{7} \right]$

11. a. Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper two perpendicular axes Ox and Oy for the intervals $-10 \leq x \leq 10$ and $-10 \leq y \leq 10$.

   b. Draw on the same graph sheet indicating clearly the coordinates of all vertices,
      i. ΔPQR with vertices $P(6, 9)$, $Q(4, 4)$ and $R(9, 6)$.
      ii.   The image $\Delta P_1 Q_1 R_1$ of ΔPQR under a reflection in the line $y = 1$, where $P \to P_1$, $Q \to Q_1$ and $R \to R_1$.
      iii.   The image $\Delta P_2 Q_2 R_2$ of ΔPQR under an anticlockwise rotation of $90°$ about the origin, where $P \to P_2$, $Q \to Q_2$ and $R \to R_2$.
      iv.   The image $\Delta P_3 Q_3 R_3$ of ΔPQR under a translation by the vector $\begin{pmatrix} -9 \\ -9 \end{pmatrix}$, where $P \to P_3$, $Q \to Q_3$ and $R \to R_3$.

   c. Find the gradient of the line $P_3 Q$.

12. a. A ship leaves a point T and sails on a bearing $030°$ to a point P, 15km away. It then sails on a bearing $120°$ to a point Q, 20km away from P. Calculate $|TQ|$.

   b. i. Using a ruler and a pair of compasses only construct a quadrilateral

ABCD with $|AB| = 9cm, |BC| = 10cm, |AD| = 7.5cm, \angle ABC = 45°$ and $\angle BAD = 135°$.

ii.   What type of quadrilateral is ABCD?

SSSCE NOVEMBER 2003

SECTION A
[40 marks]

Answer all the questions in this section. All questions carry equal marks.

1.   a.   Draw a table for multiplication, modulo 7 on the set $P = \{2, 3, 4, 5, 6\}$.

    b.   Use your table to fin on the set P, the truth set of $n \otimes (n \otimes 6) = 3$.

2.   a.   Without using calculators or mathematical tables, simplify $\dfrac{0.0245 \times 1.2}{0.08 \times 1.75}$ leaving your answer in standard form.

    b.   Find the truth set of the inequality $2 - \frac{1}{3}(2x - 1) > \frac{2}{3}x$.

3.   a.   Given that $\sqrt{3} = 1.73205$, find correct to five significant figures, the value of $5 - \frac{5}{\sqrt{3}}$.

    b.   A man spends $\frac{1}{9}$ of his monthly salary on rent, $\frac{1}{2}$ on food and $\frac{1}{4}$ on clothes and other items. If he has ¢19,500.00 left at the end of the month, how much does he earn?

4.   There are 30 students in a class. 20 of them play football, 16 play hockey and 16 play volley, 9 play all the three games, 15 play volley and football, 11 play football and hockey, while 10 play hockey and volley.

    a.   Illustrate the information on a Venn diagram.

    b.   Using your Venn diagram, find the number of students who play at least two games.

    c.   What is the probability that a student chosen at random from the class does not play any of the 3 games?

5.   a.   Copy and complete the table of values for the relation $y = (x + 1)(3 - x)$ for the interval $-2 \le x \le 4$.

x	-2.0	-1.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	-5		3					1.75	0	-2.25	-5.00

    b.   Draw the graph of $y = (x + 1)(3 - x)$ using a scale of 2cm to 1 unit on both axes for the interval $-2 \le x \le 4$.

    c.   Using your graph find the greatest value of $(x + 1)(3 - x)$ and the value of x at which it occurs.

SECTION B
[60 marks]

Answer four questions only from this section. All questions carry equal marks

6.   The monthly electricity charges in a country are calculated as follows:

First 50 units	¢4,000.00
Next 100 units	¢120.00 per unit
Next 150 units	¢150.00 per unit
Next 300 units	¢220.00 per unit
Remaining units	¢350.00 per unit

    a.   How much did Mr. Owusu pay for using 720 units in a month?

    b.   A man paid ¢73,260.00 for electricity consumed in a month. How many units of electricity did he consume?

7.   The table shows the marks obtained by 60 candidates in a test.

Marks	1-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40
Frequency	2	3	7	9	11	13	7	5

41- 45	46-50
2	1

    a.   Construct a cumulative frequency table and use it to draw the cumulative frequency curve.

    b.   Use your cumulative frequency curve to determine:

        i.   the median mark;

        ii.   the number of candidates who passed, if the pass mark was 18 marks;

        iii.   the lowest mark for distinction, if 10% of the candidates obtained distinction.

8.   a.   What principal will amount to ¢160,000.00 in 3 years at 15% per annum simple interest?

    b.   P, Q and R are three villages on level ground. Q is 4km on the bearing 040° from P, while R is 3km on the bearing 130° from Q. Calculate the distance and bearing of P from R. State $\overrightarrow{PR}$ in the distance bearing form.

9.   a.   The cost C, of weeding a rectangular plot of land is partly constant and partly varies jointly as the length L, and breadth B, of the plot. For a plot of length 50m and breadth 20m, the cost of weeding is ¢85,000.00 and for a plot of length 40m and breadth 30m, the cost of weeding is ¢100,000.00.

        i.   Find the relationship between C, L and B.

        ii.   Use your answer in (i) to calculate the cost of weeding a plot of length 50m and breadth 40m.

b.
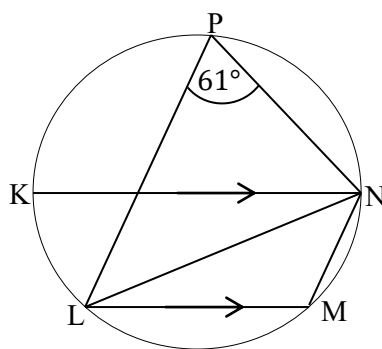
In the figure above LM is a chord parallel to the diameter KN of the circle KLMNP. If angle $NPL = 61°$, calculate the angle MLN.

10. A triangle has vertices A(1, 1), B(2, 4) and C(5, 8).

    a. Calculate the coordinates of the vertices of the image triangle $A^1B^1C^1$ of triangle ABC under a translation vector $\begin{pmatrix} 1 \\ -1 \end{pmatrix}$.

    b. Calculate the vertices of the image triangle $A^{11}B^{11}C^{11}$ of triangle ABC under an enlargement with scale factor 2 from the origin.

    c. The triangle ABC undergoes a transformation involving a rotation in an anticlockwise direction through $90°$ about the origin followed by a translation such that $A \to A^{111}$, $B \to B^{111}$ and $C \to C^{111}$. If A^{111} is $(2, -1)$, find:

        i. the translation vector;

        ii. find the coordinates of B^{111} and C^{111}.

11. a. A man bought n articles for x cedis each. He sold p of them for $(x + 2)$ cedis each and the remainder for $(x + 1)$ cedis each.

        i. Find his profit in terms of p and n.

        ii. If $n = 800{,}000, p = 640{,}000$ and $x = 50$, express his profit as a percentage of the cost.

    b. An aeroplane leaves Barcelona at 10:10pm and reaches Accra 4,415km away at 5:50am the next morning. Find correct to the nearest whole number, the average speed of the aeroplane in kmh⁻¹.

12. A solid metal cuboid of length 11cm, breadth 4cm and height 3cm is melted to form another solid consisting of a cone and a cylinder joined together as shown in the diagram.
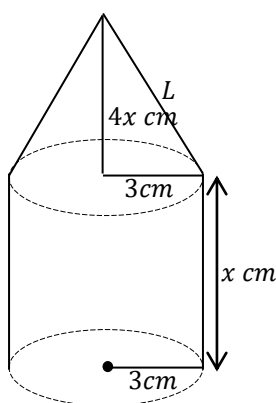
The height of the cone is four times that of the cylinder and the radius of the cylinder is 3cm. Assuming that no material was lost, calculate:

a. the height of the cone;

b. correct to two decimal places, the volume of the cylinder;

c. the total surface area of the new solid formed. $\left[Take\ \pi = \frac{22}{7}\right]$.

SSSCE JULY 2004

SECTION A

1. a. Find the value of x such that $365_{seven} + 43_x = 217_{ten}$.

b. Simplify $(1 - \sqrt{5})\left(\frac{1}{5} + \sqrt{5}\right)$, leaving your answer in the form $p + q\sqrt{5}$, where p and q are rational numbers.

2. Three candidates K, L and M were voted into office as school prefects. K secured 45% of the votes, L had 33% of the votes and M had the rest of the votes. If M secured 1,430 votes, calculate

a. the total number of votes   b. how many more votes K received than L

3. a. An irregular polygon has its external angles as $28°, 40°, 120°, 142°$ and x. Find the value of x.

b. Given that $\log_{10} 2 = 0.3010$ and $\log_{10} 5 = 0.6990$, evaluate correct to 3 significant figures, $\log_{10} 50 - \log_{10} 40$.

4. A, B, C and D are four points such that $A(-3, 2), C(6, 3), \overrightarrow{AB} = \binom{5}{4}$ and $\overrightarrow{CD} = \binom{-5}{-4}$.

a. Calculate;

i. the coordinates of B and D;

ii. $\overrightarrow{BC}$ and $\overrightarrow{AD}$;

iii. What is the relationship between $\overrightarrow{BC}$ and $\overrightarrow{AD}$?

5. a. Using ruler and a pair of compasses only, construct triangle ABC in which $|AB| = 8cm, |BC| = 9cm$ and angle $ABC = 75°$;

b. Measure angle BAC.

SECTION B

6. a. i. Draw the addition $\oplus$ and multiplication $\otimes$ tables for the set $\{2, 3, 5, 7\}$ in arithmetic modulo 9.

ii. From your table find:

α. the values of $(5 \otimes 5) \oplus (3 \otimes 7)$;

β. the truth set of $n \otimes 3 = 6$.

b. Find the equation of the line which passes through the point L$(1, 3)$ and is parallel to the line $y = \frac{2}{3}x + 1$.

7.   a.   Kofi bought six books and ten pencils from a store. Ama bought three books and twenty-two pencils of the same kind from that store. If each of them paid ¢17,000.00 for the items, find the cost of;
       i.   each pencil;   ii.   each book;
       iii.   two books and four pencils.

    b.   Find the truth set of $3x + \frac{8}{x} = 10, x \neq 0$.

8.   The following are the marks obtained by students in an achievement test.

90	25	31	35	52	50	48	15	19	40
60	93	23	38	40	70	55	65	43	68
58	57	62	83	46	33	9	75	5	94
67	15	63	19	50	47	42	47	28	21

    a.   Construct a cumulative frequency table of the distribution using the class intervals 1 – 10, 11 – 20, 21 – 30 …

    b.   Draw a cumulative frequency curve for the distribution.

    c.   Use your graph to find:
       i.   the lower quartile;
       ii.   the mark obtained by the student who was 15th in the test.

9.   a.   Three blue balls, five green balls and a number of red balls are put together in sack. One ball is picked at random from the sack. If the probability of picking a blue ball is $\frac{1}{6}$, find;
       i.   the number of balls in the sack;
       ii.   the probability of picking a green ball.

    b.   i.   Copy and complete the following table for the relation $y = x^2 - 5x - 2$ in the interval $-1 \leq x \leq 6$.

x	−1	0	1	2	3	4	5	6
y	4			−8		−6		

       ii.   Using a scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graph of the relation;
       iii.   Use your graph to find the minimum value of y.

10.   A boy 1.5m tall is standing 12m away from a church building which has a tower on top of its roof. The top of the cross on the tower is 14.6m away from the boy's head(eyes). If the boy has to raise his eyes through an angle of 31° in order to see the top of the roof.
    a.   Calculate, correct to the nearest degree, the angle through which the boy must his eyes to see the top of the cross on the tower;
    b.   Calculate, correct to one decimal place, the height of the top of the cross from the ground;
    c.   Calculate, the correct to one decimal place, the height of the church building.

11.   a.

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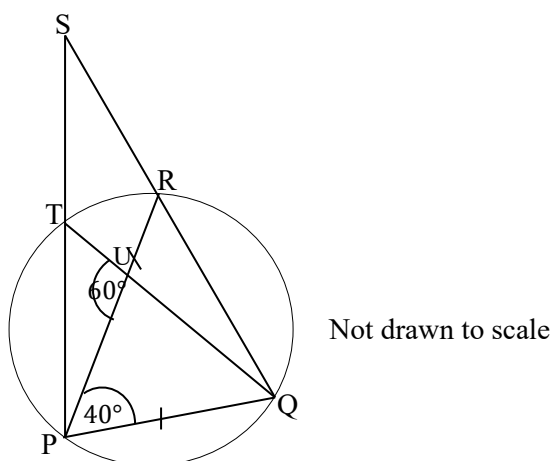
In the figure PQRT is a circle. $|PQ| = |PR|, \angle QPR = 40°, \angle PUT = 60°$.
Find: i. $\angle TQR$;   ii. $\angle PSQ$.

b.   A solid brass cube of side 10cm is melted down. It is recast to form a solid
cone of height 10cm and base radius r cm. Calculate:

i.   the radius r of the cone;

ii.   the curve surface area of the cone. $\left[Take\ \pi = \frac{22}{7}\right]$

12.   a.   Using a scale of 2cm to 2 units on both axes, draw on a graph sheet two
perpendicular axes Ox and Oy for the interval $-10 \leq x \leq 10$ and
$-10 \leq y \leq 10$.

b.   Draw, labelling all vertices and indicating the coordinates clearly,

i. ΔPQR with coordinates P(2, 0), Q(8, −4) and R(8, 0);

ii.   the image $\Delta P_1Q_1R_1$ of ΔPQR under a reflection in the line $y = 2$
where $P \rightarrow P_1, Q \rightarrow Q_1$ and $R \rightarrow R_1$;

iii.   the image $\Delta P_2Q_2R_2$ of ΔPQR under an anticlockwise rotation through
90° about the origin, where $P \rightarrow P_2, Q \rightarrow Q_2$ and $R \rightarrow R_2$;

iv.   the image $\Delta P_3Q_3R_3$ of ΔPQR under a rotation through 180° about the
origin, where $P \rightarrow P_3, Q \rightarrow Q_3$ and $R \rightarrow R_3$;

c.   What single transformation maps $\Delta P_3Q_3R_3$ onto $\Delta P_2Q_2R_3$?

SSSCE NOVEMBER 2004

SECTION A

1.   The set A, B and C are defined as $A = \{1, 3, 5, 7, 9,\ 11, 13, 15\}, B = \{3, 6, 9, 12, 15\}$
and $C = \{5, 10, 15, 20, 25\}$.

a.   Draw a Venn diagram to illustrate the above information.

b.   Find:

i. $B \cap C$;

ii. $(A \cup B)' \cap C$

iii.   the number of elements in $A \cup B$.

2. In a certain year the annual income tax was calculated as follows:

Amount	Rate of tax
First ¢1,000,000	¢4.00 in every ¢100
Next ¢2,000,000	¢8.00 in every ¢100
Next ¢4,000,000	¢20.00 in every ¢100
Next ¢6,000,000	¢32.00 in every ¢100
Remainder	¢48.00 in every ¢100

Calculate the tax paid by Mr. Obeng whose annual salary was ¢164,000,000.00 in that year.

3. $P(-4, 3)$ and $Q(2, -6)$ are points in the Cartesian plane.
   a. Find the equation of the line PQ.
   b. Calculate, correct to one decimal place $|\overrightarrow{PQ}|$.

4. a. A car dealer sold a car for ¢45,000,000 at a profit of 20%. How much did it cost him?
   b. Solve the inequality $\frac{4x+1}{2x-1} < \frac{5}{2}$, where $x \neq \frac{1}{2}$. Illustrate your answer on the number line.

5. a. Without using table or calculator, evaluate $3\sqrt{7}(7 - 2\sqrt{7})$, if $\sqrt{7} = 2.646$.
   b. Ama's age is two-thirds that of her elder sister. Four years ago Ama's age was half the sister's. How old is the sister?

SECTION B

6. a. Solve the simultaneous equations: $\frac{4}{3}x + \frac{5}{6}y = 1$ and $\frac{1}{3}x - \frac{5}{12}y = \frac{3}{2}$.
   b. The ratio of the number of boys to the number of girls in a school of 432 pupils is 5:4. If the number of boys increased by 12, the new ratio of boys to girls is 7:6. Find the increase in the number of girls.

7. Esi and Mansah entered into a business partnership. Esi contributed 35% of the capital, while Mansah contributed the rest. At the end of the year, they made a profit of ¢5,600,000. 15% of the profit was paid into a reserve fund while 25% of the remaining profit was paid as income tax. They then shared the remaining profit in the ratio of their contributions. If Mansah contributed ¢10,400,000, find
   a. the total contribution of Esi and Mansah;
   b. the amount paid as income tax;
   c. correct to one decimal place, Esi's profit as a percentage of her contributions.

8. The table below gives the heights, measured to the nearest metre, of 300 trees.

Height (m)	2	3	4	5	6	7	8	9
No. of trees	14	21	42	83	118	12	7	3

   a. Draw a histogram to illustrate the information.
   b. Calculate, the mean of the distribution, correct to the nearest metre.
   c. If a tree is selected at random, find the probability that it is at least 6m tall.

9. a. Copy and complete the following table for the relation $y = 4 + 3x - x^2$ for the interval $-2 \le x \le 5$.

x	-2	-1	0	1	2	3	4	5
y			4				0	

   b. Using a scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw on the same graph sheet, the graphs of the relations.
      i. $y = 4 + 3x - x^2$ ii. $2y + 3x = 6$

   c. Use your graphs to find:
      i. $4 + 3x - x^2 = 0$ ii. $4 + 3x - x^2 = 3 - \dfrac{3}{2}x$

      iii. the maximum value of $4 + 3x - x^2$.

10. a. Find the value of q in the equation $v\sqrt{u^2 - 2qs}$, if $v = 8, u = 12$ and $s = 4$.
    b. A ladder is leaning against a vertical wall. The ladder is 6m long and the foot of the ladder is 2m from the base of the wall. Find the angle the ladder makes with the wall.
    c. Using ruler and a pair of compasses only, construct a triangle ABC in which angle $BAC = 45°, |AB| = 7cm$ and $|AC| = 9cm$. Locate a point P, inside the triangle ABC, which is 5cm from A and equidistant from B and C. Find $|PB|$.

11. The diagram below is a net of a pyramid on a square base of side 6cm.
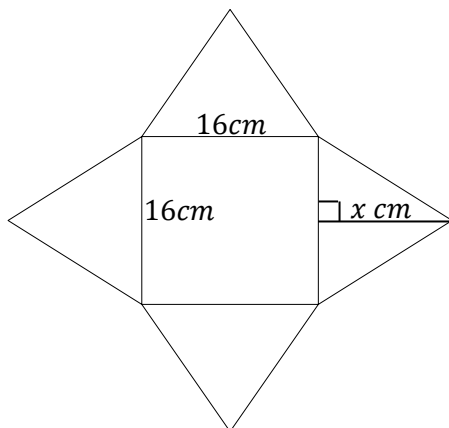
   Calculate, correct to one decimal place,
   a. the value of x, if the total surface of the net is $744cm^2$;
   b. the height of solid formed from this net;
   c. the angle that the slant edge makes with the base;
   d. the volume of the solid.

12. a. Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper, two perpendicular axes Ox and Oy for the intervals $-10 \le x \le 10$ and $-12 \le y \le 12$.
    b. Draw on the same graph, indicating clearly the coordinates of all vertices,
      i.   triangle ABC with $A(8, 9), B(8, 3)$ and $C(2, 3)$;
      ii. triangle $A_1 B_1 C_1$ with $A_1(8, -11), B_1(8, -5)$ and $C_1(2, -5)$;
      iii. triangle $A_2 B_2 C_2$ with $A_2(-9, 8), B_2(-3, 8)$ and $C_2(-3, 2)$.

c.   i.   If triangle $A_1B_1C_1$ is the image of triangle ABC under a reflection where $A \rightarrow A_1$, $B \rightarrow B_1$ and $C \rightarrow C_1$, draw the mirror line. What is the equation of the mirror line?

ii.   What single transformation will map triangle ABC onto triangle $A_2B_2C_2$ such that $A \rightarrow A_2$, $B \rightarrow B_2$ and $C \rightarrow C_2$?

iii.   Draw the image triangle $A_3B_3C_3$ of triangle $A_2B_2C_2$ under a reflection in the line $y = 0$, where $A_2 \rightarrow A_3$, $B_2 \rightarrow B_3$ and $C_2 \rightarrow C_3$.

SSSCE JULY 2005

SECTION A

1.   a.   A function $f: x \rightarrow \frac{3x+1}{x-1}$, $x \neq 1$, is defined on the set $\{-1, 0, 2, 3, 4, 5\}$.

i.   Find the image of -1 and 3.

ii.   Find the value of x for which $f(x) = 7$.

b.   If $\cos(\theta + 60)° = 0.0872$, what $0° \leq \theta \leq 90°$, find θ.

2.   a.   Given that $\log_{10} 6 = 0.778$, find without using tables or calculator the value of $\log_{10} 600$.

b.   A factory installs a new machine costing ¢90,000,000.00. In its operation it depreciates at the rate of 15% in the first year and 10% yearly thereafter.

Calculate the estimated value of the machine at the end of the third year.

3.

W	R	Q
3	4	4
w_2	1	2
8	r_3	6

In the table $W \propto \frac{Q}{R^2}$, where W, R and Q are positive integers. Solve for w_2 and r_3.

4.   a.

CLASS	A	B	C
BOYS	16	13	13
GIRLS	14	22	18

The table shows three classes A, B and C in a certain school. The three classes are put together to select a prefect. What is the probability that the prefect will be

i.   a boy?   ii.   a girl in class B?

b.   In a trapezium ABCD, $|AB| = 20cm$, $|CD| = 15cm$ and line AB and CD are parallel. If the perpendicular distance between the parallel sides is $10cm$, find the area of the trapezium.

5.   a.   i.   Make l the subject of the relation $A = \pi rl + \pi r^2$.

ii.   Find l when $r = 3$, $A = 176$ and $\pi = \frac{22}{7}$.

    b.   A ship sails from port X to port Y, 500km away on a bearing of 145° and then sails 1,200km from port Y on a bearing of 235° to port Z. Calculate the distance between X and Z.

SECTION B

6.   The scores obtained by students in a test are 21, 25, 27, 25, 27, 21, 24, 23, 23 and 24.

    a.   Draw a bar chart to illustrate the information.

    b.   Calculate:

        i.   the mean score;   ii.   the standard deviation.

7.   a.   Copy and complete the table of values for the relation $y = \frac{1}{2}(x-3)(x+1)$ for the interval $-3 \leq x \leq 5$.

x	-3	-2	-1	0	1	2	3	4	5
y	6			-1.5	-2		0		

    b.   Draw on the same graph sheet and using the same axes the graphs of the relations $y = \frac{1}{2}(x-3)(x+1)$ and $y = -\frac{1}{2}x$ for the given interval.

    c.   Use your graphs to solve,

        i. $(x-3)(x+1) = 2$;   ii. $(x-3)(x+1) = -x$.

8.   a.   If $123_x = 38_{ten}$, find the value of x.

    b.   The vertices of a triangle are $P(1,-3)$, $Q(7,5)$ and $R(-3,5)$.

        i.   Express $\vec{PQ}$, $\vec{QR}$ and $\vec{PR}$ as column vectors.

        ii.   Show that triangle PQR is isosceles.

9.   a.   Using ruler and a pair of compasses only, construct the quadrilateral ABCD such that $|AB| = 7cm$, $|BC| = 5cm$, angle $ABC = 120°$ and $|AD| = |AC| = |DC|$.

    b.   Construct the locus,

        i. l_1 of points equidistant from B and C;

        ii. l_2 of points equidistant from B and A.

    c.   i.   Locate, O, the point of intersection of l_1 and l_2;

        ii.   With O as centre, construct a circle to pass through A, B and C.

    d.   Measure:

        i.   angle BCD;   ii.   the radius of the circle.

10.   a.   A group of 50 girls were asked which of the three colours red, yellow and green they liked. 5 of them said they liked all three colours, 25 liked red and 22 liked green. 15 liked red and yellow, 12 liked red and green. 4 liked only yellow and 2 liked only green.

        i.   Illustrate the information on a Venn diagram.

        ii.   How many girls did not like any of the three colours?

    b.   A shopkeeper bought 150 articles and paid ¢40,000.00 for transporting them to her shop. The articles were marked for sale at ¢10,000.00 each. The shopkeeper sold 90 of them at this price and the remainder at a discount of

30% on the marked price. Altogether she made a profit of 32% on the total amount she spent. Calculate the amount she paid for each article.

11. a.

Not drawn to scale
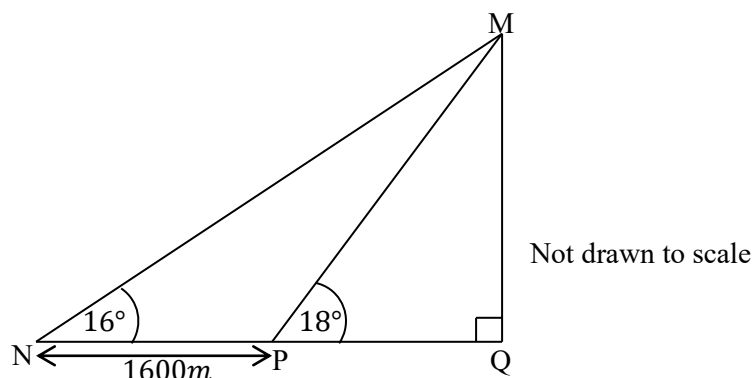
A surveyor at sea level observed that the angle of elevation of the top of a mountain, M, from two points N and P due west of it are 16° and 18° respectively, as shown in the diagram. If $|NP| = 1600m$ and the base of the mountain, Q, is vertically below M, calculate the height of the mountain.

b.

Not drawn to scale
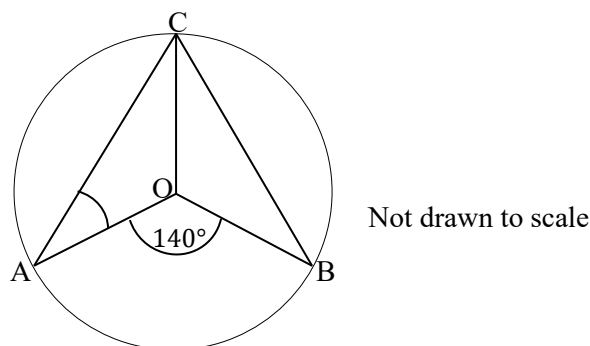
In the diagram, O is the centre of the circle. The points A, B and C are on the circumference of the circle. Angles CAO and AOB are 32° and 140° respectively. Calculate:

i.   angle OBC;   ii.   angle COB.

12.   A pyramid ABCD, whose base BCD is an equilateral triangle of side $8cm$, has its slant edge AB, AC and AD each of length $10cm$. The foot of the perpendicular from A to the base BCD is M. Calculate:

a. $|BM|$;   b. $|AM|$;

c.   the angle between the face ABC and the base;

d.   the volume of the pyramid.

SSSCE NOVEMBER 2005

SECTION A

1.   a.   Draw a table for multiplication $\otimes$ is modulo 8 on the set $\{3, 5, 7\}$.

      b.   Using your table,

              i.   evaluate $(7 \otimes 3) \otimes 5$ and $7 \otimes (3 \otimes 5)$;

      ii.   find the truth set of $n \otimes n = 1$.

2.   a.   The set $P = \{n: 10 < n < 20\}$, where n is an integer. The set Q is a subset of P such that $Q = \{n: 55 - 2n \geq 25\}$. Find Q.

    b.   If y is inversely proportional to $x + 2$ and $y = 48$ when $x = 10$, find the value of x when $y = 30$.

3.   a.   How many sides has a regular polygon whose interior angle is 156°?

    b.   A man borrowed a sum of money from a bank at an interest of 12%. After 1 year he paid ¢896,000.00 to settle the loan and the interest. How much did he borrow from the bank?

4.   In a household, the meter reading for water at the end of October, 1999 was 7848 thousand litres. The meter reading at the end of November, 1999 was 7908 thousand litres. The household was charged for the consumption at the following rates:

- The first 10 thousand litres at ¢500.00 per thousand litres
- The next 30 thousand litres at ¢1,300.00 per thousand litres
- The next 40 thousand litres at ¢1,820.00 per thousand litres

Calculate:

a.   the consumption at the end of November;

b.   the total charge for the consumption.

5.
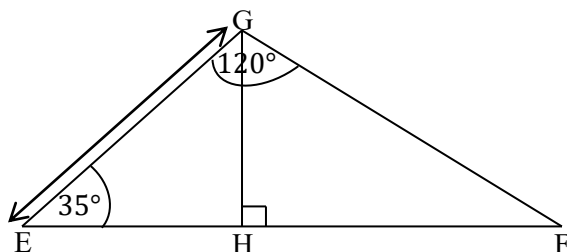
In the figure, angle $GEH = 35°$, angle $EGF = 120°$, $|\overline{EG}| = 25.4cm$ and $\overline{GH}$ is perpendicular to $\overline{EF}$. Calculate $|\overline{EF}|$, correct to three significant figures.

SECTION B

6.   a.   In his will, a father left an estate worth ¢76,000,000.00. Out of this ¢16,000,000.00 was reserved for various purposes. The rest of the amount was shared among his three children. The eldest son received 20% of the amount. The remaining amount was shared between the other son and the daughter in the ratio 3:2 respectively. Calculate:

    i.   the amount that the eldest son received;

    ii.   the amount that the daughter received;

    iii.   the difference between the amounts the two sons received.

    b.   The total cost of 60 apples and 100 eggs is ¢108,000.00. The cost of 72 apples is the same as that of 30 eggs. Find how much 12 apples and 20 eggs will occur?

7. a. Using a scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graphs for the straight lines $y + 2x = 1$ and $y - 3x = 11$ on the same graph sheet. From your graphs find the coordinates of the point of intersection.

b. Solve for x if $133_x = 43_{seven}$.

c.
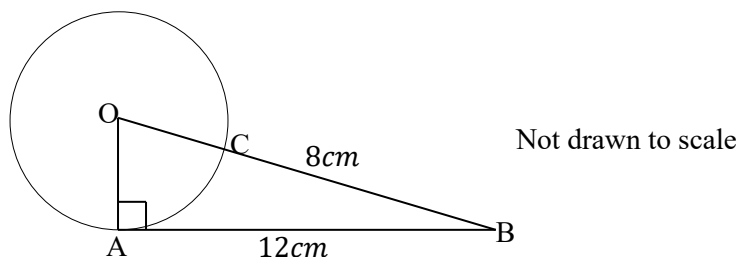
In the diagram $\overline{AB}$ is a straight line touching the circle centre O at A. If $|AB| = 12cm$, $|BC| = 8cm$ angle $OAB = 90°$, calculate the radius of the circle.

8. The table gives the frequency distribution of the marks scored by some candidates in an examination.

Marks	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Freq.	8	10	14	28	46	25	17	9	2	1

a. Construct a cumulative frequency table and use it to draw a cumulative curve for the distribution.

b. Use your curve to estimate the
  i. inter-quartile range;
  ii. percentage of candidates who scored at least 65 marks.

9. a. If $\overrightarrow{BA} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$ and $\overrightarrow{AC} = \begin{pmatrix} 4 \\ 9 \end{pmatrix}$, calculate the magnitude of $\overrightarrow{BC}$.

b. Salifu walks 500 metres due north then 250 metres due east and finally 500 metres on a bearing of $055°$.
  i. Sketch a diagram to illustrate Salifu's movement.
  ii. Calculate, correct to the nearest whole number, how far north Salifu has moved from the starting point.
  iii. Calculate the bearing of Salifu's final position from the starting point.
  iv. Calculate the bearing of Salifu's final position from the starting point.

10. a. Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper, two perpendicular axes Ox and Oy for $-10 \le x \le 10$ and $-12 \le y \le 12$.

b. Draw on the same graph sheet showing clearly the coordinates of all vertices,
  i. the triangle ABC with $A(2,6)$, $B(4,2)$ and $C(8,6)$;
  ii. the image triangle $A_1B_1C_1$ of triangle ABC under an anticlockwise rotation of $90°$ about the origin where $A \to A_1$, $B \to B_1$ and $C \to C_1$;
  iii. the image triangle $A_2B_2C_2$ of triangle ABC under a translation by the vector $\begin{pmatrix} 1 \\ -7 \end{pmatrix}$, where $A \to A_2$, $B \to B_2$ and $C \to C_2$;
  iv. the image triangle $A_3B_3C_3$ of triangle ABC under a reflection in the

line $y = -2$, where $A \rightarrow A_3$, $B \rightarrow B_3$ and $C \rightarrow C_3$;

c.   Find $|B_1 B_3|$.

11.   a.

In the diagram, MNPS is a quadrilateral. A line is drawn through N to cut SP at Q. Angle $MNQ = 132°$, angle SMN is twice angle MSQ and angle NPQ is twice angle QNP. If NP bisects the acute angle at N, find:

i.   angle SQN;   ii.   angle MSQ.

b.

In the diagram, P, Q, R and S are points on the circle. Angle $QPR = 48°$ and angle $PSQ = 35°$ and angle $PRS = 31°$. Calculate:

i.   angle PQR;   ii.   angle QRS.

12.   a.   A piece of cupboard, 30cm squared has small square of side 2.5cm cut from each corner as shown in the diagram.

Not drawn to scale

The sides are then folded along the dotted lines to form an open box of height 2.5cm. Calculate:

i.   the total surface are of the open box;

ii.   the volume of the box formed.

b.   PQRS is a quadrilateral with P(2, 2), S(4, 4) and R(6, 4). If $\overrightarrow{PQ} = 4\overrightarrow{SR}$, find the coordinates of Q.

WASSCE JUNE 2006

SECTION A

1. a. Solve the equation $4^{2-x} \times 16^{x+1} = 64$.

   b. R varies inversely as the cube of S. If $R = 9$ when $S = 3$, find the value of S when $R = \frac{243}{64}$.

2. a. Factorize $6x^2 - 5x - 6$.

   b. Three friends went to a bookshop. The first bought 3 biros and 4 pencils for ₦30.00. The second bought 2 biros and 5 pencils for ₦27.00. If the third bought a biro and a pencil only, how much did he pay?

3. a.
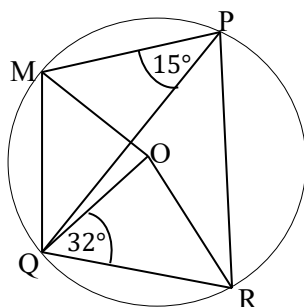
   In the diagram, O is the centre of the circle, $\angle OQR = 32°$ and $\angle MPQ = 15°$. Calculate:

   i. $\angle QPR$; ii. $\angle MQO$.

   b. The sum of the interior angles of a convex polygon is $1260°$. How many sides has the polygon?

4. a. Given that $a = 4.0 \times 10^{-2}, b = 3.0 \times 10^{-2}$ and $c = 100$, evaluate without using tables or calculator, $\sqrt{\frac{a^2 + b^2}{c}}$. Leave your answer in the standard form.

   b. The ratio of the length of an arc of a circle to the circumference of the circle is given as 2:5. If the radius of the circle is 14cm, calculate, correct to one decimal place,
   i. the perimeter of the minor sector.
   ii. the area of the minor sector. $\left[Take \ \pi = \frac{22}{7}\right]$

5. a. The probabilities that two boys pass an examination are $\frac{2}{3}$ and $\frac{5}{8}$. Find the probability that
   i. the two boys pass the examination;
   ii. only one of the boys passes the examination.

   b. A bag contains 12 balls of which x are red. When 18 more red balls are added, the probability of selecting a red ball is $\frac{9}{10}$. Find the number of red balls that were originally in the bag.

SECTION B

6. a. Find the value of x in the equation $\frac{3x-1}{6} - \frac{2x-1}{3} = \frac{1}{4}$.

    b. A survey of 150 traders in a market shows that 90 of them sell cassava, 70 sell maize and 80 sell yam. Also, 26 sell cassava and maize, 30 sell cassava and yam and 40 sell yam and maize. Each of the traders sell at least one of these crops.
        i.   Represent the information on a Venn diagram.
        ii. Find the number of traders who sell all the three food crops.
        iii. How many of the traders sell one food crop only?

7. a. The marked price of a wrist watch in a shop was Le 50,000. The shopkeeper allowed a discount of 10% off the marked price and still made a profit of 15% on the cost price. Calculate, correct to the nearest Leone, the cost price.

    b.
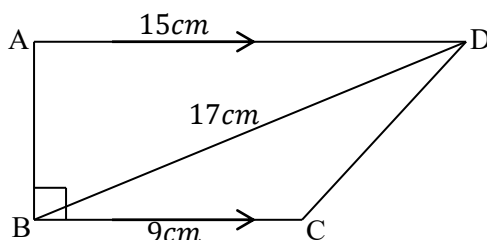
    In the diagram, ABCD is a trapezium in which AB//BC and $A\hat{B}C = 90°$. If $|AD| = 15cm, |BD| = 17cm$ and $|BC| = 9cm$, calculate:
        i. $|AB|$;   ii. the area of $\triangle BCD$;
        iii. $|CD|$;   iv. the perimeter of the trapezium.

8. a. Using a ruler and a pair of compasses only,
        i.   construct a parallelogram ABCD with $|AB| = 8cm, \angle BAC = 45°$ and $\angle ABC = 60°$;
        ii. locate a point P inside $\triangle ACB$ such that $|PA| = |PB|$ and $|PC| = 4cm$.
    b. Measure $|PD|$.

9. a. Draw a table of multiplication $\otimes$ in modulo 8 on the set $\{2, 3, 5, 7\}$.
    b. Use your table to find the solution set of:
        i. $3 \otimes n = 5$;   ii. $n \otimes n = 1$.
    c. The set $P = \{-2, -1, 0, 1, 2\}$ maps onto Q by the function $f(x) = x^2 - 2$, where $x \in P$.
        i.   Find the elements of Q.
        ii. Draw a diagram showing the mapping between P and Q.

10. a. Copy and complete the following table of values of the relation $y = 4 + 5x - 2x^2$ for $-3 \le x \le 5$.

x	-3	-2	-1	0	1	2	3	4	5
y		-14		4	7				-21

    b. Using 2cm to 1 unit on the x-axis and 2cm to 5 units on the y-axis, draw the graph of $y = 4 + 5x - 2x^2$ for $-3 \le x \le 5$.

c.   From your graph, find the
   i.   value of x for which y is maximum;
   ii. gradient at $x = 0$;
   iii. values of x for which $1 + 5x - 2x^2 = 0$.

11. a.
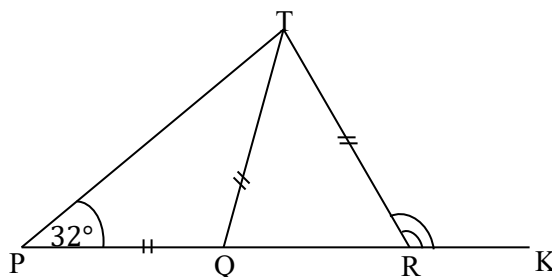
In the diagram, $\angle TPQ = 32°$ and $|PQ| = |QT| = |TR|$. Calculate $\angle TRK$.

b.
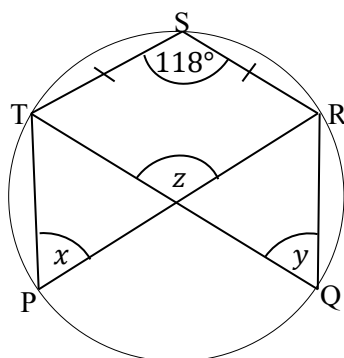
In the diagram, O is the centre of the circle. $|TS| = |SR|, T\hat{Q}R = x, T\hat{Q}R = z$.
   i.   Find the relationship between x, y and z.
   ii. Find $S\hat{T}P$.

c.   Simplify: $\dfrac{\log a^3 - \log a}{\log a}$.

12. a.   In the diagram, $\overrightarrow{AC} = n, \overrightarrow{AB} = m$ and T is such that $|CT| : |TB| = 2 : 1$.
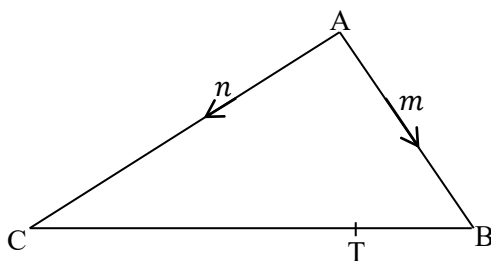
   i.   Find, in terms of n and m, $\overrightarrow{BC}$;
   ii. Show that $\overrightarrow{TA} = -\dfrac{1}{3}(2m + n)$;

b.   If $p = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$ and $q = \begin{pmatrix} -5 \\ 7 \end{pmatrix}$,
   i.   calculate $|q - p|$, correct to one decimal place;
   ii. find the vector r such that $p + r = 2q$.

13.   The following are the marks obtained by a number of students in an examination

79	51	19	50	47	40	44	25	42	34
80	41	29	43	55	31	11	26	70	34
49	10	30	49	55	32	21	35	51	34
68	18	36	41	60	10	29	33	20	67
70	28	33	45	50	20	30	48	26	71

a.   Construct a cumulative frequency table for the distribution using the intervals,
1 – 10, 11 – 20, …, 71 – 80.

b.   Draw a cumulative frequency curve for the distribution.

c.   Using your cumulative frequency curve,

i.   determine the pass mark if four-fifth of the class passed.

ii.   find the probability that a student selected at random had distinction if
the minimum mark for distinction is 75%.

14.   a.   A right circular cone stands on a hemisphere. The base radius of the cone is
equal to the radius of the hemisphere. If the base radius of the cone is 10cm
and its height is 15cm, calculate, correct to three significant figures, the total
volume of the solid. $[\pi = 3.142]$

b.
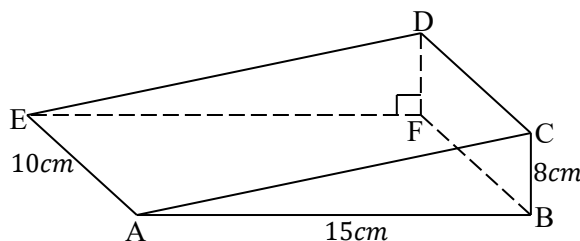
The figure shows a solid triangular prism ABCDEF. $\angle ABC = 90°$,
$|EA| = 10cm, |BC| = 8cm$ and $|AB| = 15cm$. Calculate the

i.   length of the edge AC;

ii.   length of EC, correct to one decimal place.

15.   a.   Two towns A$(Lat. 20°, Long. 50°E)$ and B$(Lat. 20°, Long. \theta°W)$ are two
points on the earth's surface. Their distance apart, along the parallel of
latitude, is 10,000km. Calculate the value of θ, correct to the nearest degree.
$[R = 6400km \; and \; \pi = 3.142]$
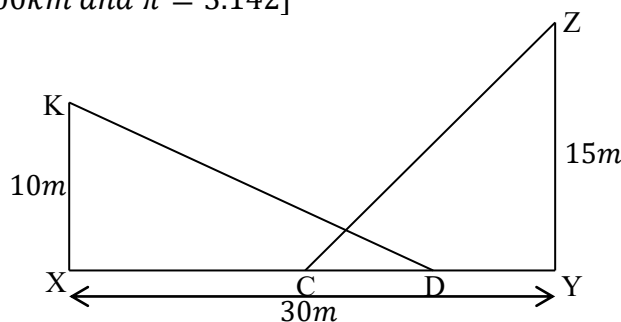
b.   i.   In the diagram, KX and ZY are vertical poles, 10m and 15m high

respectively. The poles are 30m apart. If the angle of depression of the point C from Z is 40° and that of D from K is 30°, find$|CD|$, correct to one decimal place.

ii. A cylindrical tank 3.8m in diameter is full of water. If 500 litres of water is drawn from the tank, by how many centimetres, correct to two decimal places, does the water level fall? $\left[\pi = \frac{22}{7}\right]$

WASSCE NOVEMBER 2006
SECTION A

1. a. Draw the addition $\oplus$ and multiplication $\otimes$ tables on the set $T = \{2, 5, 7, 11\}$ in arithmetic modulo 12.

   b. From your tables
      i. evaluate $(5 \otimes 7) \oplus (7 \otimes 11)$;
      ii. find the value of n, if $n \otimes (n \oplus 2) = 11$.

2. a. Given that $3^{x/y} = \frac{1}{81}$, find x in terms of y. Hence find the value of x, if $2x + 3y = 3$.

   b. Simplify $\left(14 + 3\sqrt{7}\right)\left(2 - \frac{3}{\sqrt{7}}\right)$.

3. Solve for x, if $233_x = 125_{seven}$.

4. a. Factorize $m^2 - 2mn + n^2 - 9r$.

   b. i. Solve the inequality $\frac{1}{3}(x + 3) - 2(x - 5) > 4\frac{1}{3}$.

      ii. Illustrate the answer on the number line.

5.
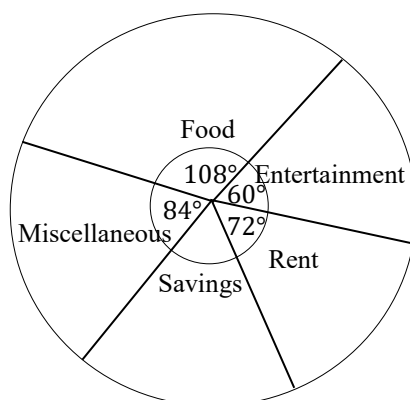
The pie chart shows how a worker spends his salary in a month. If he spends ¢180,000.00 on rent, find:

a. how much he earns in a month;

b. how much he saves in a month;

c. the percentage of his salary that he spends on Food and Entertainment together.

SECTION B

6. a. There are 100 boys in a sports club. 65 of them play soccer, 50 play hockey and 40 play basketball. 25 of them play soccer and hockey, 20 play hockey and basketball and 5 play all three games. Each boy plays at least one of the three games.
    i. Draw a Venn diagram to illustrate this information.
    ii. Find the number of boys who play:
        α. soccer only;
        β. basketball only;
        γ. exactly two games.

    b. The volume of a solid cylinder is $704cm^3$. If the height is 3.5cm, calculate the radius. $\left[\pi = \frac{22}{7}\right]$.

7. a. Copy and complete the table below for the relation $y = 2x^2 - x - 6$ for the interval $-2.5 \le x \le 3$.

x	-2.5	-2	-1	0	1	1.5	2	2.5	3
$2x^2$	12.5		2	0	2	4.5	8		18
$x + 6$		4	5	6		7.5	8	8.5	
y			-3	-6		-3	0	4	

    b. Using a scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graph of the relation $y = 2x^2 - x - 6$, for the given interval.
    c. Use your graph to solve
    i. $2x^2 - x - 6 = 0$;
    ii. $2x^2 - x - 12 = 0$.

8. a. Simplify $6\frac{2}{3} \div \left(3\frac{4}{15} - 1\frac{3}{5}\right)$.

    b. Mrs. Mensah paid ¢1.5 million as $12\frac{1}{2}$% VAT on goods she purchased. Find the cost of the goods that Mrs. Mensah bought.

    c. The equation $px^2 + 16x + 4 = 0$ is satisfied by $x = -\frac{2}{3}$, find
    i. the value of p;
    ii. the other value of x which makes the equation true.

9. Using a pair of compasses and ruler only,
    a. construct a trapezium ABCD with AB parallel to DC, $|AB| = 10.2cm$, $|BC| = 5.6cm, |CD| = 5.8cm$ and angle $ABC = 60°$. Measure $|AD|$.
    b. construct a perpendicular from D to meet AB at N. Measure $|DN|$.
    c. Find the area of the trapezium.

10. The marks obtained by 40 students in an examination are as follows:

91	81	78	87	59	84	60	72	47	60
38	36	60	57	63	42	18	42	36	27
66	54	27	42	63	27	18	9	38	24
39	45	24	30	49	38	45	12	14	72

    a. Using the class intervals $1 - 10, 11 - 20, 21 - 30, \ldots$, construct a cumulative

frequency table for the distribution.

b.   Draw the cumulative frequency curve.

c.   Use your curve to find

    i.   the median mark;

    ii.   the probability that a student selected at random scored a mark less than 32.5.

11.   A trader bought m oranges for ¢48,000.00. She found that 40 of them were rotten. She then sold all the remaining oranges. The selling price of one orange was ¢100.00 more than the cost price.

a.   Find in terms of m

    i.   the cost price of one orange;

    ii.   the number of oranges that she sold;

    iii.   the selling price of one orange;

    iv.   an expression for the total sum that she received from the sale.

b.   If she made a profit of ¢12,000.00 from the sales, find:

    i.   the number of oranges she originally bought;

    ii.   the cost price for an orange.

12.   a.   Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper two perpendicular axes, Ox and Oy for the intervals $-10 \leq x \leq 10$ and $-12 \leq y \leq 12$.

b.   Draw on the same graph sheet, clearly labelling the vertices of the triangles and indicating the coordinates:

    i.   triangle ABC with A$(4, 4)$, B$(6, 8)$ and C$(2, 8)$;

    ii.   the image triangle $\Delta A_1 B_1 C_1$ of ΔABC under a reflection in the line $x = -2$, where $A \rightarrow A_1$, $B \rightarrow B_1$ and $C \rightarrow C_1$;

    iii.   the image $\Delta A_2 B_2 C_2$ of ΔABC under an enlargement with scale factor -1 from the origin, where $A \rightarrow A_2$, $B \rightarrow B_2$ and $C \rightarrow C_2$;

    iv.   the image $\Delta A_3 B_3 C_3$ of ΔABC under a reflection in the line $y = 0$, where $A \rightarrow A_3$, $B \rightarrow B_3$ and $C \rightarrow C_3$;

c.   What single transformation maps $\Delta A_2 B_2 C_2$ onto $\Delta A_3 B_3 C_3$?

WASSCE JUNE 2007

SECTION A

1.   a.   Make y the subject of the relation: $\dfrac{m}{n-y} = \dfrac{n}{m+y}$

b.   A boy has to cover 4km to catch a bus. He walks part of the distance at 3km/h and runs the rest at 5lm/h. If he takes 1 hour to complete the distance, how many kilometres does he walk?

2.   a.   Factorize: $x^2 + ax - x - a$

b.   In the diagram, PQRS is a cyclic quadrilateral. $\overline{PS}$ and $\overline{QR}$ are produced to meet at T. $\overline{SR}$ and $\overline{PQ}$ are produced to meet at U. If $P\hat{S}R = 84°$ and

$S\hat{R}Q = 126°$, find the values of x and y.
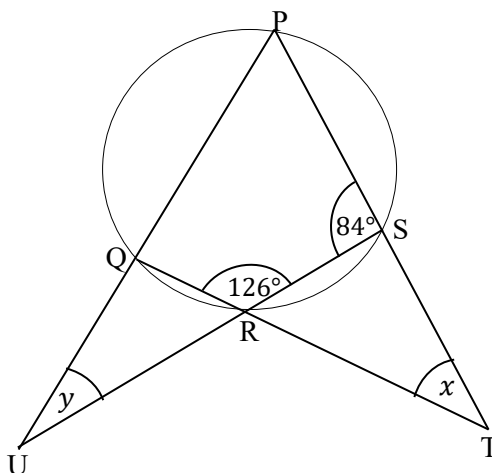
3.
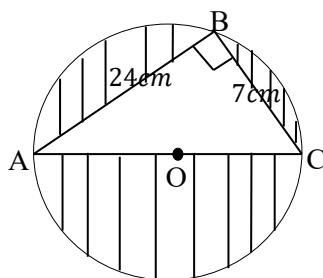
In the diagram above, O is the centre of the circle. Sides AB and BC of ΔABC are 24cm and 7cm respectively. Calculate the:

a.   radius of the circle;

b.   area of the shaded portion, correct to the nearest whole number.

$\left[Take\ \pi = \dfrac{22}{7}\right]$

4.   Two cyclists left a point at the same time. The first cyclist covered 300m on a bearing of 296° and the second cyclist covered 250m on a bearing of 206°. Calculate, correct to three significant figures:

a.   the distance between the two cyclists;

b.   the bearing of the second cyclist from the first.

5.   The probability of two candidates A and B, passing an examination are $\dfrac{2}{3}$ and $\dfrac{3}{4}$ respectively. Find the probability that:

a.   only one candidate will pass;

b.   at least one candidate will pass.

SECTION B

6.   a.   Simplify $\dfrac{4}{x^2 - 4} - \dfrac{1}{x^2 - 3x + 2}$

        b.   A bus travels a distance of 56km at an average speed of 70km per hour. It travels a further 60km at an average speed of 50km per hour. Calculate, for the whole journey;

                i.   the total time taken;   ii.   the average speed.

7. a. Solve the equation $2x^2 + 5x - 12 = 0$
    b. Given that $\log_{10} 0.6 = \bar{1}.7781$ and $\log_{10} 2 = 0.3010$, find without using mathematical tables or calculators, $\log_{10} 3$.
    c. Solve the equations: $2^{x+y} = 8$ and $2x + y = 4$.

8. a. A cylindrical water tank has radius 1m and height 1.5m. Calculate, in litres, the volume of water it can hold. $[Take\ \pi = 3.142]$
    b. In a triangle ABC, $|AB| = 15cm, |BC| = 18cm$ and $|AC| = 5cm$. D and E are points on $\overline{AB}$ and $\overline{AC}$ respectively. If $|AD| = 9cm$ and $\overline{DE}$ is parallel to $\overline{BC}$ calculate;
        i. $|DE|$;   ii. $|EC|$.

9. a. Using a ruler and a pair of compasses only, construct:
        i.   a quadrilateral ABCD such that $|AB| = 8cm, |BC| = 6.5cm,$ $|AD| = 5.5cm, A\hat{B}C = 60°$ and $B\hat{A}D = 75°$;
        ii.   locus l_1 of points equidistant from A and B;
        iii.   locus l_2 of points equidistant from B and C.
    b. Locate a point P, where P is the point of intersection of l_1 and l_2.

10. a. If y is inversely proportional to x and $y = 5.2$ when $x = 0.5$;
        i.   write an equation connecting x and y.
        ii.   find the value of y when $x = 26$.
    b. A sector of a circle of radius 14cm subtending an angle of 135° at the centre is cut and folded to form a cone. Find, correct to two decimal places,
        i.   the radius of the base;
        ii.   the perpendicular height of the cone.

11. The table below gives the distribution of the number of letters per word in the first fifty words of an essay.

No. of letters	1	2	3	4	5	6	7	8	9
No. of words	1	3	x	10	12	y	6	4	1

    a. If the average number of letters per word is 5, find the values of x and y.
    b. Calculate, correct to two decimal places, the standard deviation of the distribution.

12. a. Using a scale of 2cm to 4 units on both axes, draw on a graph sheet, two perpendicular axes Ox and Oy, for the intervals $-16 \le x \le 16$ and $-16 \le y \le 16$.
    b. Draw $\triangle ABC$ with vertices $A(2, 2)$, $B(8, 2)$ and $C(6, 6)$.
    c. Draw the image $\triangle A_1B_1C_1$ of $\triangle ABC$ when $\triangle ABC$ is rotated through 180° about the origin where $A \to A_1, B \to B_1$ and $C \to C_1$.
    d. Draw the image $\triangle A_2B_2C_2$ of $\triangle ABC$ under a translation by the vector $\begin{pmatrix} -8 \\ 8 \end{pmatrix}$, where $A \to A_2, B \to B_2$ and $C \to C_2$.
    e. Draw the image $\triangle A_3B_3C_3$ of $\triangle A_1B_1C_1$ under the reflection in the line

$x - 2 = 0$, where $A_1 \rightarrow A_3, B_1 \rightarrow B_3$ and $C_1 \rightarrow C_3$.

    f.   Describe the transformation that will map ΔABC onto $\Delta A_3 B_3 C_3$.

13.   a.   Given that $f(x) = 2x - 1$ and $g(x) = x^2 + 1$:

           i.   find $f(x + 1)$;

           ii.   find the range of values of x for which $f(x) < -3$;

           iii.   simplify $f(x) - g(x)$.

    b.   Given A$(1, 3)$, B$(-2, -1)$ and C$(2, 3m)$ where m is a constant find:

           i. $|\overrightarrow{AB}|$;   ii.   the value of m if $\overrightarrow{BC} = \begin{pmatrix} 4 \\ -5 \end{pmatrix}$.

14.   Two places P$(52°N, 47°E)$ and Q$(52°, X°E)$ are on the earth's surface. Q is 1990 due east of P along their parallel of latitude. Taking the radius of the earth to be 6400km and $\pi = 3.142$, calculate:

    a.   the circumference of the parallel of latitude through P and Q, correct to the nearest 100km;

    b.   the value of X to the nearest degree;

    c.   the shortest distance on the earth's surface from P to the equator, correct to the nearest km.

15.   a.   Copy and complete the table $y = 9 \cos x + 5 \sin x$, to one decimal place.

x	0°	30°	60°	90°	120°	150°
y		10.3			−0.2	

    b.   Using a scale of 2cm to 30° on the x-axis and a scale of 2cm to 2 units on the y-axis, draw the graph of $y = 9 \cos x + 5 \sin x$ for $0° \le x \le 150°$.

    c.   Use your graph to solve the equations:

           i. $9 \cos x + 5 \sin x = 0$;   ii. $9 \cos x + 5 \sin x = 3.5$.

    d.   Find, correct to one decimal place, the y for which x is 72°.

WASSCE NOVEMBER 2007

SECTION A

1.   a.   Without using four-figure table or calculators, evaluate

$$\left(\frac{2}{3} \text{ of } 2\frac{2}{4} \right) \div \left(3\frac{1}{2} - 2\frac{1}{4} \right);$$

    b.   Simplify $\frac{1}{2} \log_{10} \frac{25}{4} - 2 \log_{10} \frac{4}{5} + \log_{10} \frac{320}{125}$.

2.   a.   i.   Solve the inequality $3x - (x - 1) < \frac{3}{2}(x - 2)$;

           ii.   Illustrate your answer on the number line.

    b.   If $x \propto \sqrt{y}$ and $x = 2$ when $y = 16$, find the value of y when $x = 7$.

3.   a.   Given that $\tan(x + 25°) = 5.145$, where $0° \le x \le 90°$, find, correct to one decimal place, the value of x.

    b.   P, Q, R are three points on a horizontal plane. Q is on a bearing of 065° from

P and R on a bearing of 335° from P. If $|PQ| = 12cm$ and $|RQ| = 20cm$, find $|RP|$.

4.   Two fair dice are tossed at the same time.
    a.   Draw the sample space for the possible outcomes.
    b.   Find the probability of:
        i.   a total of 6 or 8;
        ii.   the same number on the two dice;
        iii.   a total of not less than 5.

5.
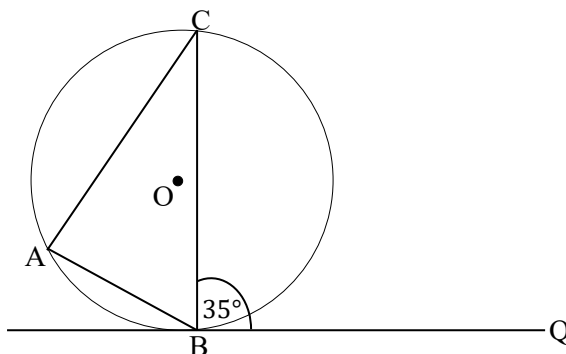
In the diagram, A, B, C are points on the circle with centre O. The radius of the circle is 7cm, $\angle CBQ = 35°$ and PQ is a tangent to the circle at B. Calculate, correct to two decimal places;
    a.   the length of the minor are BC;
    b.   the length of the chord BC.

SECTION B

6.   a.   Given that A, B, C are subsets of the universal set μ of real numbers such that:
        $A = \{1, 2, ..., 6\}, B = \{x: 0 < x < 16\}$, where x is an odd integer and
        $C = \{p: p < 16\}$ where p is prime.
        i.   List all the elements of B   ii.   Find $B \cap C$;
        iii.   Find $(A \cap B)'$.
    b.   If 136 to base n is equal to 76, find the value of n.
    c.   Without using four-figure tables or calculator, simplify;
        $\sqrt{50} - 3\sqrt{2}(2\sqrt{2} - 5) - 5\sqrt{32}$.

7.   a.   The perimeter of a rectangle is 35cm. The ratio of the length of the rectangle to its width is 3:2. Calculate the dimensions of the rectangle.

    b.
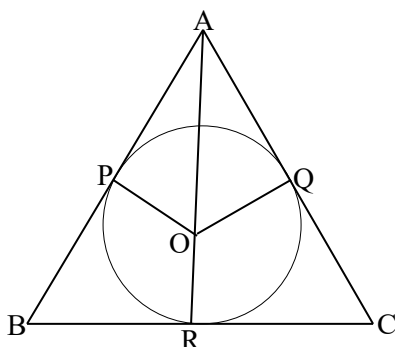
In the diagram above, $|AB| = |AC|$ and the circle centre O to touch all the sides of the isosceles ΔABC.

    i.   Show that ΔAPO and ΔARB are similar;

    ii.   If $|AO| = 50cm$ and the radius of the circle is 30cm, calculate $|BR|$.

8.   a.   Copy and complete the table of values for the relation $y = 2x^2 + 5x - 3$.

x	-5	-4	-3	-2	-1.5	-1	-0.5	0	1	2	2.5
y	22		0			-6		-3	4		22

    b.   Using a scale of 2cm to 1 unit on the x-axis and 2cm to 5 units on the y-axis, draw the graph of $y = 2x^2 + 5x - 3$, for the interval $-5 \le x \le 2.5$.

    c.   Use your graph in (b) to solve the equation $2x^2 + 6x - 5 = 0$.

9.   The table below gives the frequency distribution of marks scored by 400 students in a test.

Mark(x)	1	2	3	4	5	6	7	8	9	10
Freq. (f)	14	30	32	40	52	80	59	56	21	16
fx	14	60	96	160	260	480	413	448	189	160

Find, correct to one decimal place,

    a.   the mean mark of the distribution;

    b.   the standard deviation of the distribution.

10.   a.   The functions f and g are defined as follows:

        $f: x \to \dfrac{x-1}{2}$ and $g: x \to 3x + 1$

        i.   Evaluate $f\left(-\dfrac{1}{2}\right) + 1$;   ii.   Solve $f(x) = g(-2)$.

    b.   If multiplication $\otimes$ is defined on $A = \{1, 2, 3, 4\}$, a set of numbers in modulo five, find the value of n for which $2 \otimes (3 \otimes n) = 2$.

    c.
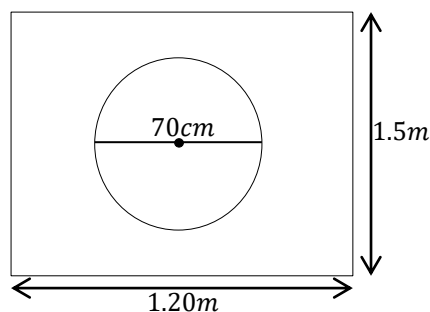
The diagram shows the cross-section of a pipe laid in the ground. The external diameter of the pipe is 70m. A rectangular trench, 1.20m by 1.50m is dug to lay the pipe. If the pipe is 20m long, calculate, in m^3, the quantity of sand required to refill the trench after the pipe is laid.

11.   a.   Using a ruler and a pair of compasses only, construct,

        i. ΔPQR in which $|QR| = 7cm, |PQ| = 8cm$ and $\angle PQR = 75°$;

        ii.   the locus l_1 of points equidistant from PR and QR;

   iii. the locus l_2 of points equidistant from Q and R;

 b. Locate the point S, the intersection of l_1 and l_2.

 c. Measure: i. $|SR|$;   ii. $\angle PRQ$.

12. If $p = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$, $q = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$ and $r = \begin{pmatrix} 5 \\ -6 \end{pmatrix}$, find:

 a. m and n, such that $r = mp + nq$, where m and n are scalars.

 b. i. $|g|$, if $g = 3q + r$;   ii. the bearing of g.

13. a. Using a scale of 2cm to 2 units on both axes draw on a sheet of graph paper, two perpendicular axes Ox and Oy for $-10 \le x \le 10$ and $-10 \le y \le 10$.

 b. Draw, labelling all the vertices clearly together with their coordinates.

   i. triangle PQR with vertices $P(2, 3)$, $Q(8, 9)$ and $R(7, 2)$;

   ii. the image $P_1 Q_1 R_1$ of ΔPQR under a rotation through $-90°$ about the origin, where $P \to P_1$, $Q \to Q_1$ and $R \to R_1$;

   iii. the image $\Delta P_2 Q_2 R_2$ of ΔPQR under the enlargement with scale factor -1 from the origin, where $P \to P_2$, $Q \to Q_2$ and $R \to R_2$.

 c. Find the bearing of R and P.

14. a. The numbers $11, p, q, 21\frac{1}{2}, \dots$ from an arithmetic progression (A.P). Find the value of p and q.

 b. The second term of a geometric progression (G.P) is 36 more than the first term. The difference between the 4th and 3rd term is 900. Calculate:

   i. the common ratio;   ii. the first term of the G.P.

15. a. Two locations, A and B on the same longitude are 3,940km apart. A is on Latitude $15°N$ and B on Latitude $x°S$.

   i. Find, correct to the nearest degree, the value of x.

   ii. How long would it take an aeroplane to fly from A to B at $760 kmh^{-1}$?

   $\left[Take\ \pi = \frac{22}{7}, radius\ of\ the\ earth = 6400km\right]$

 e. Without using mathematical table or calculator, evaluate $3 \cos 315° - 2 \sin 210°$, leaving your answer in surd form.

WASSCE JUNE 2008

<div align="center">SECTION A</div>

1. a. If $\frac{p - 2q}{2p + q} = \frac{2}{5}$, find the ratio $p : q$.

 b. Solve the equations: $\frac{4t}{3} + \frac{3s}{2} = 4$ and $\frac{t}{2} + \frac{s}{4} + 1 = 0$.

2. a. The angles of a pentagon are $x, (x + 20)°, (x + 25)°, 2x$ and $(2x + 5)°$. Find the value of x.

 b. The base of a pyramid is a 4.5m by 2.5m rectangle. The height of the pyramid is 4m. Calculate its volume.

3. a. Given that $211_c = 320_{four}$, find the value of c.

b. Simplify $(\sqrt{5})^{-2} \times 75^{1/2} \times 12^{-1/2}$.

4. a. The angle of depression of the top of a flagpole is $42°$ from a point P which is 180 metres from the foot (B) of the flagpole. Q is a point on the same horizontal line BP such that $|BQ| = 45$ metres. Calculate, correct to one decimal place, the angle of elevation of the top of the flagpole from Q.

b. Solve the equation $\frac{tan^2 x}{3} - 1 = 0$, where $0° \le x \le 90°$.

5. a. If a number is chosen at random from the set of integers $\{x: 7 \le x 26\}$; find the probability that the number chosen is prime or a multiply of 3.

b. In the diagram, BD//AE and ΔBCG is isosceles. If $\angle BCG = 36°$ and $|BC| = |CG|$, find the value of i and j.
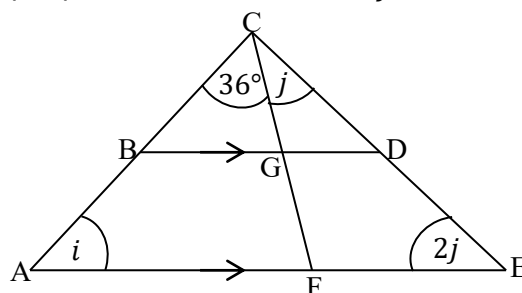
SECTION B

6. a. Without using logarithm tables, find the value of x given that:
$2 \log\frac{2}{3} = \frac{1}{2}\log x - \log 18 + \log 16$.

b. Solve the inequality: $2(x + 3) - 3(x - 1) \le 12$.

c. A cyclist starts a journey at 10:30am and plans to get home 45km away by 3:00pm. At first, he travelled for 2 hours at $7\frac{1}{2}kmh^{-1}$ and then $x\ kmh^{-1}$ for the rest of the time in order to arrive promptly at home. Find the value of x.

7. a. Copy and complete the table below for $y = x^2 - 5x + 2$ for $-2 \le x \le 6$.

x	-2	-1	0	1	2	3	4	5	6
y	16		2			-4	-2		

b. Using scales of 2cm to 1 unit on the x-axis and 2cm to 5 units on the y-axis, draw the graph of $y = x^2 - 5x + 2$.

c. On the same axes, draw the graph of $y = 5 - 3x$.

d. Use your graph to find the roots of the equation $x^2 = 2x + 3$.

8. a. In the diagram, A, B and C are three points on a circle with centre O. If $\angle OAB = m$, $\angle OCA = p$ and $\angle OCB = q$, show that $p + q + m = 90°$.

b. In the diagram A, B, C, D are points on the circumference of a circle with centre O. If AO is parallel to DC and $\angle OAC = 38°$, find:

i. $\angle ACB$;   ii. $\angle DBC$.

9. a. Use tables to evaluate $\dfrac{(17.3)^2 \times 4.97}{\sqrt[3]{7850000}}$

b. A car costs D60,000. Its value depreciates by 25% for the first year, 20% for the second year and 15% for the third year. Find its value at the end of the third year.

c. Find the compound interest on $300 in 3 years at 4% interest per annum. Give your answer to the nearest dollar.

10. The table below shows the lengths of 50 rods measured to the nearest cm.

Length (cm)	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59
Freq.	1	2	8	10	12	12	3	2

a. Calculate the mean length of the rods.

b. Draw the cumulative frequency curve for the distribution.

c. Use your cumulative frequency curve to determine the probability that the length of a rod chosen at random is at least 46cm.

11. a. A goat is tied to a post at the centre of a square field of side 20m by a rope 10m long. Find the fraction of the field the goat is able to graze on.
$\left[\pi = \dfrac{22}{7} \right]$

b. In the diagram, PS and QT are two ladders 10m and 12m long respectively, placed against a vertical wall TR. PS makes an angle of 60° with the horizontal and $PQ = 0.5m$. Calculate, correct to two significant figures;

i. the angle which QT makes with the horizontal;

ii. the height of point T above the horizontal.

12. a. Given that $f(x) = px + q$, find the value of p and q, if $f(2) = 4$ and $f(4) = 10$.

b. If $A(3, -5)$, $B(1, 3)$ are two points in a plane and $\overrightarrow{BC} = \begin{pmatrix} 4 \\ -7 \end{pmatrix}$, find;

    i. the coordinates of C;

    ii. the value of $\left|\overrightarrow{AC}\right|$, correct to two significant figures.

13. a. Using a scale of 2cm to 2 units on each axis, draw on a sheet of graph paper, two perpendicular axes Ox and Oy, for the intervals $-10 \le x \le 10$ and $-10 \le y \le 10$.

b. Draw, labelling all the vertices clearly together with their coordinates;

    i. ΔABC with vertices $A(2, 6)$, $B(2, 2)$ and $C(6, 2)$;

    ii. the image $\Delta A_1 B_1 C_1$ of ΔABC under an enlargement with a scale factor of -1 about the origin, where $A \to A_1$, $B \to B_1$ and $C \to C_1$;

    iii. the image $\Delta A_2 B_2 C_2$ of ΔABC under an anticlockwise rotation about the point $(-2, 2)$ where $A \to A_2$, $B \to B_2$ and $C \to C_2$;

    iv. the image $\Delta A_3 B_3 C_3$ of ΔABC under a translation by the vector $\begin{pmatrix} 2 \\ -6 \end{pmatrix}$, where $A \to A_3$, $B \to B_3$ and $C \to C_3$;

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14. a. Two places X and Y are on the same latitude 52°N. X is on longitude 32°E an Y is on longitude 28°W.

    i. Calculate, correct to two decimal places, the distance between X and Y along the parallel of latitude.
      [Take $\pi = 3.142$, radius of the earth $= 6400$km]

    ii. How long, to the nearest hour, will it take a plane to cover the distance in a(i), at a speed of $825kmh^{-1}$?

b. Two points A and B are on bearing 040° and 120° respectively from a point O. If $|OA| = 12m$ and $|OB| = 15m$, calculate, correct to three significant figures, the distance between A and B.

15. a. Solve the equation $2x^2 + 7x + 2 = 0$, by the method of completing squares. Give your answer correct to three decimal places.

b. A hollow cylinder, 1cm thick, is made of metal. Its external diameter is 12cm and it weighs 5.520kg. If the density of the metal is $8.00gcm^{-3}$, calculate, correct to the nearest cm, the length of the cylinder.

$\left[Take\ \pi = \frac{22}{7}\right]$ Hint: $Density = \frac{mass}{volume}$

WASSCE NOVEMBER 2008

SECTION A

1. a. Solve the equations: $8x - 7y = -52$ and $x = 2y - 11$.
    b. The sides of a triangle are in the ratio 4:5:7 and its perimeter is 64cm. Find the sides.

2. a. A bag contains some balls of which $\frac{1}{4}$ are red. Forty more balls of which 5 are red are added. If $\frac{1}{6}$ of all the balls are red, how many balls were there originally?
    b. Given that $Y = \{-2 \le x \le 5\}$ and $W = \{1 < x < 6\}$, illustrate $Y \cup W$ on the number line.

3. The table below shows the monthly expenditure of a family.

Item	Rent	Clothing and food	Transport	Savings	Lighting and fuel
Expenditure (cedis)	120,000	190,000	125,000	105,000	60,000

    a. Draw a pie chart to represent the information.
    b. What percentage of the monthly expenditure goes into savings?

4. A cyclist moves 40km from a point P on a bearing of 045° to Q. He then moves 20km on a bearing of 135° to R. Calculate the
    a. distance between P and R, correct to three significant figures;
    b. bearing of P from R.

5. a. In the diagram, ABCD is a circle with centre O, AOD is a straight line and $\angle AOC = 126°$.
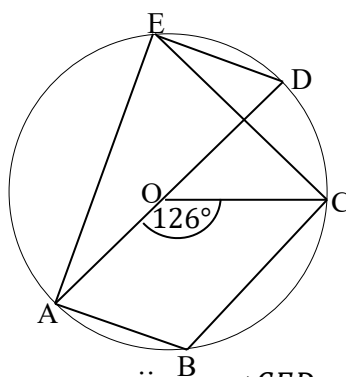
    Find:
    i. $\angle ABC$;   ii. $\angle CED$.
    b.
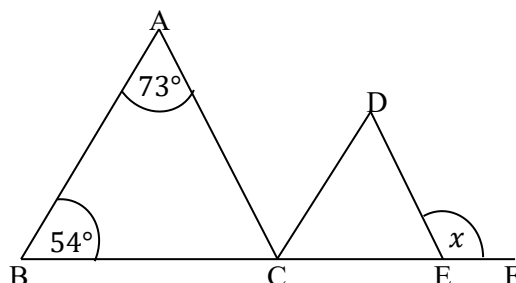
Find the value of x in the diagram above.

SECTION B

6. Using a ruler and a pair of compasses only,
   a. construct a quadrilateral PQRS in which $|PQ| = 6.5cm$, $|PS| = 7.0cm$, $Q\hat{P}S = 105°$, $R\hat{Q}P = 120°$ and $\overline{PQ}$ is parallel to $\overline{SR}$.
   b. Measure: i. $|QR|$;   ii. $|SR|$.

7. The marks obtained by 40 students in a Mathematics tests are as follows:

83	18	88	95	55	35	29	98	45	21
89	83	95	65	36	34	86	31	31	54
40	55	28	53	14	21	76	20	96	25
39	99	45	77	92	67	69	84	38	68

   a. Copy and complete the table for the distribution.
   b. i. Draw a histogram for the distribution.
      ii. Use your histogram to estimate the modal mark.

8. a. Copy and complete the for the table for $y = 3x^2 - 5x + 4$ for $-3 \le x \le 4$.

x	-3	-2	-1	0	1	2	3	4
$3x^2$		12	3		3	12	27	
$-5x + 4$			9		-1		-11	-16
y	46	26		4				32

   b. Use a scale of 2cm to 1 unit along the x-axis and 2cm to 5 units along the y-axis to draw the graph of $y = 3x^2 - 5x + 4$.
   c. Use your graph to
      i. solve the equation $3x^2 - 5x + 4 = 10 + 3x$;
      ii. find the least value of y and the corresponding value of x.

9. The diagram represents a playground in the shape of a trapezium PQRS from which a semi-circular portion XZY has been removed. PQ//SR.
   $|SR| = 314cm$, $|PX| = |YQ|50cm$, $|PS| = |QR| = 200cm$ and $\angle PSR = \angle QRS = 60°$. Calculate the
   a. perimeter of the playground;
   b. area of the playground. $\left[Take\ \pi = \frac{22}{7}\right]$

10. a. A motorcycle cost $800. Its value depreciates each year at 12%. How much is it worth after a year of use?
    c. A trader bought a radio for £68.00 and sold it at a profit of $7\frac{1}{2}$%. The following week, the cost price of the same type of radio increased by 8%. By what percentage, correct to two significant figures, must the trader increase his selling price in order to make the same profit?

11. a. If $8 \sin x += 5$, find the value of x correct to the nearest degree.

b. Two towers A and B are $48m$ and $30m$ high respectively. Tower A and lies to the west and B to the east of a man 1.5m tall. From the man's eye level, the angles of elevation of the top of A and B are $66°$ and $28°$ respectively. Calculate, correct to three significant figures, the distance between A and B.

12. a. The function f is defined as $f : x \rightarrow 3x^2 - 5x$.
   i. Evaluate $f(-3)$;
   ii. Find the values of x for which $f(x) = -\frac{4}{3}$.

b. A rhombus ABCD has A at $(0, 2)$ and B at $(5, 3)$. If the diagonals intersect at $(0, 3)$, find the coordinates of C and D.

13. a. Using a scale of 2cm to 2 units on both axes, draw two perpendicular axes Ox and Oy for the intervals $-8 \le x \le 8$ and $-10 \le y \le 10$.

b. Draw and label clearly all the vertices and coordinates of,
   i. triangle PQR with vertices $P(-3, 6)$, $Q(-1, 1)$ and $R(4, 2)$;
   ii. $\Delta P_1 Q_1 R_1$ with $P_1(-3, -8)$, $Q_1(-1, -3)$ and $R_1(4, -4)$;
   iii. $\Delta P_2 Q_2 R_2$, the image of ΔPQR under a rotation through $180°$ about the origin where $P \rightarrow P_2, Q \rightarrow Q_2$ and $R \rightarrow R_2$;
   iv. the point Q_3, the image of Q under a translation by the vector $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$.

d. What single transformation maps ΔPQR on $\Delta P_1 Q_1 R_1$?

WASSCE JUNE 2009
SECTION A

1. a. Solve the equation $\frac{64^n \times 2}{16^{1-n}} = 4^{2n}$.

b. Simplify: $\frac{x^2 + x - 6}{x^2 - 3x + 2} \times \frac{x^2 - x}{x^2 - 9}$.

2. The table below shows the number of children per family in a village.

No. of children	1	2	3	4	5	6
No. of families	3	5	7	4	3	2

a. Find the:
   i. mode; ii. third quartile;
   iii. the probability that a family has at least 3 children.

b. If a pie chart is to be drawn for the data, what would be the sectorial angle representing the families with 2 children?

3. a. If $4 \tan x = 3$, where $0° \le x \le 90°$,
   i. find the value of x;
   ii. evaluate: $\frac{1 + \cos x}{2 - \cos x}$.

b. A ladder 8.5 metre long leans against a vertical wall. The top (T) of the ladder makes an angle of 58° with the wall. How, far, correct to one decimal place, is the foot (F) of the ladder from the wall?

4. a. Given that $\log p = x$ and $\log q = y$, express $\log \frac{pq}{1000}$ in terms of x and y.

b. In the diagram below, XYZ is a triangle, $|XZ| = 3cm$, $|YZ| = 5cm$ and $\angle YXZ = \angle XNZ = 90°$. Find $|XN|$.
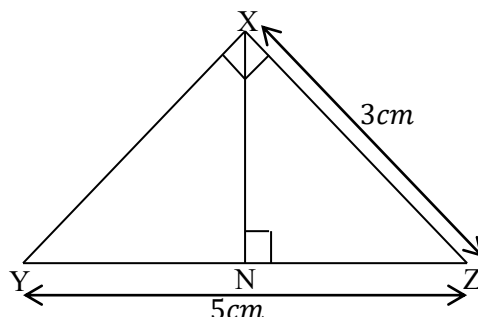
5. The base of a prism, whose height is 12cm, is a right angled triangle with dimension 17cm and 8cm. Calculate the total surface area of the prism.

SECTION B

6. a. If $9\left(\frac{x - 2y}{x + 2y}\right) = 1$, find the ratio of x to y.

b. A mixture consists of $x$kg of coffee at D200.00 per kg and $y$kg of another brand of coffee at D220.00 per kg. If the total mass of the mixture is 20kg and the total cost is D4240.00, calculate:
   i.   the value of x and y.
   ii. correct to the nearest whole number, the percentage profit of the mixture is now sold for D250.00 per kg.

7. The marks scored by 40 candidates in aptitude test area as follows:

85	77	87	74	77	78	79	89	85	90
78	73	86	83	91	74	84	81	83	75
77	70	81	69	75	63	76	87	61	78
69	96	65	80	84	80	77	74	88	72

a. Using a class interval of 60 – 64, 65 – 69, 70 – 74, …, prepare a frequency distribution table.

b. Calculate the mean mark of the candidates.

c. If 85 was the pass mark for the test, what percentage of the candidates passed the test?

8. a. Copy and complete the table below for the relation $y = 7 - 5x - 2x^2$ for $-4 \le x \le 2$.

x	-4	$-3\frac{1}{2}$	-3	-2	-1	0	1	$1\frac{1}{2}$	2
y	-5		-4						

b. Using a scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graph of the relation in (a).

c. Using the graph, find the:
   i. equation of the axis of symmetry of the curve;
   ii. maximum value of y;
   iii. roots of the equation $5 - 5x - 2x^2 = 0$;
   iv. range of values of x for which $7 - 5x - 2x^2 > 0$.

9. Using ruler and a pair of compasses only, construct:,
   i. a trapezium ABCD such that $|AB| = 6.8cm$, $\angle ABC = 120°$, BC//AD, $|AD| = 10.6cm$ and $|AC| = 9.3cm$;
   ii. locus l_1 of points equidistant from A and C;
   iii. locus l_2 of points equidistant from B and C;
   iv. If S is the point of intersection of l_1 and l_2, measure $|AS|$.

10. a. If $\left(\dfrac{x+y}{n-1}\right)^2 = p$ and $2s = n(y+x)$, express s in terms of n and p only.

    b.
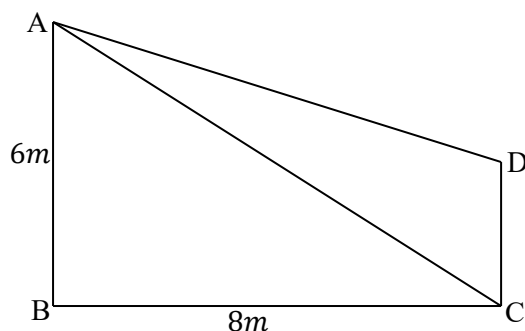
The diagram represents the vertical cross-section of a shed with a sloping roof, AD. The heights AB and CD represent the vertical walls of the shed. If the root, AD, makes an angle of $12°$ with the horizontal, $|AB| = 6cm$ and $|BC| = 8cm$, find, correct to two significant figures.
   i. $\angle ACB$;
   ii. the height of the shortest wall, DC;
   iii. the area of $ABCD$.

11. A rectangle is $(x + 3)cm$ long and ycm wide. The perimeter of the rectangle is $24cm$ and the area is $27cm^2$.
   a. Show that:
      i. $y = 9 - x$; ii. $x^2 - 6x = 0$.
   b. Find the length and width of the rectangle.

12. a. Copy and complete the multiplication table modulo 5 on the set $\{1, 2, 3, 4\}$.

*	1	2	3	4
1	1		3	
2		4	1	
3	3			2
4		3		1

b.   From the table,
  i. solve the expression $2n * 4 = 3$;
  ii. find the value of n for which $2 * (3 * n) = 2$.

c. The functions f and g are defined as: $f: x \rightarrow x - 2$ and $g: x \rightarrow 2x^2 - 1$.
  Solve:
  i. $f(x) = g\left(-\frac{1}{2}\right)$;   ii. $f(x) + g(x) = 0$.

13. a. $P(7, 4)$ is a vertex of triangle PQR. If $\overrightarrow{QP} = \begin{pmatrix} 3 \\ 5 \end{pmatrix}$ and $\overrightarrow{PR} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$, find:
    i. the coordinates of Q;
    ii. $\overrightarrow{PN}$ where N is the midpoint of $\overrightarrow{QR}$.

  b. A straight line passes through the points $(1, 4)$ and $(3, 0)$. Find the:
    i. gradient of the line;   ii. equation of the line.

WASSCE NOVEMBER 2009
SECTION A

1. a. If $\frac{1}{2}(81^n) = \frac{1}{54}$, find the value of n.

  b. If $\sin x = \frac{8}{17}$, find the value of $\dfrac{\tan x}{1 + 2 \tan x}$.

2. a. Solve the equation $3(6 + 7y) + 2(1 - 5y) = 42$.

  b. The total surface area of a closed circular cylinder of radius 3.5cm is $1320 cm^2$. Calculate the volume of the cylinder.

3. a. Simplify $\sqrt{5\frac{44}{49}} \times \left(11\frac{1}{3}\right)^{-1}$, leaving your answer in the form $\frac{p}{q}$ where p and q are positive integers.

  b. Two tanks X and Y are filled to capacity with petrol. Tank X holds 600 litres more than tank Y. If 100 litres of petrol were pumped out of each tank, tank X would then contain 3 times as much as tank Y. Find the capacity of each tank.

4.
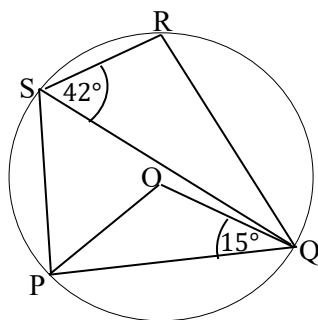
In the diagram, O is the centre of the circle $\angle PQO = 15°$ and $\angle QSR = 42°$.
Calculate:
  a. $\angle QSP$;   b. $\angle RQO$.

5. A bag contains 6 red, 8 black and 10 yellow identical beads. Two beads are picked at random, one after the other, without replacement. Find the probability that
   a. both are red;
   b. one is black and the other yellow.

SECTION B

6. a. A group of 34 women sells at least one of the following foodstuffs: yam, maize and plantain. Of these, 22 sell yam, 14 sell maize, 18 sell plantain, 7 sell both yam and maize, 9 sell yam and plantain and no one sells all three items.
   i. Draw a Venn diagram to illustrate this information.
   ii. Find the number who sell maize and plantain only.
   iii. What is the probability that a woman selected at random from the group sells plantain only?

7. a.
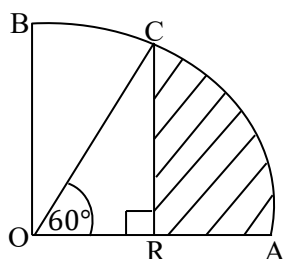
In the diagram, the radius of the quadrant is 7cm and $\angle AOC = 60°$. Find the area of the shaded portion to 1 decimal place.

   b. ABC is an isosceles triangle with $|AB| = |AC|$ and $\angle ABC = 30°$. The perpendicular from A to BC is $\sqrt{3}$ metres. Without using mathematical tables, calculate the area of triangle ABC, leaving your answer in surd form.

8. a. If $\log_{10} x = 0.5$ and $\log_{10} y$ 1.5, find $x + y$.
   b. In a class, there are 20 boys and their total score in a test is 810 marks. If the average score of the girls is 37 and that of the whole class is 39, calculate the
   i. number of students in the class;
   ii. ratio of the total marks of the girls to that of the boys.

9. a. Using ruler and a pair of compasses only.
   i. construct $\triangle PQR$ such that $|PQ| = 6.6cm$, $|QR| = 8.0cm$ and $\angle PQR = 60°$;
   ii. locate by construction, a point S on PQ such that $|PS| = |SQ|$;
   iii. construct ST parallel to QR such that STRQ is a parallelogram.
   b. Measure:
   i. $|PR|$; ii. $|TR|$; iii. $\angle SRT$.

10. a. Given that $5 \sin x = 4.33$ where $0° \le x \le 90°$, find the value of x correct to the nearest degree.
    b. The length of the shadow of a pole on level ground increases by 60 metres when the angle of elevation of the sun changes from 54° to 32°. Calculate the height of the pole, correct to three significant figures.

11. a. Find the values of x which satisfy the following inequalities:
$5 - x > 1$ and $9 + x \geq 8$. Illustrate your answer on the number line.

b. A man left the sum of ₦1,260,000 to be shared equally among all his surviving children. Three of the children died before their father and so each of the survivors received ₦70,000 more than they would have received if all had lived. How many children survived their father?

12. a. If triangle ABC is an isosceles triangle such that $\overrightarrow{AB} = \overrightarrow{BC}$ and M is a point on $\overrightarrow{AC}$ such that $|AM|:|MC| = 1:1$, show that $\overrightarrow{BA} + \overrightarrow{BC} = 2\overrightarrow{BM}$.

b. The coordinates of the vertices of a parallelogram WXYZ are $W(1,6)$, $X(2,2)$, $Y(5,4)$ and $Z(a,b)$. Find:
i. $\overrightarrow{WX}$;   ii. $\overrightarrow{ZY}$;   iii. the coordinates of Z.

13. a. Find the image of the position vector $\begin{pmatrix} 4 \\ 3 \end{pmatrix}$ under the translation $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$.

b. If $A(2,3)$ is reflected in the x-axis, find the image A' of A.

c.
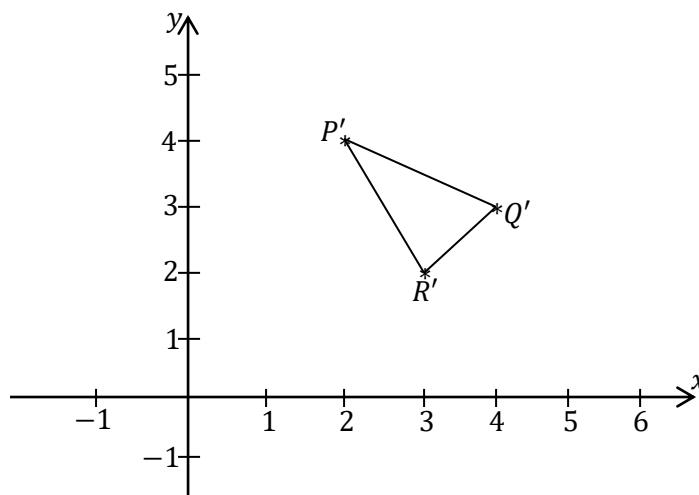
In the graph above, triangle $P'Q'R'$ is the image of triangle PQR after the transformation by the vector $\begin{pmatrix} -2 \\ 4 \end{pmatrix}$. Draw, using the scale on the graph and indicating the coordinates,
i. triangle $P'Q'R'$;
ii. triangle PQR before it was transformed;
iii. the image triangle $P''Q''R''$ of triangle $P'Q'R'$ under a rotation about the origin through 90° clockwise.

WASSCE NOVEMBER 2010
SECTION A

1. a. Simplify $37\frac{1}{2} \div \frac{5}{9}$ of $\left(\frac{4}{7} + \frac{1}{5}\right) - 80\frac{1}{3}$.

b. The nth term of a sequence is $5 + \frac{2}{3^{n-2}}$ for $n \geq 1$. What is the sum of the

fourth and fifth terms? Leave your answer in the form $\frac{x}{y}$ where x and y are integers.

2.   a.   Factorize $x^2 + 4x + 3 + mx + 3m$.

   b.   A T-shirt cost 5 times as much as a singlet. For GH¢800, a trader can buy 32 more singlets than T-shirt. How much does a T-shirt cost?

3.   The diagram shows a field ABCD in the form of a trapezium.
   If $|AD| = |BC| = 600m$, $\angle ADC = \angle BCD = 120°$ and $|DC| = 450m$.

Not drawn to scale
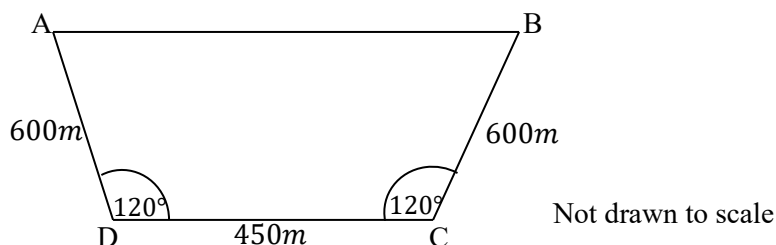
   a.   Find the perimeter of the field;
   b.   Calculate, correct to three significant figures, the area of the field.

4.   a.

Not drawn to scale
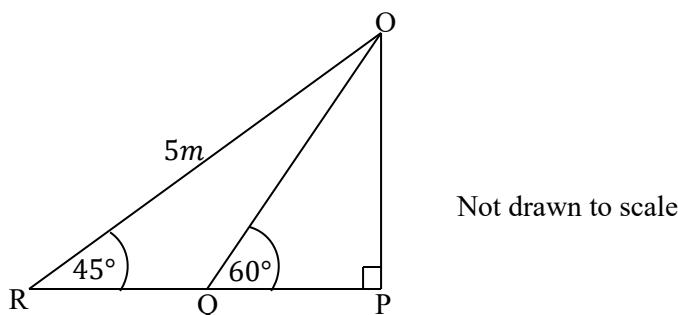
   In the diagram, $|OR| = 5m$, $\angle ORP = 45°$, $\angle OPR = 90°$. Find the distance QP, leaving your answer in surd form.

   b.   X and Y are two cylindrical tanks with base radii $2r$ cm and r cm respectively. If the water level in Y is $10cm$, what level will the same quantity of water be in X?

5.   a.   In a class, the probability that a student passes a test is $\frac{2}{5}$. What is the probability that if 2 students are chosen at random from the class, one would pass and the other would fail?

   b.
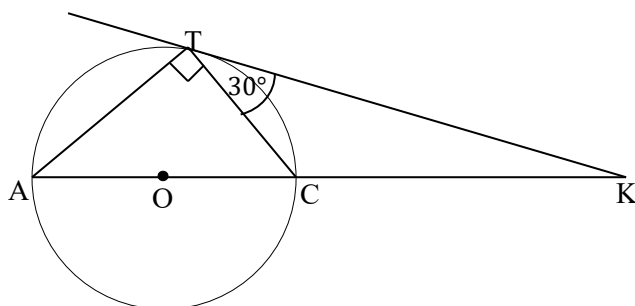
   In the diagram, O is the centre of the circle. AK is straight line and TK is a

tangent. If $\angle CTK = 30°$, calculate $\angle TKC$.

SECTION B

6.   a.   In a class of 31 students, 16 play football, 2 play table-tennis and 5 play both games. Find the number of students who play

        i.   at least one of the games;

        ii.   none of the games.

    b.   Two commodities A and B cost D70 and D80 per kg respectively. If 34.5kg of A is mixed with 26kg of B and the mixture is sold D85 per kg, calculate the percentage profit.

7.   a.   Copy and complete the following table of values for the relation $y = (x - 4)(x + 2)$ for $-3 \le x \le 5$.

x	-3	-2	-1	0	1	2	3	4	5
y				-8					

    b.   Using scales of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graph of $y = (x - 4)(x + 2)$ for $-3 \le x \le 5$.

    c.   Using the graph, find the:

        i.   values of x for which y is decreasing;

        ii.   gradient of the curve at $x = 0$.

8.   a.   Using a ruler and a pair of compasses only, construct:

        i.   triangle PQR such that $|PQ| = 8.5cm$, $\angle QPR = 60°$ and $|PR| = 7.5cm$;

        ii.   the locus l_1 of points equidistant from P and R;

        iii.   the locus l_2 of points equidistant from Q and R;

        iv.   locate the point of intersection I, of the loci l_1 and l_2.

    b.   i.   Construct a circle passing through the three vertices of the triangle PQR.

        ii.   Find the radius of the circle.

        iii.   Measure $|QR|$.

9.   a.   Simplify $\sqrt{\left(\frac{x^3 y^5}{xy^7}\right)}$, where $x > 0$ and $y > 0$.

    b.   A man 1.7m tall observes the angle of elevation of the tip of a tower to be 35°. He moves 50m away from the tower and now observes the angle of elevation to be 28°. How far above the ground is the tip of the tower to three significant figures?

10.   The table shows the distribution of marks scored by 50 students in a test.

Marks (%)	$1 - 10$	$11 - 20$	$21 - 30$	$31 - 40$
Frequency	1	3	5	8

$41 - 50$	$51 - 60$	$61 - 70$	$71 - 80$	$81 - 90$
12	10	5	4	2

    a.   Construct a cumulative frequency table for the distribution.

    b.   Draw a cumulative frequency curve for the distribution.

    c.   Use the curve to estimate the:

        i.   interquartile range

        ii.   the percentage of students who scored more than 66%.

11.   The base of a right pyramid with vertex O is a square ABCD of side 13cm. Each slant edge is 12cm long. Calculate, correct to two significant figures, the:

    a.   vertical height $|OE|$ of the pyramid;

    b.   volume of the pyramid.

12.   a.   The operation $\odot$ is defined on the set $\{2, 4, 6\}$ by $m \odot n =$ the unit digit in the product of mn.

        i.   Copy and complete the table.

$\odot$	2	4	6
2	4	8	2
4		6	
6			

        ii.   Use the table to solve the following equation:

            α. $x \odot 4 = 8$;   β. $e \odot e = e$;

            γ. $(4 \odot f) \odot 4 = f$.

    b.   The functions f and g are defined as $f: x \to 2 - x^2$ and $g: x \to \frac{1}{x-1}$.

        Evaluate: i. $g\left(-\frac{1}{4}\right)$;   ii. $\frac{f(2)}{g(3)}$.

13.   a.   A triangle has vertices $A(1, 1)$, $B(2, 4)$ and $C(5, 8)$.

        i.   If the triangle is translated by the vector $\begin{pmatrix} 1 \\ -1 \end{pmatrix}$ to $A'B'C'$, where $A \to A'$, $B \to B'$ and $C \to C'$, calculate the coordinates of A', B' and C'.

        ii.   The triangle ABC undergoes a transformation involving rotation in anticlockwise direction through 90° about the origin followed by a translation. If the final position is $A''(2, -1)$, $B''(-1, 0)$ and $C''(-5, 3)$, determine the translation vector.

    b.   In triangle PQR, $\overrightarrow{PQ} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ and $\overrightarrow{RQ} = \begin{pmatrix} -6 \\ -4 \end{pmatrix}$, find $\overrightarrow{PR}$.

    c.   Find the equation of the line which is perpendicular to the line $y = 2x - 1$ and passes through the point $(2, 5)$.

WASSCE JUNE 2011

SECTION A

1. (a) Simplify without using a calculator: $\dfrac{3\frac{4}{7}-1\frac{1}{3}\div 2\frac{2}{5}}{\frac{13}{3}-1\frac{6}{7}}$.

    (b) Simplify: $\dfrac{2}{3+2\sqrt{2}} + \dfrac{1}{3-2\sqrt{2}}$ leaving your answer in the form $a + b\sqrt{2}$.

2. (a) Simplify: $\dfrac{x+\frac{1}{x}+2}{x^2-1}$.

    (b) The sum of the ages of Akin and Dop is 35 years. The sum of twice Akin's age and three times Dop's age is 89 years. Find their present ages.

3. (a)

    In the diagram, $PQRS$ and TSR are straight lines, $\angle QRS = 25°$ and $\angle QPS = 35°$. Find $\angle SQT$.
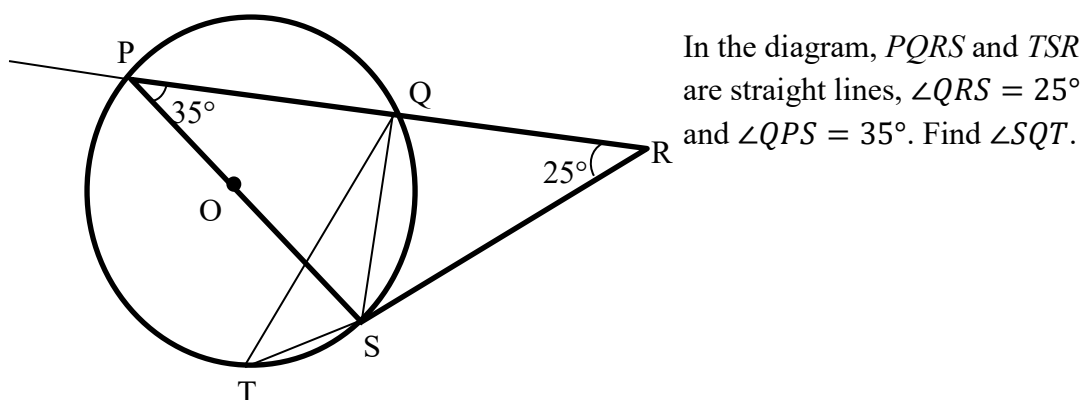
    (b) In the diagram $\overline{AM}$ and $\overline{AN}$ are straight lines, ABC is an isosceles triangle, $\angle BAC = 80°$, the bisectors of $\angle MBC$ and $\angle NCB$ meet at K. Calculate $\angle BKC$.
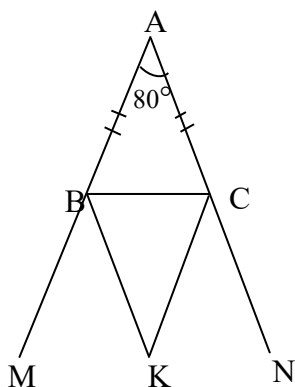
4. (a)

    In the diagram, a circle is drawn in a square $PQRS$ as shown. If the total area of the shaded portion is $42\ cm^3$, calculate the radius of the circle.

    (Take $\pi = \dfrac{22}{7}$)

(b) A cube of length 4 cm has the same volume as a cone with base diameter 7 cm. Find, correct to the **nearest** cm, the height of the cone. (Take $\pi = \frac{22}{7}$).

5.   The table shows, in percentages, the monthly expenditure of an employee whose gross monthly salary is GH¢10,800.

Item	Percentage
Social security	5
Income tax	25
Food	40
Transport	10
Rent	12.5
Others	7.5

(a) Draw a *pie chart* to illustrate the data.

(b) If the social security contribution and income tax are deducted from the gross monthly salary before payment, calculate, correct to the **nearest** whole number, the expenditure on rent as a percentage of the employee's take home pay.

SECTION B

6.   In a survey, 74 out of 88 tourists interviewed said they had visited at least one of Africa (A), Europe (E) and South America (S). Of these, 19 had visited Europe and Africa, 30 Europe and South America, 26 South America and Africa. No one had visited only Africa, 10 only Europe, 7 only South America and x had visited all the three continents.

(a) Draw a *Venn diagram* to represent this information.

(b) Write down a suitable equation in x.

(c) Find   (i) n[$(E \cap A) \cup S$]   (ii) n[$(E \cup S)' \cap A$]   (iii) n(A)

7.   (a) If $u = 1 - \frac{3v}{vt-w}$, make t the subject of the relation.

(b)
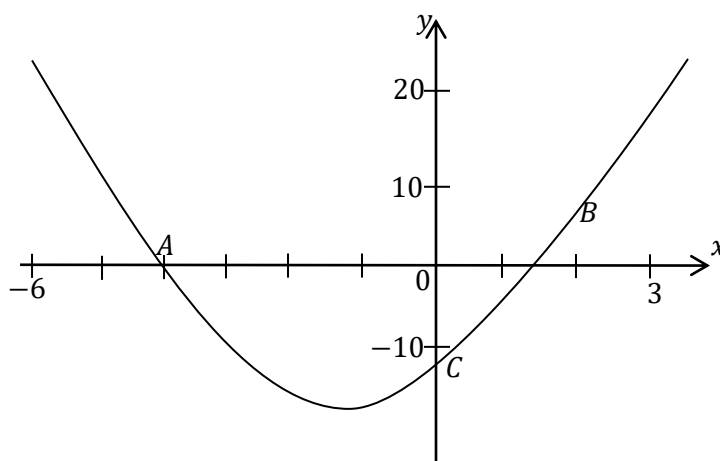
The graph is that of the relation $y = ax^2 + bx + c$

(i) From the graph determine;

    (α) the minimum value of y;

    (β) the roots of the equation $ax^2 + bx + c = 0$.

(ii) Using the roots, determine the value of a, b and c.

8.   (a) From a point P on a horizontal ground, the angle of elevation of the top S of a tower (RS) 32 m high is 58°.

    (i) Calculate the distance PR, correct to the **nearest** metre.

    (ii) If P is the due south of the tower and another point Q is 35 m due east of the tower, calculate correct to **one** decimal place the:

        (α) distance PQ (β) bearing of P from Q.

(b) The table is a multiplication table in modulo 10 over the the set y = {2, 4, 6, 8}. Find the identity element.

⊗	2	4	6	8
2	4	8	2	6
4	8	6	4	2
6	2	4	6	8
8	6	2	8	4

9.   An aircraft leaves airport P and flies on a bearing 060°. From a distance of 10 km due east of P, another aircraft leaves airport R and flies on a bearing of 330°. Both planes meet at Q. Using ruler and a pair of compasses **only,** with a scale of 1 cm to 1 km,

(a) construct triangle PQR,

(b) how far is Q from: (i) P (ii) R ?

(c) measure $\angle PQR$.

(d) Calculate how far north of R, Q, is, correct to **one** decimal place.

10.

Marks	3	4	5	6	7	8
Frequency	5	m	$m + 1$	9	4	1

The table gives the gives the frequency distribution of marks obtained by a number of students in a test. If the mean mark is 5, calculate the:

(a) value of m (b) median   (c) standard deviation of the distribution.

11.   (a) Given that $\sin x = 0.6$ and $0° \le x \le 90°$, find $1 - \tan x$, leaving your answer in the form $\frac{a}{b}$, where a and b are integers.

(b) Two equal chords PQ and QR are each 12 cm long. They meet at a point Q on the circle making angle $PQR = 120°$. Calculate, correct to the **nearest** whole number

the;
   (i) radius of the circle
   (ii) perimeter of the major segment cut off by the chord PR.

12.   (a) Find the image of (-2, 4) under the mapping $\begin{pmatrix} x \\ y \end{pmatrix} \rightarrow \begin{pmatrix} 2y \\ y-3x \end{pmatrix}$

(b) Two functions f and g are defined as: $f: x \rightarrow \frac{x^2}{4} - 9$ $\qquad$ $g: x \rightarrow \frac{1}{2x} (x = 0)$

   (i) Evaluate $f(4) + g\left(-\frac{1}{3}\right)$ $\qquad$ (ii) If $f \times g = 2$, solve for x

13.   (a) Using a scale of 2 cm to 2 units on both axis, draw on a graph sheet two perpendicular OX and OY for the interval $-8 \leq y \leq 8$.

(b) Draw clearly and label the vertices as appropriate:

   (i) triangle PQR with point $P(1, 2)$, $Q(5, 3)$ and $\overrightarrow{RQ} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

   (ii) the image $\Delta P'Q'R'$ of ΔPQR under a rotation of 180° about the origin where $P \rightarrow P', Q \rightarrow Q'$ and $R \rightarrow R'$

   (ii) the image $\Delta P''Q''R''$ of $\Delta P'Q'R'$ under a reflection in the line $x = 0$ where

   $P' \rightarrow P'', Q' \rightarrow Q''$ and $R' \rightarrow R''$.

(c) Describe fully, a single transformation that maps $\Delta P''Q''R''$.

WASSCE NOVEMBER 2011
SECTION A

1.   a.   Simplify $1\frac{1}{2} - \frac{3}{5} \div \frac{2}{3}$

   b.   Evaluate, using logarithm tables only $\sqrt[3]{0.246 \times 1.023}$

2.   a.   Solve for x and y in the following equations
      $2^{(x+4y)} = 1$ and $2^{(x+8y)} = \frac{1}{4}$

   b.   Simplify $\frac{m+1}{m-1} - \frac{m-1}{m+1} + \frac{4}{m^2-1}$

3.   a.   A strip of metal sheet 2cm thick is wound ten times round a cylindrical rod of diameter 9cm and height 8cm such that it fits exactly. Calculate the volume of

      the resulting object. $\left[Take \; \pi = \frac{22}{7}\right]$

   b.
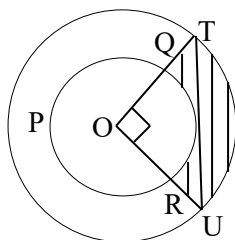
In the diagram, STU and PQR are concentric circles with centre O.
If $|QR| = 5cm, \angle TOU = 90°$ and the shaded is $6\pi cm^2$, calculate $|RU|$.

4.　　a.　　In the triangle PQR, $\cos x = \frac{15}{17}$. Find $\tan y$.

　　　　b.　　A ship leaves port X and sails 30km due south. It then sails 60km due west to another port Y. Calculate, correct to the nearest degree, the bearing of X from Y.

5.　　a.　　Cards labelled P, Q, R, S are contained in a pack. The table shows the frequency of these letters

Card	P	Q	R	S
Frequency	2	4	3	1

If two cards selected at random the pack without replacement, find the probability that both cards bear the letter P.

　　　　b.　　In a class test, Ali, John and Renner scored 27, 34 and x marks respectively. Expressing the marks in percentage, Ali scored 54%, John y% and Renner z%. If the mean for the three marks is 60%, calculate x, y and z.

SECTION B

6.　　A man on a basic salary of GH¢60,000.00 per annum has three children. He is allowed the following tax reliefs:

　　　　Personal allowance　　- 40% of basic salary;
　　　　Children allowance　　- GH¢1,500.00 each up to a maximum of 4 children;
　　　　Dependents　　　　　- 25% of basic salary
　　　　Insurance　　　　　　- 10% of basic salary

Calculate his
　　　　a.　　taxable income;
　　　　b.　　monthly tax if tax is charged at the rate of 12 pesewas in the Ghana cedis.

7.　　a.　　If $\sin x = \frac{1}{2}$, where $0° \leq x \leq 90°$, evaluate $\dfrac{\sin x \cos x}{\cos x + \tan x}$.

　　　　b.　　K is a point on the side of a tower while T is its top. The angle of elevation from a point P on the same level ground as the foot of the tower, of K and T are 20° and 60°, respectively. If $|PK| = 100m$, find, correct to three significant figures, the
　　　　i.　　distance between P and the foot of the tower;
　　　　ii.　　height of the tower;
　　　　iii.　　$|KT|$.

8.　　a.　　Copy and complete the following table for the relation $y = 8x^2 - 18x - 35$ for $-2 \leq x \leq 4$.

x	-2	-1.5	-1	0	0.5	1	1.5	2	3	4
y	33		-9	-35			-44		-17	

b.   Using scales of 2cm to 1 unit on the x-axis and 2cm to 10 units on the y-axis, draw the graph of the relation $y = 8x^2 - 18x - 35$ in the given interval.

c.   Use your graph to solve:

     i. $8x^2 = 18x + 35$ ii. $8x^2 - 18x = 15$

9.   a.   Using ruler and a pair of compasses only construct:

     i.   a quadrilateral PQRS such that $|QR| = 7cm, \angle PQR = 90°$, $|PQ| = 6cm, |PS| = |SR|$ and $\angle PSR = 60°$;

     ii.   the perpendicular bisector of $\overline{QR}$ to meet $\overline{PR}$ at X;

     iii.   the bisector of $\angle PRS$ to meet $\overline{PS}$ at Y.

   b.   Measure $|XY|$.

10.   a.   Draw the table for:

     i.   addition $\oplus$ modulo 7;

     ii.   multiplication $\otimes$ modulo 7 on the set $\{0, 1, 2, 3, 4\}$.

   b.   From your tables, evaluate:

     i. $m \otimes m = 2$;   ii. $m \oplus (m \otimes 4) = 5$;

     ii. $m \otimes (m \oplus 3) = 0$.

11.   The diagram is a right pyramid with a triangular base PQR and height $|SN|$. If $|PQ| = 6cm, |PR| = |RQ| = 5cm, |PN| = 3.3cm$ and $\angle SPN = 52°$, calculate, correct to two significant figures, the

   a.   vertical height $|SN|$ of the pyramid;

   b.   area of the base of the pyramid;

   c.   volume of the pyramid;

   d.   angle between the slant face SPQ and the base PRQ of the pyramid.

12.   The table gives scores of 50 students in a test.

Scores	$5-9$	$10-14$	$15-19$	$20-24$	$25-29$	$30-34$	$35-39$
No. of students	4	5	12	16	7	4	2

Calculate, correct to one decimal place, the

   a.   range of the distribution;

   b.   mean deviation of the distribution.

13.   a.   Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper, two perpendicular axes Ox and Oy for $-10 \le x \le 10$ and $-10 \le y \le 10$.

   b.   Draw on this graph, indicating clearly the coordinates of all the vertices:

     i.   quadrilateral ABCD with $A(4, 8)$, $B(2, 2)$, $C(6, 2)$ and $D(8, 8)$;

     ii.   the image quadrilateral $A'B'C'D'$ of ABCD under a rotation through $180°$ about the origin where $A \to A'$, $B \to B'$, $C \to C'$ and $D \to D'$.

     iii.   the image quadrilateral $A''B''C''D''$ of ABCD under a reflection in the line $y = 2$, where $A \to A''$, $B \to B''$, $C \to C''$ and $D \to D''$.

   c.   Draw the $\overline{AC''}$ and calculate its gradient.

WASSCE JUNE 2012

<u>**SECTION A**</u>

1. (a) Simplify: $\left(4\frac{3}{4} - 1\frac{5}{6}\right) \div 1\frac{1}{24} \times \left(1\frac{2}{3} + 2\frac{1}{2}\right)$.

(b) If $\frac{3}{4}$ of a number is added to $\frac{5}{6}$ gives the same result as subtracting $\frac{7}{8}$ of the number from $20\frac{1}{3}$, find the number.

2. (a) The ratio of the present ages of Kwasi and Yaw is 2:9. Four years ago, the sum of their ages was 47 years. How old is Yaw now?

(b) In the diagram, O is the centre of the circle. W, X, Y, Z are points on the circle such that $\overline{OZ}$ is parallel to $\overline{XY}$, $\overline{WOX}$ is a diameter and $\angle OZX = 46°$. Calculate $\angle ZWO$.
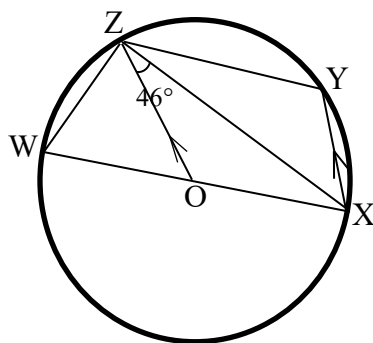
3. (a) Evaluate, correct to **two** decimal places $q = \frac{y(x-m)}{m-p}$, when $y = 2.5$, $m = 15$, $x = 10$ and $p = 18$.

(b) PQR is a triangle in which $|PQ| = |PR|$ and S is a point on PR such that $|QS| = |QR|$. If $\angle PQS = 30°$, calculate $\angle QPR$.

4. (a) Without using tables or calculator, simplify $\frac{\sin 45° + \tan 30°}{\tan 45° - \cos 60°}$.

(b) A small stone is tied to a point P vertically above it by an inelastic string 102 cm long. If the string is moved such that it is inclined at an angle of 50° to the vertical, how high does the stone rise? [*Correct your answer to **two** decimal places.*]

5. (a) In the diagram, $|MN| = |MO| = |NO| = |OP| = 3.5 \ cm$. If NP is an arc of a circle centre O, calculate the perimeter of $MNPOM$.
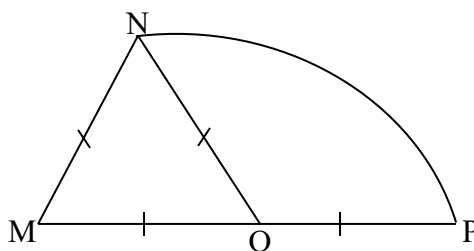
(b) A box contains 25 balls of which y are red.

(i) If a ball is selected at random from the box, what is the probability that is red?

(ii) When 15 more balls of which 7 are red are added, the probability of selecting a red ball becomes $\frac{5}{8}$. Find the number of red balls altogether in the box.

SECTION B

6.   (a) If $\log_{10} N = \bar{2}.7526$, find the value of N in standard form.

(b) Given that $425_6 = 320_x$, evaluate $123_x - 34_x$.

(c) A man invested a certain amount of money in two separate projects in the ratio 3:2. His profit was calculated on interest rates of 5% and 4% simple interest, respectively. If after two years, he received a sum of GH¢ 9200.00 as his profit for the two projects, calculate the total amount he invested in the two projects.

7.   (a) (i) Solve the inequality: $0.5(2x + 1) \leq 0.3x + 1.9$

(ii) Illustrate your answer on the number line.

(b) Copy and complete the table of values for the equation $y = x^2 + 3x$ for $-4 \leq x \leq 4$.

x	-4	-3	-2	-1	0	1	2	3	4
y				-2	0		10	18	

(i) Using scales of 2 cm to 1 unit on the x-axis and 2 cm to 5 units on the y-axis, plot the graph of the relation $y = x^2 + 3x$.

(ii) Using your graph, find
(α) the minimum value of y   (β) the value of y when $x = 1.5$

8.   Town M is 20 km from town N and 22 km from town P while N is 18 km from P. A market is to be built to serve the three towns. It is to be located such that the traders from N and M will always travel equal distance to access the market while traders from P will travel exactly 10 km to reach the market.

(a) Using ruler and a pair of compasses **only**, find by construction, the possible locations
     for the market. Use a scale of 1 cm to 2 km.
(b) How many of such locations are there?
(c) Measure and record the distances of the location from town N.
(d) which of the locations would be convenient for all the three towns?

9.   (a) A container in the form of a cube of side 24 cm is three-quarters full of water. How
     many litres of water does it hold?

(b) The perimeter of a circle is 88 cm. A and B are points on the circumference of the circle such that $\overline{AB}$ is a chord which subtends an angle of 70° at the centre of the circle. Calculate, correct to **three** decimal places, the

(i) length of the chord AB,

(ii) area of the minor segment cut off by the chord, [Take $\pi = \frac{22}{7}$]

10. (a)

Table 1

$\oplus$	0	1	2	3	4	5
0	0	1	2	3	4	5
1	1	2	3	4	5	0
2	2	3	4	5	0	1
3	3	4	5	0	1	2
4	5	0	1	2	3	4
5	5	0	1	2	3	4

Table 2

$\otimes$	0	1	2	3	4	5
0	0	0	0	0	0	0
1	0	1	2	3	4	5
2	0	2	4	0	a	4
3	0	3	0	3	0	3
4	0	4	2	0	4	2
5	0	5	4	3	2	1

Tables 1 and 2 are the addition $\oplus$ and multiplication $\otimes$ tables for modulo six respectively.

(i) Find the value of a in Table **2**.

(ii) If $5 \oplus (m \otimes 3) = 2$, find the values of m.

(b) Given that $x * y = 2x - y$, where x and y are real numbers, find the value of

(i) $5 * (4 * 5)$ (ii) y if $y * (3 * y) = 6$

11. (a) If $\tan x = \frac{15}{8}$, $0° \le x \le 90°$, find the value of $\cos x$.

(b) Two vertical poles, 3 m and 7 m long are on the same straight line with a point P on the ground. The shorter pole is 20 m from P and is between P and the longer pole. The angle of elevation of the top T of the longer pole from the top R of the shorter one is 30°. Calculate
(i) $|RT|$
(ii) the horizontal distance from P to the longer pole, correct to **three** significant figures
(iii) the angle of elevation of T from P, correct to the **nearest** degree.

12. Using a scale of 1 cm to 1 unit on **each** axis, draw two perpendicular axes $0y$ amd $0x$ for $-6 \le y \le 6$ and $-5 \le x \le 5$ on a graph sheet.
(a) Draw on the same graph sheet, labelling all vertices clearly together with their

coordinates
(i) triangle PQR with vertices P(-3, 3), Q(-1, -2) and R(3, -1);
(ii) triangle UVW with vertices U(-2, 6), V(0,1) and W(4, 2).

(b) Deduce the transformation that maps triangle PQR onto triangle UVW.

(c) Draw, labelling all the vertices together with their coordinates
(i) the image $U_1V_1W_1$ of triangle UVW under a rotation of 180° about the origin where $U \to U_1$, $V \to V_1$ and $W \to W_1$
(ii) the image $U_2V_2W_2$ of triangle $U_1V_1W_1$ under a reflection in the line $x = 0$, where $U_1 \to U_2$, $V_1 \to V_2$ and $W_1 \to W_2$.

13.   Out of 40 customers in shop, 25 bought plantain, 16 bought yam and 21 bought corn. Each of the customers bought **at least** one of the three items. Eight bought **both** plantain and yam, 11 bought plantain and corn and 6 bought yam and corn.

(a) (i) Represent the information on a Venn diagram.

(ii) How many customers bought all the **three** items?

(b) What is the probability that a customer selected at random bought

(i) **either** plantain only **or** corn only?

(ii) **at least** two items?

WASSCE NOVEMBER 2012
SECTION A
1.   X and Y are subsets of U such that $U = \{10, 11, 12, \dots, 20\}$, $X = \{x: 10 \le x < 15\}$ and $Y = \{even\ numbers\ < 18\}$. Find
   a. $X \cap Y$ b. $n(X' \cap Y)$ c. $Y \cup (X' \cap Y')$

2.   a.   Factorize completely: $9a^2 - 4(a - b)^2$.
       b.   A number is written as 14_n. If three times the number is equal to 45_n, find the value of n.

3.   a.
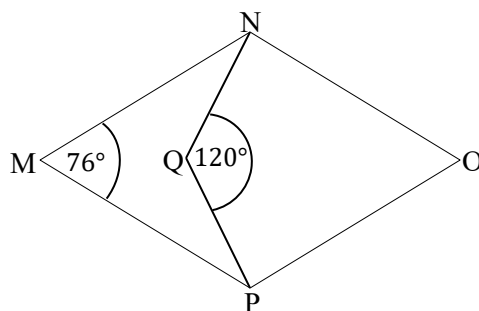
In the diagram, MNOP is a rhombus and PQNO is a kite; angle $PMN = 76°$ and angle $PQN = 120°$. Calculate the size of angle QPO.

b.
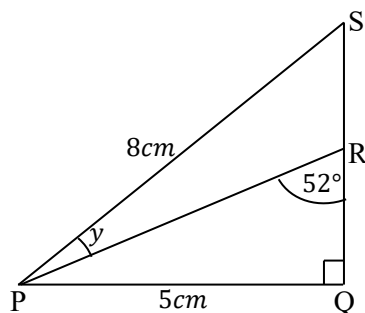
In the diagram, $\triangle PQS$ is right-angled at Q, $|PQ| = 5cm$, $\angle SPR = y$. $|PS| = 8cm$ and $\angle PRQ = 52°$. Calculate to the nearest degree, the value of angle y.

4.
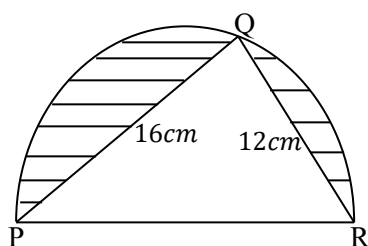
In the diagram, PQR is a semi-circle. If $|PQ| = 16cm$ and $|QR| = 12cm$, calculate, correct to 3 significant figures,

a.   the radius of the circle;

b.   the area of the shaded part.

5.   a.   The following are scores of a number of students in a test:

14	15	14	11	13	12	12	10	13	14
14	11	13	10	14	15	12	13	12	13
15	13	14	12	13	11	12	15	12	13
11	13	12	14	13	10	13	14	12	13

i.   Construct a discrete frequent distribution table for the data;

ii.   Determine the median score.

b.   A farmer bought 3 seeds. The probability of each of them germinating is $\frac{3}{4}$. If he plants all of them, find the probability that only one of them germinates.

SECTION B

6.   a.   Given that $S = \frac{m^2(tP - n)}{2Pn}$.

i.   make P the subject of the relation;

ii.   Find the value of P if $m = 4, S = 60, n = \frac{1}{3}$ and $t = 3$.

b.   Kuffor and Yaw contributed GH¢15,000 and GH¢25,000 respectively as capital in a business partnership. Kuffor as Managing Director is paid 15% of the profit as salary while the remaining profit is shared between them in the ratio of their contributions. If Kuffor received GH¢4,800 from the total profit made, how much did Yaw receive?

7.   a.   The length of the sides of a triangle are in the ratio $7:9:9$. Calculate, correct to the nearest degree, the angle between the equal sides.

     b.   The angle of elevation of the top of a building from the top of a vertical pole is $30°$. The pole is 2 metres high and its foot is 12 metres from that of the building. Find, correct to 2 decimals places, the:

       i.   height of the building;

       ii.   angle of the depression of the pole from the top of the building;

       iii.   angle of elevation of the top of the pole from the foot of the building.

8.   a.   Copy and complete the following table of value for the relation
$y = 3 - 2x - x^2$ for $-5 \le x \le 3$.

x	-5	-4	-3	-2	-1	0	1	2	3
y				3		3			-12

     b.   Using scale of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graph of $y = 3 - 2x - x^2$ for $-5 \le x \le 3$.

     c.   From your graph, find the

       i.   equation of the axis of symmetry;

       ii.   values of x from which y decreases;

       iii.   values of x for which $x^2 + 3x - 3 = 0$.

9.   a.   A tank weighs 5.6kg when it is ¼ filled with water. If it weighs 10.4kg when it is full, what will be its weight when it is empty?

     b.
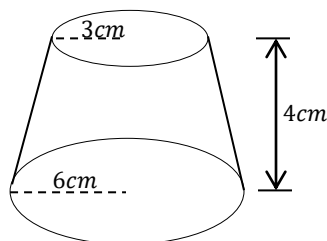
       The figure shows a cone whose upper part has been cut off. The base radius is 6cm and the upper radius is 3cm. If the height of the remaining portion is 4cm, calculate, correct to the nearest whole number the volume of the

       i.   original cone;   ii.   remaining portion. $\left[Take\ \pi = \frac{22}{7} \right]$

10.   a.   Using ruler and a pair of compasses only, construct a parallelogram PQRS such that $|PQ| = 8cm, |SP| = 7cm$ and $\angle SPQ = 30°$.

     b.   Locate a point M on PQ produced such that area of $\triangle SPM =$ the area of parallelogram PQRS.

     c.   Measure:

       i. $|SM|$;   ii. $\angle QMS$.

11.   a.   With GH¢184, I can buy x packets of biscuit. If I can buy two more packets of the same biscuit with GH¢230, find the value of x.

     b.   The mean of five consecutive odd numbers is 11. Find the

       i.   numbers;   ii.   mean deviation of the numbers.

12.　a.　i.　Draw the multiplication table,$\otimes$, in base 6 on the set $\{1, 2, 3, 4\}$.

　　　ii.　From the table, solve:

　　　　　α.　　$2 \otimes x = 2$　　　　β.　　$m \otimes m = 4$

　　b.　Given that $f: x \to 2x^2 - 8x + 5$ and $g: x \to x - 2$.

　　　i.　　Calculate $f(-3)$;

　　　ii.　Find the values of x such that $f(x) = g(x)$.

13.　a.　Using a scale of 1cm to 1 unit on both axes, draw on a graph sheet, two perpendicular axes Ox and Oy for $-10 \leq x \leq 10$, $-10 \leq y \leq 10$.

　　b.　Draw ΔPQR with vertices $P(1, 1)$, $Q(1, 5)$ and $R(5, 4)$;

　　c.　Draw the image $\Delta P_1 Q_1 R_1$ of ΔPQR through a rotation of $180°$ about the origin where $P \to P_1$, $Q \to Q_1$ and $R \to R_1$;

　　d.　Draw the image $\Delta P_2 Q_2 R_2$ of $\Delta P_1 Q_1 R_1$, under a translation by the vector $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$, where $P_1 \to P_2$, $Q_1 \to Q_2$ and $R_1 \to R_2$;

　　e.　Draw the image $\Delta P_3 Q_3 R_3$ of ΔPQR, under a reflection in the line $x = 0$ where $P \to P_3$, $Q \to Q_3$ and $R \to R_3$.

WASSCE JUNE 2013

SECTION A

1.　(a) Simplify $\dfrac{\frac{3}{4} - \frac{7}{8} + \frac{1}{2}}{\frac{3}{4} \, of \, \left(\frac{7}{8} - \frac{1}{2}\right)}$

　　(b) Using $\log_{10} 2 = 0.3010$ and $\log_{10} 3 = 0.4771$, evaluate $\log_{10} 0.24$

2.　The sum of the ages of two brothers is 38. Four years ago, the age of the elder brother was the square of the younger brother's age. Find their ages.

3.
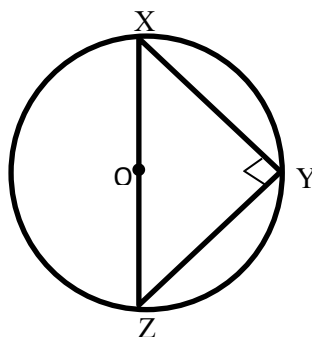
In the diagram, triangle XYZ is cut off from the circle, center O. If $/XZ/ = 35$ cm and $/YZ/ = 28$ cm, find the area of the remaining part of the circle.　　[Take $\pi = \frac{22}{7}$]

4.　(a) If $\sin x = \frac{5}{13}$ and $0° \leq x \leq 90°$, find without using tables or calculators $\dfrac{\cos x - 2 \sin x}{2 \tan x}$

(b)
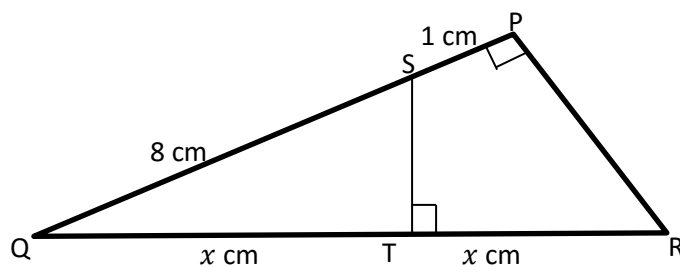
In the diagram, $/PS/$ = 1 cm, $/SQ/$ = 8 cm, $/QT/ = /TR/$ = x cm and $S\hat{T}Q = Q\hat{P}R = 90°$.

(i) Name the triangle that is similar to triangle PQR.

(ii) Hence calculate the value of x.

5.   (a)
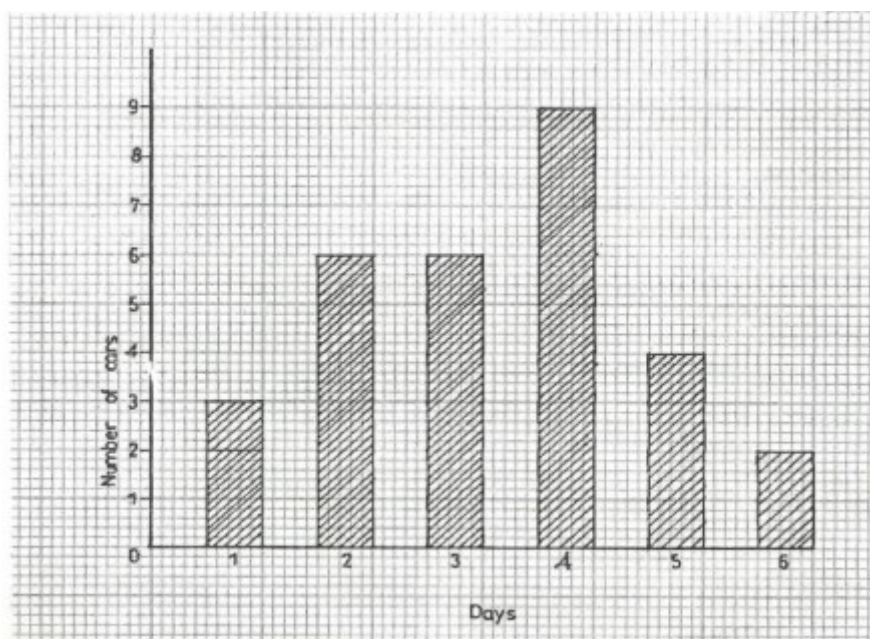
The bar chart shows the number of cars sold by a dealer in the first six days of the month. Find the average number of cars sold per day.

(b) A man spent $\frac{2}{5}$ of a certain amount on food and shared the remainder between two brothers in the ratio 2:3. If the brother with the smaller share has GH¢ 6000.00, what is the value of the amount initially?

SECTION B

6.   A company buys a car for GH¢ 27,000.00 and sells it to Mr. Fosu for GH¢ 36,000.00 after a discount of 10% on the marked price.

(a)   Calculate the:

        (i)   marked price of the car

        (ii)   percentage profit made by the company.

(b)   If Mr. Fosu sells the car after covering a mileage of 128,000 km, find the;

        (i)   find the value of the car if the rate of depreciation is GH¢ 0.03 per km

        (ii)   the range of values Mr. Fosu could sell the car so that he does not lose more than GH¢ 2,000.00 or gain more than GH¢ 3,000.00 on the depreciated value.

7.   (a) *Copy and complete the following table of values for the relation*
$y = 2x^2 - 7x - 3$

x	-2	-1	0	1	2	3	4	5
y	19		-3		-9			

(b) Using scales of 2 cm to 1 unit on the x-axis and 2 cm to 5 units on the y-axis, draw the graph of $y = 2x^2 - 7x - 3$ for $-2 \le x \le 5$.

(c) from the graph, find the:

   (i) minimum value of y

   (ii) the gradient of the curve at $x = 1$, correct to the nearest whole number

   (iii) values of x for which $2x^2 - 7x - 3 = 2x + 4$

8.   (a) The points **M** (2,3) and **N** (5,-2) and **T** (3,-5) are in the $x - y$ rectangular plane.

If k $\overrightarrow{OM}$ + l $\overrightarrow{ON}$ = $\overrightarrow{MT}$, where k and l are real numbers, calculate the value of

(i) k   (ii) l

(b) Given that $\overrightarrow{AC} = \binom{-7}{12}$, calculate the:

   (i) the length of $\overrightarrow{AC}$, correct to three significant figures

   (ii) bearing of C from A, correct to the nearest degree

9.   (a) Using ruler and a pair of compasses only, construct a quadrilateral *PQRS* such that /PQ/ = 8 cm, $Q\hat{P}S = 105°$, $P\hat{Q}S = 30°$ /PR/ =9 cm and /RS/ = /RQ/.

(b) Measure:

   (i) /RS/   (ii) /PS/   (iii) angle *QRS*

10.   (a) Simplify: $\frac{3}{4}\sqrt{128} - \sqrt{50}$ leaving your answer in standard form.

(b)
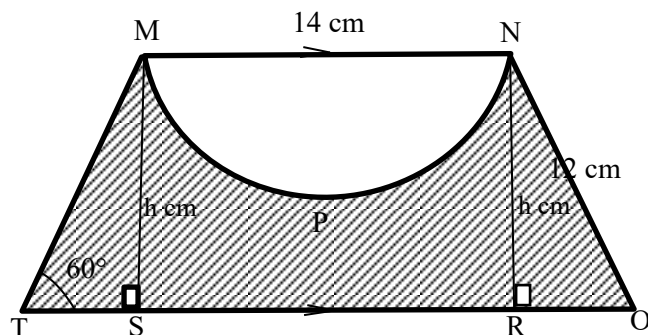
The diagram shows a trapezium *MNOT* in which *MN* // *TO*, /*MN*/ = 14 cm, $M\hat{T}O$ = 60° and /*MT*/ = /*NO*/ = 12 cm. If the semi-circle *MPN* is removed from the trapezium, calculate, correct to the nearest cm^2, the area of the remaining portion.

11.   A pole 25m long is placed is placed against a vertical wall such that its lower end is 7m from the foot of the wall on the horizontal ground. If the upper end of the pole is pushed down by 2m, calculate, correct to 2 significant figures;

   (a) how much farther away from the wall the lower end will move
   (b) the angle the pole now makes with the horizontal.

12.

No. of accidents	0	1	2	3	4	5	6	8	10	11	13	15	17	18	19
No. of days	20	10	8	7	5	3	3	5	4	4	3	2	2	3	1

The number of road accidents recorded in a given period was as follows:

(a) Using the group intervals 0-2, 3-5, 6-8,… prepare a group frequency distribution for the   data.
(b) Construct a cumulative frequency table.
(c) Draw a cumulative frequency curve.
(d) use the cumulative frequency curve to estimate the;
    (i) median   (ii) upper quartile

13.   (a) A translation **T** takes the point **P** (1,2) to **P′** (5,3). What is the image of **Q** (3,4) under **T**?
   (b) Construct a table for multiplication in modulo 7 on the set {2,3,5,6}. Use the table to solve the following equations;
        (i) m ⊗ m = 2   (ii) n ⊗ (n ⊗ 6) = 3
   (c) Consider the statements:
   p: Martin trains hard   *q:* Martin wins the race
   If $p \Rightarrow q$, state whether or not the following statements are valid:
   (i) If Martin wins the race, then he has trained hard
   (ii) If Martin does not train hard, then he will not win the race
   (iii) If Martin does not win the race, then he has not trained hard.

WASSCE NOVEMBER 2013
                    SECTION A
1.   a.   If $2^{x+2} \times 8^x = 1$, find the value of x.
   b.   Solve: $\frac{1}{2}\left(\frac{x}{3} + 1\right) = \frac{x}{4} - 2$.
   c.   Four interior angles of a hexagon are 130°, 160°, 112° and 80°. If the remaining angles are equal, find the size of each of them

2.
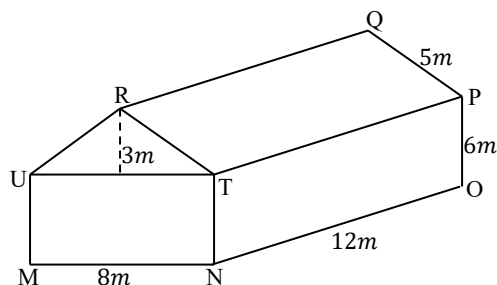
The diagram shows a hut used in storing grains which is in the shape of a triangular prism mounted on a cuboid. If the dimensions are shown in the diagram, calculate the

a.   volume of the hut;

b.   total external surface area of the hut.

3.   a.   Solve the inequality: $\frac{1}{3}x - \frac{1}{4}(x+2) \geq 3x - 1\frac{1}{3}$.

     b.   A man gave out GH¢24,000 to his three brothers, X, Y and Z to be shared among them. If X takes twice as much as Y and Y is given one-third of what Z takes, how much did each of them receive?

4.   The monthly income of Mr. Yeboah, a senior manager of a company is GH¢108,000.00. His monthly expenditure is as follows:

Fuel	GH¢12,000.00
Food	GH¢30,000.00
Clothing	GH¢10,500.00
Wife's allowance	GH¢21,000.00
Children's education	GH¢24,000.00
Savings	GH¢10,500.00

     a.   Represent the information on a pie chart.

     b.   Calculate, correct to one decimal place, the percentage of Mr. Yeboah's monthly income that is spent on his children's education.

5.   Two boats A and B leave port at the same time. A travels 15km on a bearing of 020° while B travels 14km on a bearing of 290°. Calculate, correct to two decimal places, the

     a.   distance between A and B;

     b.   bearing of A from B.

SECTION B

6.   a.   A trader was charged 2 pesewas per month for every GH¢1.00 he borrowed from a bank.

         i.   At what percentage rate per annum was the interest charged?

         ii.   How much would the trader pay as interest on a loan of GH¢ 5,000.00 for 6 months?

     b.   If R varies inversely as the square of $(3q-2)$ and $R = 4$ when $q = 2$, find

         i. R when $q = 1$;   ii. q when $R = 16$.

7.   a.   If $10x^2 - 9xy + 2y^2 = 0$, find the ratio $x:y$.

b.   A train fare for school children is half the fare of a teacher. The total fare for 120 children and 15 teachers for an excursion is GH¢180.00.

        i.   Find the fare of a child;

        ii.   How many children will go on the excursion with 20 teachers for a total fare of GH¢240.00?

8.   a.   A solid rectangular block with dimension 15cm, 12cm and 8cm respectively is melted completely and recast into a solid right circular cone of base radius 12cm. Calculate, correct to two significant figures, the height of the cone. $[Take\ \pi = 3.142]$

       b.
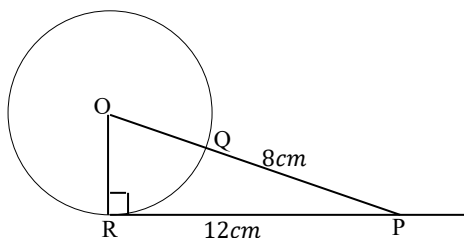
In the diagram, O is the centre of the circle and PR is a tangent to the circle at R. If $|PR| = 12cm$ and $|PQ| = 8cm$, calculate the

        i.   radius;

        ii.   length of the minor arc QR, correct to two decimal places.

10.
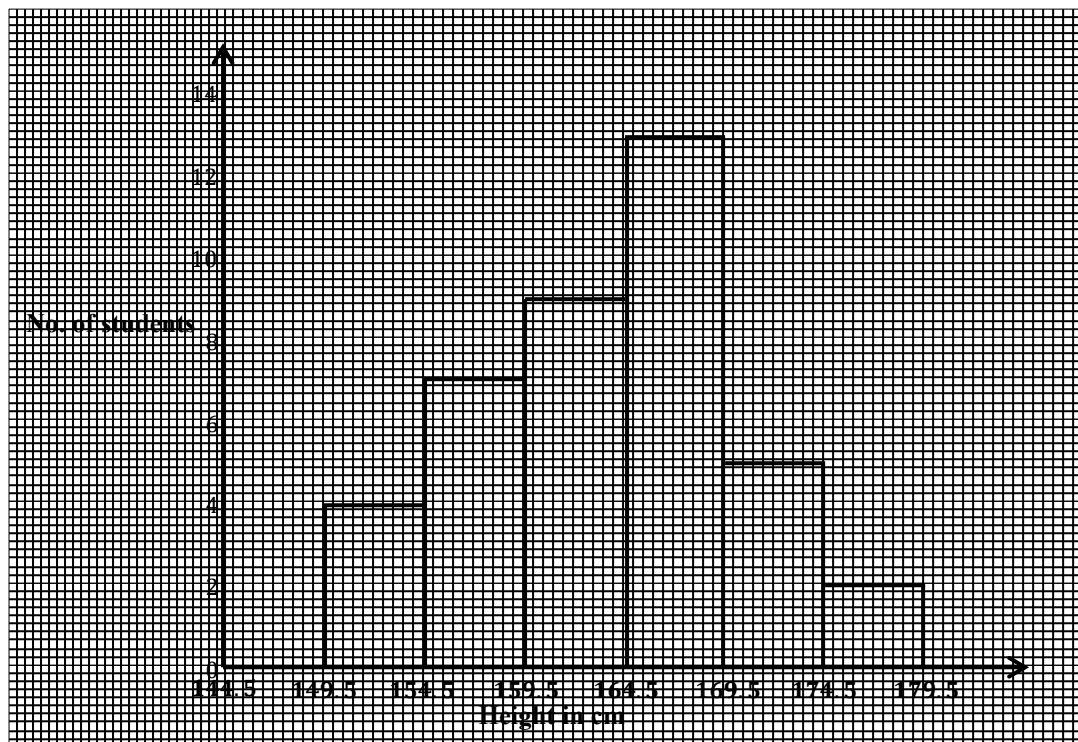
The diagram shows the height of a group of students in a school.

       a.   Use the histogram to construct the frequency distribution table.

       b.   What percentage of the students has their heights between 159.5cm and 164.5cm?

c.   Calculate the mean height.

11.   a.   Find the equation of the line which passes through the points $(2, -3)$ and $(1, -3)$.

b.   i.   Draw the multiplication $\otimes$ table for arithmetic modulo 7.

ii.   Using the table

α.   state with reason whether or not the operation is commutative;

β.   evaluate $(4 \otimes 6) \otimes (5 \otimes 4)$;

γ.   find the truth set of $n \otimes n = n$.

12.   a.   In the diagram, WXYZ are points on the circumference of a circle O, $\angle XYW = 80°$. Calculate $\angle ZYW$.
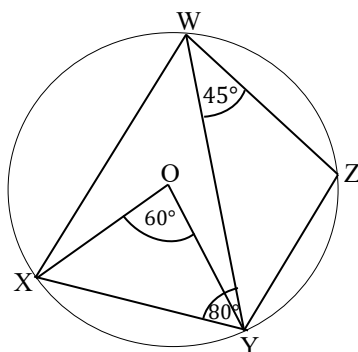
b.   A tank 2m tall stands on top of a concrete pillar. From a point (P) on the same horizontal ground as the foot of the pillar, the angles of elevation of the top (T) and bottom (B) of the tank are $49°$ and $42°$ respectively.

i.   Draw a diagram to represent this information;

ii.   Calculate, correct to one decimal place, the height of the pillar;

iii.   Calculate, correct to one decimal place, $|PB|$.

13.   a.   Using a scale of 2cm to 2 units on both axes, draw on a sheet of graph paper, two perpendicular axes Ox and Oy for $-10 \leq x \leq 10$ and $-10 \leq y \leq 10$.

b.   Draw on the same graph sheet, indicating clearly all vertices and their coordinates:

i.   quadrilateral PQRS with vertices $P(2, 4)$, $Q(4, 7)$, $R(8, 8)$ and $S(6, 3)$;

ii.   the image $P_1 Q_1 R_1 S_1$ of PQRS under an anticlockwise rotation of $90°$ about the origin where $P \rightarrow P_1$, $Q \rightarrow Q_1$, $R \rightarrow R_1$ and $S \rightarrow S_1$;

iii.   the image $P_2 Q_2 R_2 S_2$ of PQRS under a translation by the vector $\begin{pmatrix} 10 \\ -9 \end{pmatrix}$, where $P \rightarrow P_2$, $Q \rightarrow Q_2$, $R \rightarrow R_2$ and $S \rightarrow S_2$;

iv.   the image $P_3 Q_3 R_3 S_3$ of PQRS under a reflection in the line $y = 1$, where $P \rightarrow P_3$, $Q \rightarrow Q_3$, $R \rightarrow R_3$ and $S \rightarrow S_3$;

WASSCE JUNE 2014

SECTION A

1. (a) Without using tables or calculator, simplify: $\dfrac{0.6 \times 32 \times 0.004}{1.2 \times 0.008 \times 0.16}$. Leaving the answer in standard form (scientific notation).

    (b)
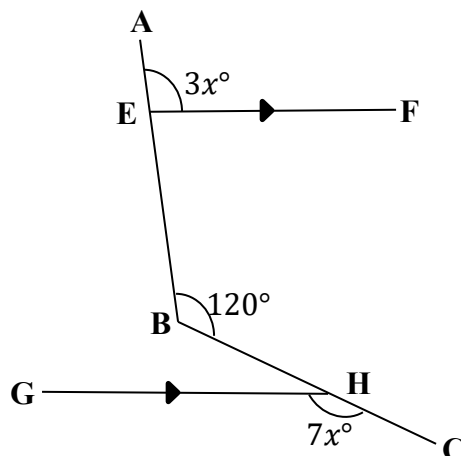
In the diagram, $\overline{EF}$ is parallel to $\overline{GH}$. If $\angle AEF = 3x°$, $\angle ABC = 120°$ and $\angle CHG = 7x°$, find the value of $\angle GHB$.

2. (a) Simplify $3\sqrt{75} - \sqrt{12} + \sqrt{108}$, leaving the answer in surd form (radicals).

    (b) If $124_n = 232_{five}$, find n.

3. (a) Solve the simultaneous equations: $\dfrac{1}{x} + \dfrac{1}{y} = 5$ and $\dfrac{1}{y} - \dfrac{1}{x} = 1$.

    (b) A man drives from Ibadan to Oyo, a distance of 45 km in 45 minutes. If he drives at 72 km/h where the surface is good and 48 km/h where it is bad, find the number of kilometers of good surface.

4. (a) In the diagram, O is the centre of the circle radius r cm and $\angle XOY = 90°$, If the area of the shaded part is $504cm^2$, calculate the value of r. [Take $\pi = \dfrac{22}{7}$]
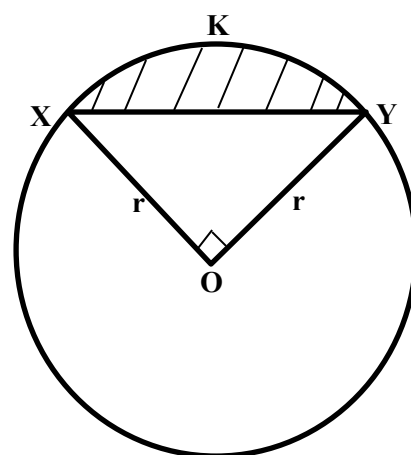
    (b) Two isosceles triangles PQR and PQS are drawn on opposite sides of a common base PQ. If $\angle PQR = 66°$ and $\angle PSQ = 190°$, calculate the value of $\angle RQS$.

5. A building contractor tendered for two independent contracts **X** and **Y**. The possibilities that he will win contract **X** is 0.5 and **not** win contract **Y** is 0.3. What is the probability that he will win:

(a) **both** contracts   (b) **exactly** one of the contracts

(c) **neither** of the contracts?

SECTION B

6.   (a) If $\dfrac{3}{2p-\frac{1}{z}} = \dfrac{\frac{1}{3}}{\frac{1}{4}p+1}$, Find p.

(b) A television set was marked for sale at GH¢760.00 in order to make a profit of 20%. The television set was actually sold at a discount of 5%. Calculate, correct to **2** significant figures, the actual percentage profit.

7.   (a) Copy and complete the table of values for the relation $y = 2\sin x + 1$

x	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°
y	1.0				2.7			0.0	-0.7	

(b) Using scales of 2 cm to 30° on the x-axis and 2 cm to 1 unit on the y-axis, draw the graph of $y = 2\sin x + 1$ for $0° \le x \le 270°$.

(c) Use the graph to find the values of x for which $\sin x = \dfrac{1}{4}$.

8.   (a) Copy and complete the following table for multiplication modulo 11

$\otimes$	1	5	9	10
1	1	5	9	10
5	5			
9	9			
10	10			

Use the table to:

(i) evaluate $(9\otimes5)\otimes(10\otimes10)$

(ii) find the truth set of

(α) $10 \otimes m = 2$

(β) $n \otimes n = 4$

(b) When a fraction is reduced to its lowest term, it is equal to $\dfrac{3}{4}$. The numerator of the fraction when doubled would be 34 greater than the denominator. Find the fraction.

9.   (a)
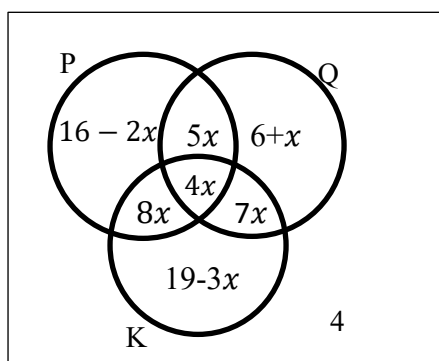
In the Venn diagram, P,Q and R are subsets of the universal set U. If n(U) = 125, find;

(i) the value of x

(ii) n$(P \cup Q \cap R)$

(b) In the diagram, O is the centre of the circle. If WX is parallel to YZ and $\angle WXY = 50°$, find the value of:

    (i) $\angle WYZ$ (ii) $\angle YEZ$
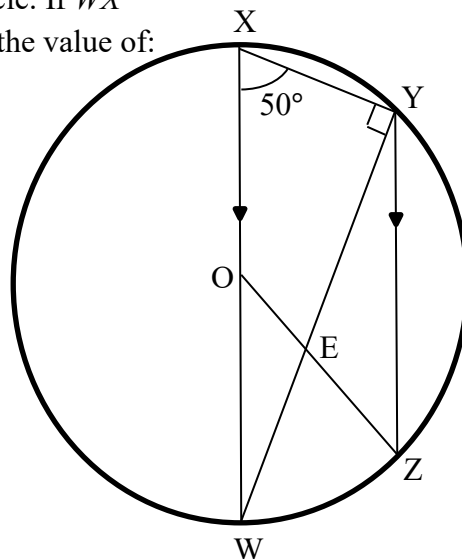
10.   (a) Solve $(x - 2)(x - 3) = 12$.

      (b)   In the diagram, M and N are centres of the two circles of equal radii 7 cm. The circles intercept at P and Q. If $\angle PMQ = \angle PNQ = 60°$, calculate correct to the nearest whole number, the area of the shaded portion. [Take $\pi = \frac{22}{7}$]
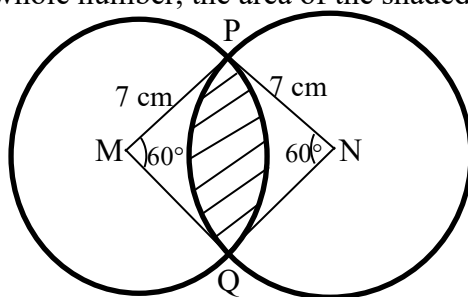
11.

Scores	1	2	3	4	5	6
Frequency	2	5	13	11	9	10

The table shows the distribution of outcomes when a die is thrown 50 times. Calculate the: (a) mean deviation of the distribution

        (b) probability that a score selected at random is **at least** a 4.

12.   (a) Given that $5\cos(x + 8.5)° - 1 = 0, 0° \leq x \leq 90°$, calculate, correct to the nearest degree, the value of x.

    (b) The bearing of **Q** from **P** is 150° and the bearing of **P** from **R** is 015°. If **Q** and **R** are 24 km and 32 km respectively from **P**;

        (i) represent the information in a diagram.

        (ii) calculate the distance between **Q** and **R**, correct to two decimal places.

        (iii) find the bearing of **R** from **Q**, correct to the **nearest** degree.

13   (a) Two function f and g are defined by $f: x \rightarrow 2x^2 - 1$ and $g: x \rightarrow 3x + 2$, where x ia a real number.

        (i) If $f(x - 1) - 7 = 0$, find the value of x.

(ii) Evaluate $\dfrac{f\left(-\frac{1}{2}\right)\bullet g(3)}{f(4)-g(5)}$.

(b) An operation * defined on the set **R**, of real numbers, $m * n = \dfrac{-n}{m^2+1}$, where m, n $\in R$. If -3, -10 $\in R$, show whether or not * is commutative.

WASSCE NOVEMBER 2014

1.   a.   Factorize completely: $m^2 - 2mn + n^2 - 9r^2$.
     b.   Solve simultaneously, the equations:
          $5x - 4y = 6;$ $3^{3(y-x)} = \dfrac{1}{27}$

2.   A man has a wife and 6 children and his total income in a year was GH¢850. He was given the following tax free allowances:
     Personal   GH¢120
     Wife   GH¢30
     Children   GH¢25 per child for a maximum of 4 children
     Medical   GH¢40
     Calculate his:
     a.   taxable income;   b.   monthly tax.

3.   In the diagram PQ and QR are straight lines, $|PS| = 6cm, |QS| = 4cm, |QT| = 5cm$ and $\angle QTS = \angle RPQ$. Calculate $|TR|$.

Not drawn to scale
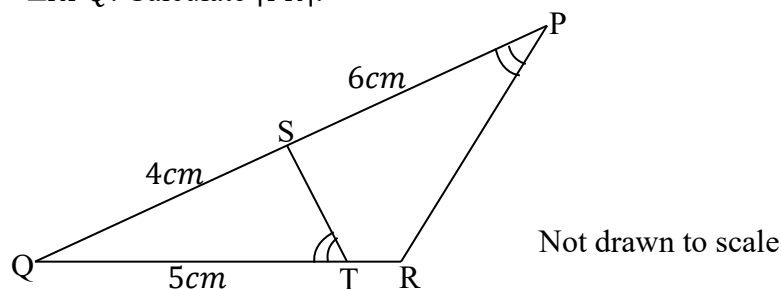
     c.   If $\sin x = \dfrac{5}{13}, 0° \le x \le 90°$, evaluate, without tables or calculators,
          $\dfrac{\cos x - 2\sin x}{2\tan x}$.

4.   a.   Without using tables or calculators, evaluate:
          $\log_{10}\left(\frac{75}{10}\right) - 2\log_{10}\left(\frac{5}{9}\right) + \log_{10}\left(\frac{100}{243}\right)$.
     b.   Given that $X = \{x: 10 \le x \le 15\}$ and $Y = \{even\ numbers\ < 18\}$ are subsets of $U = \{10,11,12, ... ,20\}$, find:
          i. $X \cap Y$;   ii. $n(X' \cap Y)$.

5.
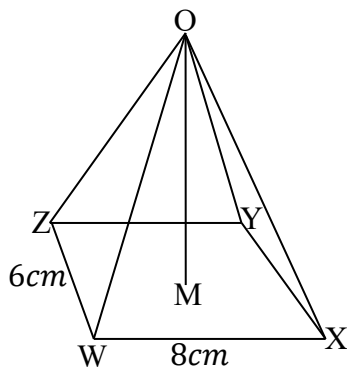
The diagram shows a right pyramid with a rectangular base WXYZ and vertex O. If $|WX| = 8cm, |ZW| = 6cm$ and $|OX| = 13cm$, calculate the:

a.   height of the pyramid;

b.   value of $\angle OXZ$, correct to the nearest degree;

c.   volume of the pyramid.

SECTION B

6.   a.   In a class of 52 students, 16 are Science students. If $\frac{1}{3}$ of the boys and $\frac{1}{4}$ of the girls are Science students, how many boys in the class?

     b.   The sum of the first and third terms of a Geometric Progression (G.P) is 40 while the fourth and the sixth terms are in the ratio $1: 4$. Find the:

          i.   common ratio;   ii.   fifth term.

7.   a.   A spherical tank of diameter 3m is filled with water from a pipe of radius 30cm at 0.2m per second. Calculate, correct to 3 significant figures, the time in minutes it takes to fill the tank. $\left[Take \; \pi = \frac{22}{7}\right]$

     b.   When k is added to the expression $y^2 - 12y$, the expression becomes $(y + p)^2$. Find the values of p and k.

8.   a.   Using ruler and a pair of compasses only, construct:

          i.   parallelogram PQRS with RS as the base such that $|PQ| = 7.8cm$, $|PQ| = 5.6cm$ and angle $QRS = 120°$;

          ii.   rectangle ABRS, equal in area to parallelogram PQRS.

     b.   Measure: i. $|AP|$;   ii. $|AS|$.

9.   An object is thrown vertically upwards from the top of a cliff and its height, y metres, above sea level after t seconds is given by $y = -16t^2 + 64t + 5$.

     a.   Copy and complete the table of values for $y = -16t^2 + 64t + 5$; $0 \le t \le 4.0$.

t	0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
y	5			65			53		

     b.   Using scales of 2cm to 0.5 seconds on the t-axis and 2cm to 10m on the y axis, draw the graph of $y = -16t^2 + 64t + 5$ for $0 \le t \le 4.0$.

c. Use the graph to find the:
    i. height reached when $t = 1.75$ seconds;
    ii. times the object was at a height of 50m;
    iii. maximum height reached.

10. a. i. Solve the inequality $\frac{1}{2}x - \frac{5}{6}(x + 2) \leq 1 + x$.
    ii. Illustrate the solution on a number line.

b. From a point P on a level ground and directly west of a pole, the angle of elevation of the top of the pole is $45°$ and from the point Q east of the pole, the angle of elevation of the top of the pole is $58°$. If $|PQ| = 10m$, calculate, correct to 2 significant figures, the:
    i. distance from P to the pole;
    ii. height of the pole.

11. a. The probabilities that Manful, John and Ernest will pass an examination are $\frac{2}{3}, \frac{5}{8}$ and $\frac{3}{4}$ respectively. Find the probability that all three will pass the examination.

b. The scores of students in a test were recorded as follows:

4	2	1	6	5	3	5	6	1	2
1	5	5	6	3	4	3	5	1	5

    i. Construct a frequency distribution table.
    ii. Represent the information in a bar chart.
    iii. Calculate the interquartile range.

12. a.
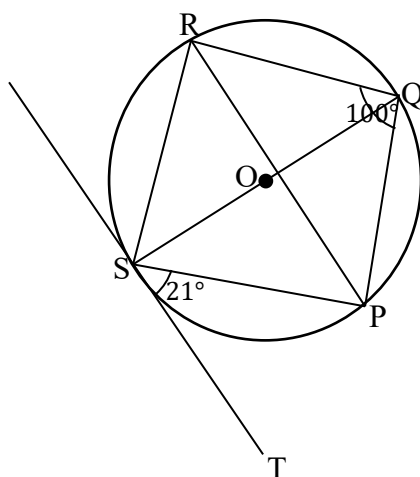
In the diagram, $\overline{TS}$ is a tangent to the circle at S. If O is the centre of the circle, $\angle TSP = 21°$ and $R\hat{Q}P = 100°$, find with reasons:
    i. $\angle SPR$;   ii. $\angle QSR$.

b. Given the relation $T = \sqrt{\dfrac{U}{\frac{1}{f} + \frac{1}{g}}}$,

    i. make g the subject of the relation;
    ii. find the value of g when $T = 3, f = 4$ and $U = 5$.

13.   a.   If $x = \begin{pmatrix} -2 \\ 4 \end{pmatrix}$ and $y = \begin{pmatrix} -3 \\ 1 \end{pmatrix}$, find, correct to 1 decimal place, $|x + y|$.

      b. $P(6, 4), Q(-2, -2)$ and $R(4, -6)$ are the vertices of triangle PQR.

           i.   Determine the coordinates of M and S, the mid-points of $\overline{PQ}$ and $\overline{PR}$ respectively.

           ii.   Find $\overrightarrow{QR}$ and $\overrightarrow{MS}$.

           iii.   State the relationship between $\overrightarrow{QR}$ and $\overrightarrow{MS}$.

           iv.   Find the equation of $\overline{MS}$.

WASSCE JUNE 2015

SECTION A

1.   (a) Without using mathematical tables or calculators, simplify: $3\frac{4}{9} \div \left(5\frac{1}{3} - 2\frac{3}{4}\right) + 5\frac{9}{10}$.

     (b) A number is selected at random from each of the sets $\{2, 3, 4\}$ and $\{1, 3, 5\}$. Find the probability that the sum of the two numbers is **greater than 3** and **less than 7**

2.   (a) Solve the inequality: $4 + \frac{3}{4}(x + 2) \leq \frac{3}{8}x + 1$.

     (b)
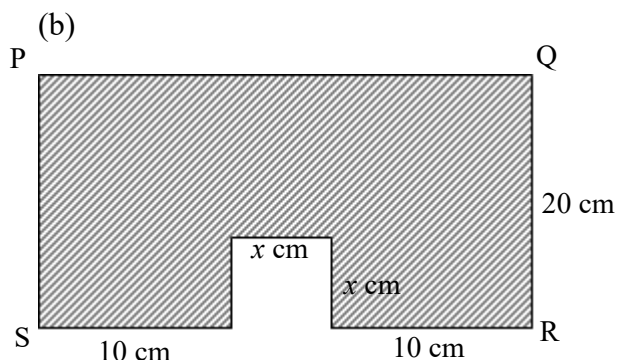
The diagram shows a rectangle $PQRS$ from which a square of side x cm has been cut. If the area of the shaded portion is $484 \ cm^2$, find the value of x

3.   (a) The ratio of the interior angles to the exterior angle of a regular polygon is $5 : 2$. Find the number of sides of the polygon.

     (b)
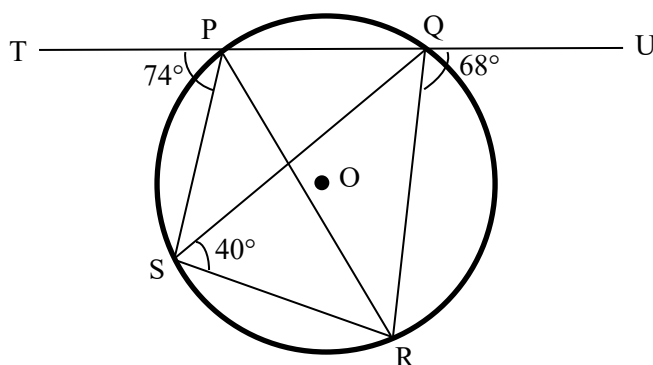
The diagram shows a circle $PQRS$ with centre O, $\angle UQR = 68°$, $\angle TPS = 74°$ and $\angle QSR = 40°$. Calculate the value of $\angle PRS$.

4.   (a) By how much is the sum of $3\frac{2}{3}$ and $2\frac{1}{5}$ **less than** 7?

     (b) The height h m, of a dock above sea level is given by $h = 6 + 4\cos(15p)^0$, $0 < p < 6$.

     Find: (i) the value of h when $p = 4$

(ii) correct to **two** significant figures, the value of p when $h = 9$ m.

5. A trapezium $PQRS$ is such that $PQ\|RS$ and the perpendicular from P to RS is 40 cm. If $|PQ| = 20\ cm$, $|SP| = 50\ cm$ and $|SR| = 60\ cm$, calculate, correct to 2 significant figures, the:
   (a) area of the trapezium   (b) $\angle QRS$.

SECTION B

6. (a)(i) Illustrate the following statement in a Venn diagram:
   All good Literature students in a school are General Arts class.
   (ii) Use the diagram to determine whether or not the following are valid conclusions from the given statement:

   (α) Vivian is the General Arts class therefore she is a good Literature student;
   (β) Audu is not a good Literature student therefore he is not in the General Arts class;
   (γ) Kweku is not in the General Arts class therefore he is not a good Literature student.

   (b) The cost (c) of producing n bricks is the sum of a fixed amount, h, and a variable amount y where y varies directly as n. If it costs GH¢ 950.00 to produce 600 bricks and GH¢ 1030.00 to 1000 bricks,
   (i) find the relationship between c, h and n;
   (ii) calculate the cost of producing 500 bricks.

7. The table is for the relation $y = px^2 - 5x + q$.

x	-3	-2	-1	0	1	2	3	4	5
y	21	6		-12				0	13

   (a)(i) Use the table to find the values of p and q.
   (ii) Copy and complete the table.

   (b) Using scales of 2 cm to 1 unit on the x-axis and 2 cm to 5 units on the y-axis, draw the graph of the relation for $-3 \le x \le 5$.

   (c) Use the graph to find:
   (i) y when $x = 1.8$ (ii) x when $y = $ -8

8. (a) Using a ruler and a pair of compasses only, construct a:
   (i) trapezium $WXYZ$ such that $|WX| = 8\ cm$, $|XY| = 5.5\ cm$, $|XZ| = 8.3\ cm$, $\angle WXY = 60°$ and $WX \| ZY$.
   (ii) rectangle $PQYZ$ where P and Q are on $\overline{WX}$.
   (b) Measure   (i) $|QX|$ (ii) $\angle XWZ$

9. (a) The first term of an Arithmetic Progression (AP) is -8. If the ratio of the 7th term to

the 9th term is 5 : 8, find the common difference of the AP.

(b) A trader bought 30 baskets of pawpaw and 100 baskets of mangoes for ₦2450.00. She sold the pawpaw at a profit of 40% and the mangoes at a profit of 30%. If her profit on the entire transaction was ₦855.00, find the:
  (i) cost price of a basket of pawpaw;
  (ii) selling price of the 100 baskets of mangoes.

10. (a) Without using Mathematical tables or calculators, simplify: $\frac{2 \tan 60° + \cos 30°}{\sin 60°}$.

(b) From an aeroplane in the air and at a horizontal distance of 1050 m, the angles of depression of the top and base of a control tower at an instant are 36° and 41° respectively. Calculate, correct to the nearest metre, the
  (i) height of the control tower
  (ii) shortest distance between the aeroplane and the base of the control tower.

11. (a) Make m the subject of the relation $h = \frac{mt}{d(m+p)}$.

(b)
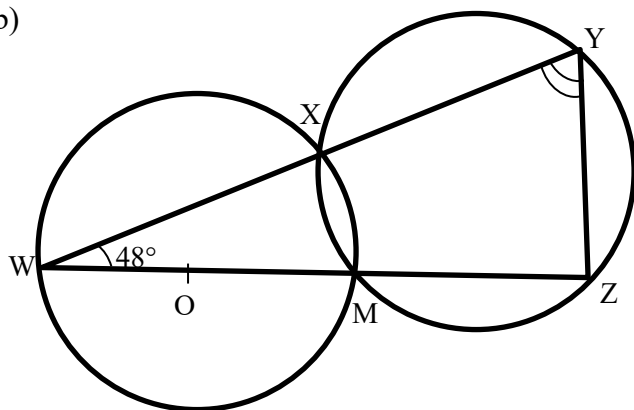
In the diagram, WZ and WY are straight lines, O is the centre of circle WXM and $\angle XWM = 48°$. Calculate the value of $\angle WYZ$.

12. A water reservoir in the form of a cone mounted on a hemisphere is built such that the plane face of the hemisphere fits exactly to the base of the cone and the height of the cone is 6 times the radius of its base.
(a) Illustrate this information in a diagram.
(b) If the volume of the reservoir is $333\frac{1}{3}\pi\ m^3$, calculate, correct to the nearest whole number, the:
  (i) volume of the hemisphere
  (ii) total surface area of the reservoir.   [Take $\pi = \frac{22}{7}$]

13. The table shows the marks scored by some candidates in an examination

Marks(%)	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Frequency	7	11	17	20	29	34	30	25	21	6

(a) Construct a cumulative frequency table for the distribution and draw a cumulative frequency curve.

(b) Use the curve to estimate, correct to one decimal place, the
    (i) lowest mark of the distribution if 5% of the candidates passed with distinction
    (ii) probability of selecting a candidate who scored **at most** 45%.

WASSCE JUNE 2016

SECTION A

1.   a.   Simplify without using mathematical tables or calculator, $\dfrac{4\frac{1}{4} - 3\frac{1}{2} + 3\frac{1}{8}}{3\frac{2}{5} \, of \, 1\frac{1}{4} \div 2\frac{5}{6}}$.

     b.   If two numbers are selected at random, one after the other, with replacement from the set $A = \{5, 6, 7, 8, 9\}$, find the probability of selecting **at least one** prime number.

2.   a.   Given that $\cos x = \frac{3}{2}, 0° < x < 90°$, calculate, without using mathematical tables or calculator, $\dfrac{3\tan x}{2\sin x + 3\cos x}$

     b.

In the diagram, PS is a tangent to the circle of centre O. If QS is a straight line and $\angle TOR = 82°$, find $\angle RST$.

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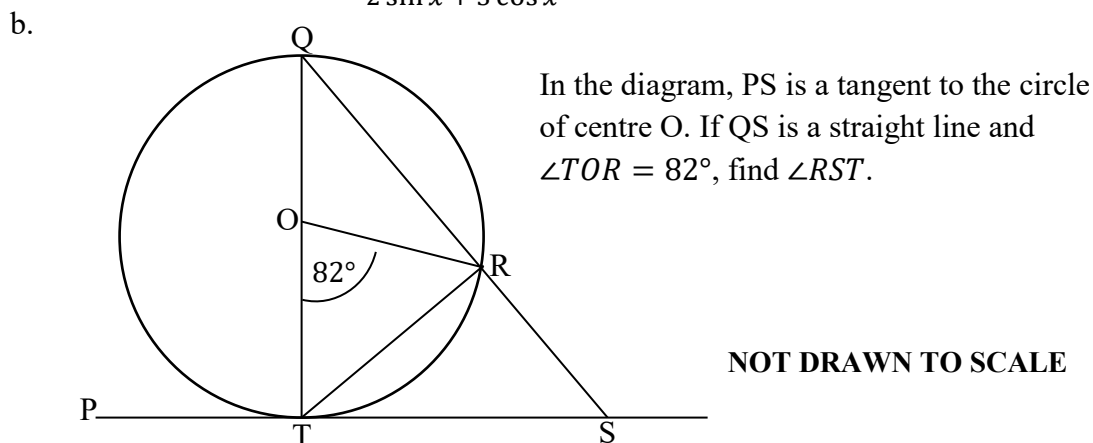
3.   a.   For what values of x is the expression $\dfrac{5}{x^2 + 2x - 8}$ **not** defined?

     b.   Three times the age of Felicia is four more than the age of Asare. In three years, the sum of their ages will be 30 years. Find their present ages.

4.   If P, Q and R are sets such that $n(P) = 20, n(R) = 21, n(P \cap Q) = 7, n(P \cap R) = 8, n(Q \cap R) = 5$ and $n(P \cap Q \cap R) = 3$,
     a.   represent this information on a Venn diagram;
     b.   find:
         i. $n(P \cup Q \cup R)$;   ii.   the probability of $\left((P \cup Q)' \cap R\right)$.
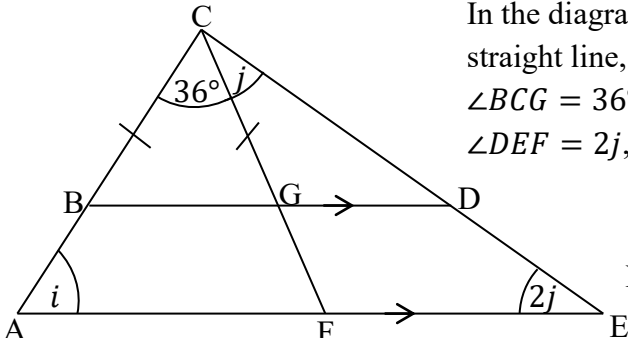
5.

In the diagram, WXYZ is a trapezium, $|XZ| = 7cm$ $\angle ZYX = 90°, \angle ZWX = 60°$ and $\angle ZXY = 30°$. Calculate, correct to the nearest whole number, the area of WXYZ.

NOT DRAWN TO SCALE

SECTION B

6.   a.   If p varies directly as t^3 and $p = 9.6$ when $t = 4$, find t when $p = 150$.

       b.   A farmer has 1 hectare of land. One half of the land was used for planting oranges, $\frac{1}{3}$ of the remainder was used for planting mangoes while plantain was planted on the rest.

              i.   Express the area of land used for mangoes as a fraction of that used for plantain.

              ii.   If a labourer was given a week to weed the orange plantation and he completes $\frac{1}{5}$ of it on the first day, what area, in square metres, was left?
              [Take 1 hectare $= 10,000m^2$]

7.   a.

In the diagram, ACE is a triangle, CF is a straight line, BD//AE and $|BC| = |CG|$. If $\angle BCG = 36°, \angle BAF = i, \angle GCD = j$ and $\angle DEF = 2j$, find the values of i and j

Not drawn to scale

       b.   An aeroplane flies from P to Q in 1 hour at a speed of 120km/min, where P and Q are on the parallel of latitude 60°N. If the aeroplane flies along this parallel of latitude, calculate, correct to **three** significant figures, the difference in longitudes of P and Q.
              [Take $\pi = \frac{22}{7}$, radius of the earth $= 6400$km]

8.   a.   Using ruler and a pair of compasses only, construct a quadrilateral, PQRS, such that $|PQ| = 8cm, |SQ| = 10.2cm, |QR| = 7.5cm, \angle QPS = 75°$ and PS//QR.

       b.   i.   Draw locus, l_1, of points equidistant from SR and QR;
              ii.   Draw locus, l_2, of points equidistant from P and Q;

       c.   Measure $|TQ|$, where T is the point of intersection of l_1 and l_2.

9.   a.   Copy and complete the table of values for the relation $y = x^2 - 5x + 5$ for $-1 \leq x \leq 6$.

x	-1	0	1	2	3	4	5	6
y		5	1				5	

       b.   Using scales of 2cm to represent 1 unit on the x-axis and 2cm to represent 2 units on the y-axis, draw the graph of $y = x^2 - 5x + 5$ for $-1 \leq x \leq 6$.

       c.   Use the graph to find the:
              i.   minimum value of y;   ii.   roots of $x^2 - 5x + 5 = 0$;
              iii.   solution of $x^2 + 2x + 5 = 7x + 2$.

10.   The table shows the distribution of 40 students in a class according to their clubs and the corresponding sectoral angles.

Club	No. of students	Sectoral angle
Debating	10	90°
Cultural	x	$(7y)°$
Literacy	14	$(18x)°$
Red Cross	y	81°

     a.   Find the value of x and y.
     b.   Illustrate the data on a pie chart.
     c.   Find the percentage of students who were in the cultural club.

11.   a.   It was observed that the shadow of a vertical pole was $6m$ longer when the angle of elevation of the sun was 30° than when it was 60°. By means of a sketched diagram, calculate, correct to **two** decimal places, the height of the pole.

     b.   The length of each non-parallel sides of a trapezium is $18m$ while the parallel sides are $32m$ and $20m$ long, respectively. Calculate, correct to the **nearest** degree, the angle which one of the non-parallel sides makes with the shorter of the parallel sides.

12.   The bearing of points X and Y from Z are 040° and 300°, respectively.
     If $|XY| = 19.5km$ and $|YZ| = 11.5$km,
     a.   illustrate the information in a diagram,
     b.   calculate, correct to the **nearest** whole number,
          i. $\angle ZXY$;   ii. $|XZ|$;   iii.   bearing of X and Y.

13.   a.   A binary operation $\otimes$ is defined on the set of real numbers, R, by $m \otimes n = mn - n - 2m$, where $m, n \in R$. If $5 \otimes x = 22$, find the value of x.

     b.   Given that $P(2, -3)$ is a vertex of a triangle PQR, $\overrightarrow{PQ} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ and $\overrightarrow{RP} = \begin{pmatrix} -4 \\ -1 \end{pmatrix}$,
          i.   find
               α.   the coordinates of Q and R;
               β. $|\overrightarrow{QR}|$.
          ii.   if M is the midpoint of $\overrightarrow{PR}$, find $\overrightarrow{MQ}$.

WASSCE NOVEMBER 2016

SECTION A

1.   a.   Solve: $\dfrac{3x + 1}{4} - \dfrac{3 + 4x}{3} \leq 1$.

     b.   i.   Given that: $\dfrac{1}{x} + \dfrac{2}{y} = \dfrac{1}{z}$, express y in terms of x and z.

          ii.   If $x = -5$ and $z = 10$, find the values of y, leaving the answer as a mixed number.

2.   A man bought 250 oranges for D1,000.00. He kept 20% of the oranges for himself, sold 115 at D6.50 each and the rest at D5.00 each. Calculate his percentage profit.

3.
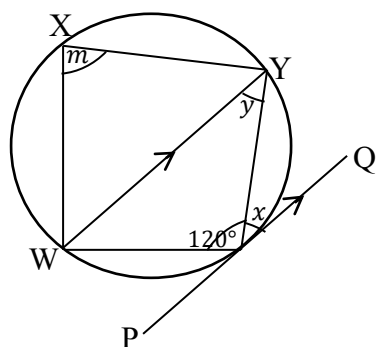
In the diagram, PQ is a tangent to the circle at Z. If PQ//WY, $\angle WZY = 120°$, $\angle WXY = x$, $\angle WYZ = y$ and $\angle YZQ = x$, find the value of :

(a)　　m;

(b)　　x.

4.　　A box contains five blue, three red and two white identical balls. If 2 balls are selected at random, one after the other with replacement, from the box, find the probability of selecting:

a.　　two blue or two red balls;　　(b)　　one red and one white ball.

5.
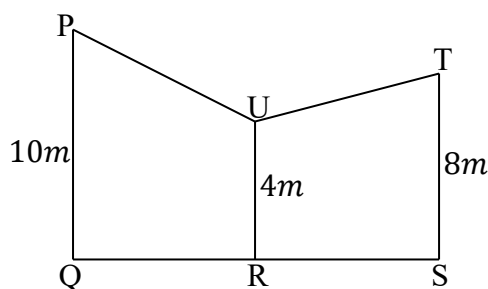
In the diagram, PQ, UR and TS are poles which are on the same horizontal ground. $|PQ| = 10m$, $|UR| = 4m$ and $|TS| = 8m$. If the angles of elevation of P and T from U are $51°$ and $20°$ respectively, find, correct to 2 decimal places,

the:　(a)　　distance between Q and S;

　　　　(b)　　angle of depression of S from U.

SECTION B

6.　　a.　　If $2^x + 2^{(x-1)} = 48$, find the value of x.

　　　b.　　A worker is given a tax-free allowance of GH¢5,000.00 and he pays 20 pesewas in the Ghana cedi as tax on the rest of his income. If his net income is GH¢21,000.00, calculate the:

　　　　　i.　　taxable;　　　ii.　　income tax.

7.　　a.　　Solve: $3 \log_{10} 2 - 2 \log_{10} 3 = 1 + \log_{10}\left(\frac{1}{x}\right)$.

　　　b.　　An engineer walked round a cylindrical petrol container $8m$ high once, keeping a constant distance of $1m$ from the container. If he walked with a speed of $3km/hr$ for 3 minutes, calculate, correct to the nearest whole number, the:

　　　　　i.　　radius of the container;

　　　　　ii.　　volume of the container.　　　　　[Take $\pi = \frac{22}{7}$]

8.　　An aeroplane flies at an average of $950km/hr$ from town P (Lat, 40°S, Long. 29.5°W) due east to town Q and then due south to town R. If the distance from Q to R along their common longitude is $4,500km$ and the whole journey took 11 hours, calculate, correct to one decimal place, the:

　　　a.　　longitude of Q;　　　b.　　latitude of R.

　　　[Take radius of the earth $= 6,400km, \pi = 3.142$]

9.　　a.　　Using ruler and a pair of compasses only, construct a:

　　　　　i.　　square ABCD of side $7cm$ and shade it;

        ii.   circle to pass through the vertices of the square.

    b.   Using the construction, calculate the perimeter of the circle.

10.   a.   Copy and complete the following table of values for the relation
$y = x^2 - 2x - 5$ for $-3 \le x \le 5$.

x	-3	-2	-1	0	1	2	3	4	5
y			-2				-2		10

    b.   Using scales of 2cm to 1 unit on the x-axis and 2cm to 2 units on the y-axis, draw the graph of the relation $y = x^2 - 2x - 5$ for $-3 \le x \le 5$.

    c.   On the same axes, draw the graph of $y = 2x - 3$.

    d.   Using the graphs, find the coordinates of the points of intersection.

11.   a.   Given that $\sin x = \frac{1}{2}$, where $0° \le x \le 90°$, evaluate $\dfrac{\sin x \cos x}{\cos x + \tan x}$.

    b.
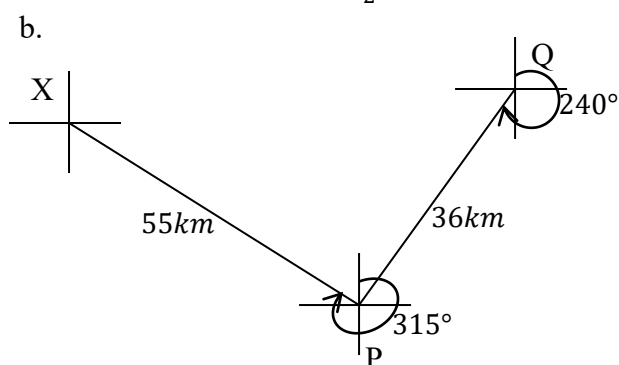
The diagram shows the position of three points P, Q and X on a horizontal plane. The bearing of P from Q is 240° and that of X from P is 315°. If $|PQ| = 36km$, and $|PX| = 55km$, calculate, correct to one decimal place,

        i. $|QX|$;

        ii.   the bearing of Q from X.

12.   a.   Using a scale of 2cm to 2 units on each axis, draw, on a sheet of graph paper, two perpendicular axes Ox and Oy for $-10 \le x \le 10$ and $-12 \le y \le 12$.

    b.   Draw on this graph, indicating the coordinates of all vertices:

        i.   quadrilateral ABCD with vertices $A(-5, -4), B(2, -1), C(0, 3)$ and $D(-8, 4)$;

        ii.   the image $A_1 B_1 C_1 D_1$ of ABCD under a translation by the vector $\begin{pmatrix} 3 \\ -8 \end{pmatrix}$ where $A \to A_1, B \to B_1, C \to C_1$ and $D \to D_1$;

        iii.   the image $A_2 B_2 C_2 D_2$ of ABCD under an enlargement from the origin with a scale factor of $-\frac{1}{2}$, where $A \to A_2, B \to B_2, C \to C_2$ and $D \to D_2$;

    c.   Find the equation of $\overline{A_1 D}$.

13.
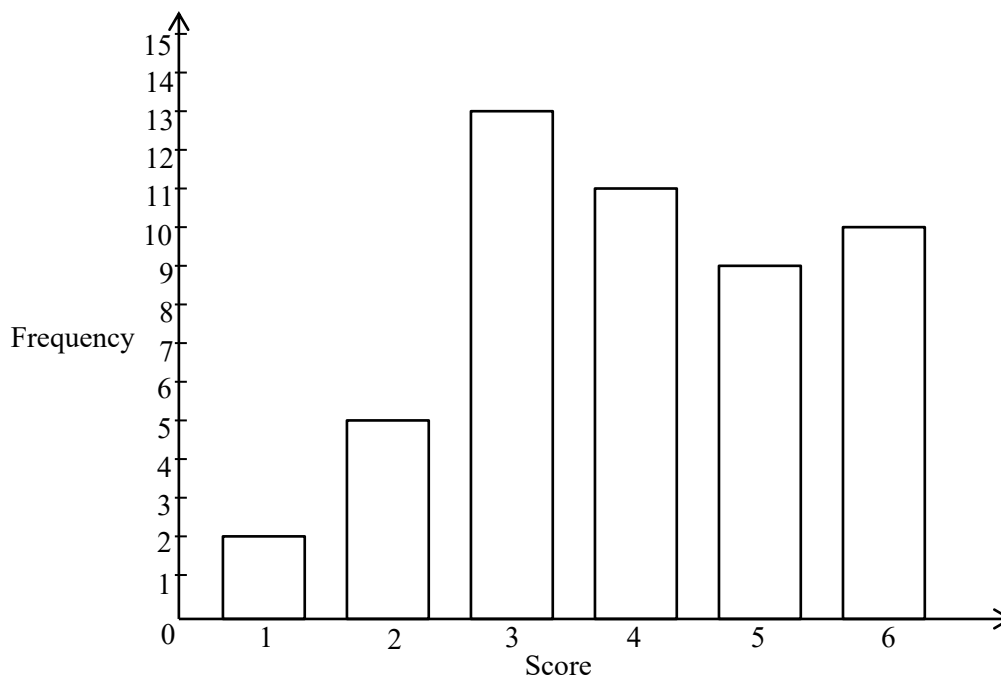
The bar chart represents the outcome when a die is rolled a number of times.
a.   Use the bar chart to construct a frequency distribution table;
b.   Use the frequency table to calculate the:
i.   mean of the distribution ;   ii.   standard deviation of the distribution.

WASSCE JUNE 2017

SECTION A

1.   (a) Given that $\log_{10} x = \bar{1}.30310$ and $\log_{10} y = 1.6021$, find $\log_{10}\sqrt{\frac{x}{y}}$.

(b) A man bought some shirts for GH¢ 720.00. If each shirt was GH¢ 2.00 cheaper, he

would have received 4 more shirts. Calculate the number of shirts bought.

2.   (a) If $\sin 30° = \frac{1}{2}$, $\cos 45° = \frac{1}{\sqrt{2}}$ and $\tan 60° = \sqrt{3}$, without using mathematical tables

or calculator, simplify: $\frac{\sin 30° + \cos 45°}{\tan 60°}$.

(b) Three interior angles of a polygon are 160° **each.** If the other interior angles are
120° each, find the number of sides of the polygon.

3.

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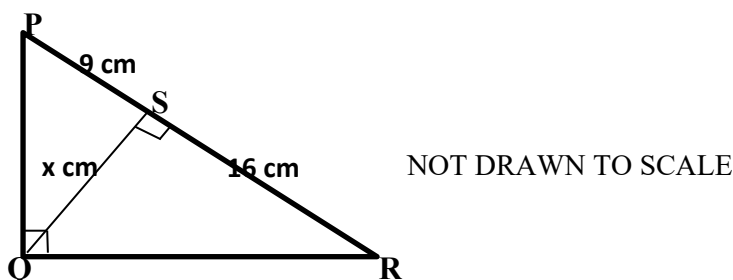
In the diagram below, $P\hat{Q}R = P\hat{S}Q = 90°$, $|PS| = 9cm$, $|SR| = 16cm$ and

$|SQ| = x \ cm.$ Find

(a) the value of x;

(b) $Q\hat{R}S$, correct to the nearest degree;

(c) $|PQ|$.

4.   (a) A trader purchased 10 dozen eggs at ₦300.00 per dozen. On getting to his shop, realized that 20 eggs were broken. How much did he sell the remaining eggs if he made a profit of 10%?

(b) Thirty-five balls were shared among four teams such that one team takes all the red balls. If the remainder is shared to the teams in the ratio 4 : 3 : 2 and the smallest share was 6 balls, how many red balls were there?

5.   (a) The probability that Mensah will pass a Mathematics and an a Economics tests are $\frac{3}{4}$ and $\frac{5}{8}$ respectively. If the probability that he passes **at least** one of the subjects is $\frac{7}{12}$, what is the probability that she offers one subject only?

(b) In a class of 30 students, 25 offer biology, 21 offer Physics and each student offers **at least** one subject. If a prefect is elected from the class, what is the probability that she offers one subject only?

SECTION B

6.   A publisher prints 30,000 copies of a book at GH¢ 2.00 **each** and sold them for GH¢ 2.76 **each**. The publisher agrees to pay the author 10% of the selling price for the first 6,000 copies sold and $12\frac{1}{2}$% of the selling price for all copies sold in excess of 6,000. If 25,380 copies were sold,

(a) calculate, correct to the nearest Ghana Cedi, the

(i) total amount received by the author;

(ii) net profit the publisher makes after he has paid the author.

(c) find, correct to **one** decimal place, the publisher's net profit as a percentage of the author's total receipt.

7.   A bag of food aid is released from an aeroplane when it **is** 1000 m above a military camp. The height, h meters, of the bag above the camp at time t seconds is given by the relation $h = 1000 - 5t^2$.

(a) Copy and complete the following table for the relation $h = 1000 - 5t^2$.

t(s)	0	1	3	5	7	9	11	13	15
h(m)				875			395		-125

(b) Using a scale of 2 cm to 2 seconds on the t-axis and 2 cm to 100 m on the h-axis, draw a graph of the relation $h = 1000 - 5t^2$ for $0 \le t \le 15$.

(c) Use your graph to find, correct to **one** decimal place, the;
    (i) time the bag takes to reach the ground;
    (ii) time the bag takes to drop though the first 650 m;
    (iii) height of the bag above the camp after falling for 7.5 seconds.

8.   (a)
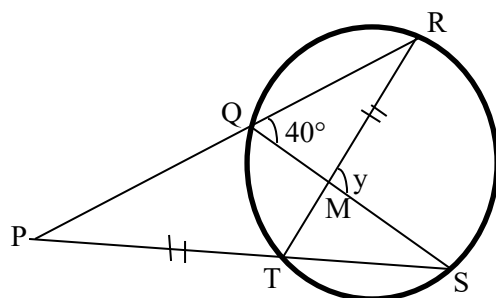
In the diagram, $\angle RQS = 40°$, $|RT| = |PT|$ and $\angle RMS = y$, find the value of y.

(b) XY is a tangent to a circle LMN at the point M. XLN is a straight line, $\angle NXM = 34°$ and $\angle NMY = 65°$.
    (i) Illustrate the information in a diagram
    (ii) Find the value of (α) $\angle MLX$ (β) $\angle LNM$.

9.   (a) If $T = WP[M^2 - (M - S^2]$, express M in terms of T, W, P and S.

(b) A point X is between two towers TP and QW and are all on the same horizontal ground. The angles of elevation of the tops T and Q from X are 62° and 48° respectively, $|TP| = 100\ m$ and $|PW| = 80m$.
    (i) Illustrate the information in a diagram
    (ii) Calculate, correct to the **nearest** metre, $|QW|$.

10.   (a) If $(x - 1)\log_{10} 4 = x\log_{10} 16$, without using Mathematical tables or calculators, find the value of x.

(b)   In the diagram, XZ is a chord which is 12 cm long. If the perpendicular distance from the midpoint of the chord to a point Y on the circumference of the circle is 4 cm, calculate, correct to **one** decimal place, the perimeter of the sector $OXYZ$.
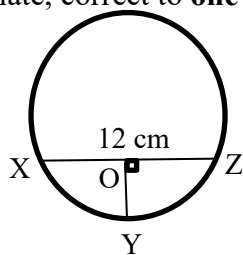
$$[\text{Take } \pi = \frac{22}{7}]$$

11.   The distribution of marks scored by some students is a test is as follows:

Marks	1	2	3	5	6

Number of students	$p + 2$	$p - 1$	$2p - 3$	$p + 4$	$3p - 4$

(a) If the mean mark is $3\frac{5}{22}$, find the value of p.

(b) Find the:

(i) interquartile range

(ii) probability of selecting a student who scored **at least** 4 marks in the test.

12. (a) The operation $\star$ is defined on the set of real numbers, **R**, by $x * y = \frac{x+y}{2}$,

$x, y \in \mathbf{R}$.

(i) Evaluate $3 \star \frac{2}{5}$

(ii) If $8 \star y = 8\frac{1}{4}$, find the value of y.

(b) In $\Delta ABC, \overrightarrow{AB} = \begin{pmatrix} -4 \\ 6 \end{pmatrix}$ and $\overrightarrow{AC} = \begin{pmatrix} 3 \\ -8 \end{pmatrix}$. If **P** is the midpoint of $\overrightarrow{AB}$, express $\overrightarrow{CP}$ as a column vector.

13. (a) Using completing the square method, solve, correct to **two** decimal places, the equation $3y^2 - 5y + 2 = 0$.

(b) Given that $\mathbf{M} = \begin{pmatrix} 1 & 2 \\ 4 & 3 \end{pmatrix}$, $\mathbf{N} = \begin{pmatrix} m & x \\ n & y \end{pmatrix}$ and $\mathbf{MN} = \begin{pmatrix} 2 & 1 \\ 3 & 4 \end{pmatrix}$, find the matrix **N.**

WASSCE NOVEMBER 2017

SECTION A

1. (a) Simplify: $\frac{2 + \sqrt{3}}{\sqrt{3}} - \frac{\sqrt{2} - 2}{\sqrt{2}}$.

(b) Mr. Kofi sold a machine and made a profit of 15%. The buyer later sold it to Mr. Nana at a loss of 10%. If Mr. Nana paid GH¢ 20,700.00 for the machine, how much did Mr. Kofi buy it?

2. (a) In the diagram, $|QR| = 2\ cm$, $\angle PQR = 90°$, $\angle RSP = 30°$ and $\angle QPR = 45°$.

Find: (i) $|PR|$

(ii) $|RS|$ in surd form (radicals)

(b)   Find the size of the angle marked x in the diagram.

3.   The distribution of the ages of 40 students in a class is as follows:

Age (years)	14	15	16	17	18	19	20	21	22
Number of students	1	3	4	6	10	6	5	3	2

Find the:
(a) mean age   (b) inter-quartile range

4.   The diagram shows a sector of a circle centre P and radius 14 cm. If QS is a chord and $\angle QPR = 60°$, calculate, correct to **one** decimal place, the area of the shaded region.
[Take $\pi = \frac{22}{7}$]

5.   (a) Solve $\frac{x}{3} - \frac{1}{4}(x + 2) > 3x - 2\frac{1}{5}$.
      (b) In the diagram, $PS//QR$, $\angle PSR = 79°$, $\angle SPR = 54°$ and TQ is a tangent to the
          circle at P. Calculate: (i) $\angle TPS$ (ii) $\angle PQR$

SECTION B

6.   (a) A trader sold an article at a discount of 8% for GH¢ 828.00. If the article was
          Initially marked to gain 25%, find the:

(i) cost price of the article   (ii) discount allowed.

(b) X varies directly as the cube of varies directly as the cube of Y and inversely as the square root of Z. If $X = 108$ when $Y = 3$ and $Z = 4$, find Z when $X = 4000$ and $Y = 10$.

7.   A ship sailed 5120 km from port X to port Y on a bearing of 345°. It then sailed 448 km on a bearing of 075° to port Z. Calculate, correct to the **nearest** whole number, the:

(a) distance from Z to X (b) bearing of Z from X

(c) time it took to sail from X to Z through Y at a constant speed of 120 km/h.

8.   (a)(i) Make q the subject of the relation: $r = \frac{f}{2} + \left(\frac{f^2}{4} + q^2\right)^{\frac{1}{2}}$.

(ii) Find, correct to **3** significant figures, the positive value of q when $f = 4$ and $r = 5$.

(b) A student plans to spend ₦ 200.00 on p notebooks. But the price of the notebooks had increased by ₦ 10.00. As a result, the number of notebooks the student could buy was reduced by 1. Find the price of **each** notebook before the increase.

9.   The boundaries of a farmland are marked by trees which are located at points P, Q and R such that $|QR| = 850\ m$, $\angle PQR = 60°$ and $\angle PRQ = 45°$. A poultry is to be located at a point S within the farmland such that S is 400 m from P and equidistant from Q and R.

(a) Using ruler and a pair of compasses only and a scale of 1 cm to 100 m:

   (i) construct the boundaries of the farmland

   (ii) locate the point S.

(b) Measure: (i) $|PR|$ (ii) $|SR|$

10.   Three bags labelled **P**, **Q** and **R** contains red, blue and white balls respectively of equal sizes. The ratio of the balls in the bags are **P** : **Q** $= 2 : 3$ and **Q** : **R** $= 4 : 5$. All the balls are removed into a big bag and properly mixed together.

 (a) Find the probability of picking a red ball.

 (b) If **two** balls are picked at random one after the other **with replacement**, find the probability of picking:

   (i) a white and a blue ball   (ii) a blue ball **first** and then a red ball

11.   (a)   The diagram shows a flower pot in the shape of a frustum of a cone. The diameters of the top and bottom ends are 64 cm and 48 cm respectively. If the slant height is 15 cm, calculate the curved surface area of the pot.

[Take $\pi = \frac{22}{7}$]
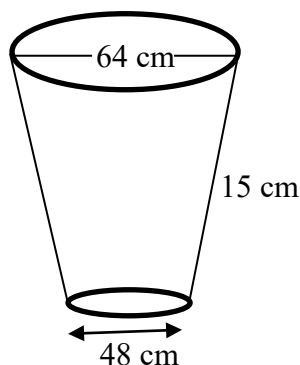
(b) From town **M** on latitude 60°S, a ship sails 440 km due West along the parallel of latitude to town **N**. Find, correct to the **nearest** degree, the angle subtended by arc **MN** at the centre of the parallel of latitude.   [Take $\pi = \frac{22}{7}$ and R = 6400 km]

12. (a) Using a scale of 2 cm to 2 units on both axes, draw on a sheet of paper, two perpendicular axes $0x$ and $0y$ for $-10 \le x \le 10$ and $-12 \le y \le 12$.

(b) Given the point A(2, 3) and the vectors $\overrightarrow{AB} = \left(\begin{smallmatrix} 1 \\ 2 \end{smallmatrix} \right)$ and $\overrightarrow{BC} = \left(\begin{smallmatrix} -4 \\ 1 \end{smallmatrix} \right)$, draw on the same graph sheet, indicating clearly all vertices and their coordinates:
(i) triangle ABC
(ii) the image $\Delta A_1 B_1 C_1$ of ΔABC under a reflection in the line $x - 4 = 0$ where $A \to A_1, B \to B_1$ and $C \to C_1$.

(c) Using the graph, calculate $\left| \overrightarrow{A_1 C_1} \right|$, leaving the answer in the form $p\sqrt{q}$ where p and q are positive integers.

13. (a) For what values of x would the matrix $\left(\begin{smallmatrix} x-10 & -6 \\ 4 & x+1 \end{smallmatrix} \right)$ has **no** inverse?
(b) (i) Using a scale of 2 cm to 1 unit on both axes, draw the graph of $y - 3 = 0, y = 6 - x$ and $x = 5$.
(ii) Shade the region which satisfies the inequalities:
$y - 3 \le 0; y \ge 6 - x$ and $x \le 5$.

ANSWERS

O/L MATHS June 1982

1. a. i. $D(12) = \{1, 2, 3, 4, 6, 12\}$

    $D(15) = \{1, 3, 5, 15\}$

    $D(12) \cup D(15) = \{1, 2, 3, 4, 5, 6, 12, 15\}$

    ii. $60 = \{L.C.M \text{ of } 12 \text{ and } 15\}$

    b. Let U={Students in fifth form}

    S={Science students} and

    F={French students}
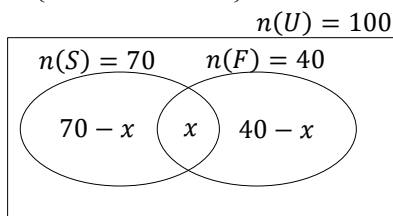
    Solving the equation

    $70 - x + x + 40 - x = 100$

    $x = 10$

    So 10% of the students study both Science and French.

2. a. i. $4\underline{p} - 2\underline{q} = \begin{pmatrix} 20 \\ -2 \end{pmatrix}$

    ii. Since $\begin{pmatrix} 20 \\ -2 \end{pmatrix} = -2 \begin{pmatrix} -10 \\ 1 \end{pmatrix}$ the vector

    $\begin{pmatrix} 20 \\ -2 \end{pmatrix}$ is parallel to the vector $\begin{pmatrix} -10 \\ 1 \end{pmatrix}$ but

    in the opposite direction.

    Also the length of $\begin{pmatrix} 20 \\ -2 \end{pmatrix}$ is twice that of

    $\begin{pmatrix} -10 \\ 1 \end{pmatrix}$

    b. 4×10^{12} $\therefore b = 4, n = 12$

3. a. i. 3   ii. $\frac{\sqrt{5}}{5} = 0.44721$

    b. i. $\{x: -3.5 \le x \le 4\}$

    ii.
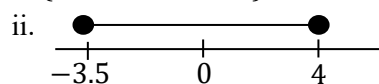
4. i.
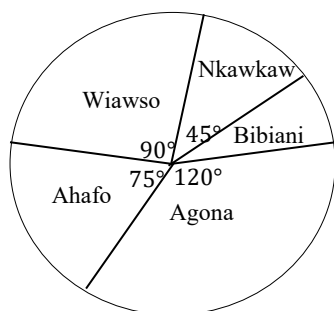
    ii. 12.5%

5. i.
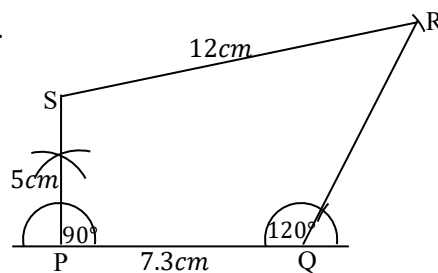
    ii. $|QR| = 8.5cm$

6.

7. a. $y = 6 + 2x - x^2$

x	-3	-2	-1	0	1
y	-9	-2	3	6	7

2	3	4	5
6	3	-2	-9

    b.

x	-3	-2	-1	0	1
y	-1	0	1	2	3

2	3	4	5
4	5	6	7

    i.
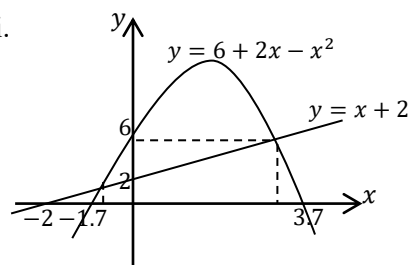
    ii. $\{(-1.6, 0.4)\}, \{(2.6, 4.6)\}$

8. a. One of the angles is 90°

    b. i. $320km$ ii. $263.6°$

9. i. $x = 3$ or $4x - 12 = 0$ or $x - 3 = 0$

    ii. $A(3, 1) \rightarrow A_1(3, -1)$

    $B(1, 1) \rightarrow B_1(1, -1)$

    $C(3, 5) \rightarrow C_1(3, -5)$

    iii. $A(3, 1) \rightarrow A_2(6, -1)$

    $B(1, 1) \rightarrow B_2(2, -1)$

    $C(3, 5) \rightarrow C_1(6, -5)$

10. i. $3.6cm$

O/L MATHS November 1982

1. b. 73.4%

2. a. i.

$\otimes$	2	3	7	8
2	4	6	5	7
3	6	0	3	6
7	5	3	4	2
8	7	6	2	1

   ii. $\{m: m = 7\}$ b. $x = 5$

3. a. i. $\overrightarrow{AB} = \begin{pmatrix} -5 \\ 6 \end{pmatrix}$ ii. $|\overrightarrow{AB}| = \sqrt{61}$ units

  b. $x = \frac{3}{4}$ c. 6×10^{-4}

4. $R_2 = \frac{RR_1}{R_1 - R}$; $\frac{50}{9} < R_2 < \frac{25}{2}$

5. c. $28 km/h$

6. i. ¢23.10   ii. 500 units   iii. 17.32%

7. a.

x	-2	-1	0	0.5	1
y	51	13	-9	-14	-15

1.5	2	3	4
-12	-5	21	63

  c. i. y starts increasing when $x > 1$
    ii. $\{x: x = -0.4, 1.4\}$

8.
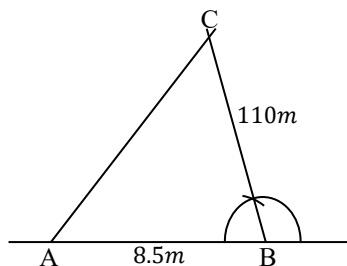
9. a. 5200km   b. 28°S   c. 120°E

10. a. $\sqrt{2}$ b. $x = -1$ or 6

   c. i. $R = \frac{Wr}{W - 2EP}$ ii. 13.3

11. b. $\frac{7}{30}$ c. 63.3

O/L MATHS June 1983

1. Let U={Children} B={Beans Eaters}
  R={Rice Eaters}   P={Plantain Eaters}
  Then $n(U) = 50, n(B) = 21, n(P) = 24$
  $n(R) = 18, n(B \cap P' \cap R') = 3,$
  $n(R \cap B' \cap P') = 2, n(P \cap B' \cap R') = 9,$
  $n(B \cap P \cap R) = 5$
  The Venn diagram is shown below
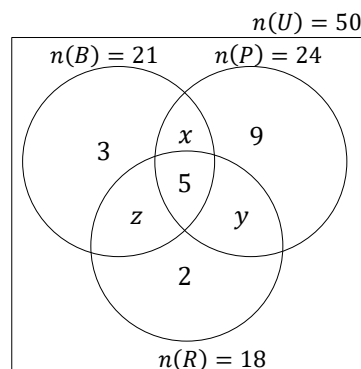
  Hint: Using the above information
    $x + z = 13$………..(1)
    $x + y = 10$ ………(2)
    $z + y = 11$ ………(3)
  Solving equations (1), (2) and (3)
  simultaneously, gives
  $x = 6, y = 4, z = 7$
  ii. a. 6   b. 12   c. 14

2.

$\otimes$	2	3	5	7
2	4	6	3	0
3	6	2	1	0
5	3	1	4	0
6	5	4	2	0

  i. $\{n: n = 3\}$ ii. $\{n: n = 2, 5\}$

3. a. i. $S = 2\pi r^2 + 2\pi rh$ ii. $h = \frac{S - 2\pi r^2}{2\pi r}$

   iii. $\frac{1}{2}(Sr - 2\pi r^5)$ b. $\left\{x: x = \frac{-5}{3}, \frac{11}{2}\right\}$

4. a.
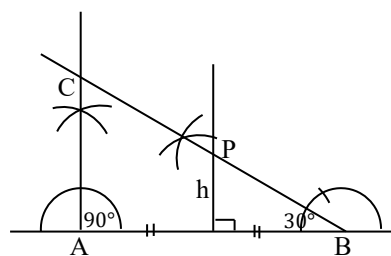
  b. Hint: Area $= \frac{1}{2} \times |AB| \times 2h$

5. i. 5.36   ii. $\frac{11}{15}$

7. i.

x	-3	-2	-1	0	0.2
y	0.2	0.6	2	5	5

0.5	1	2	3
4.4	3	1.4	0.8

  iii. 5.1   v. $\{x: x = 1.8\}$

8. d. Reflection in the x-axis followed by

translation by the vector $\begin{pmatrix} 0 \\ 4 \end{pmatrix}$

9.
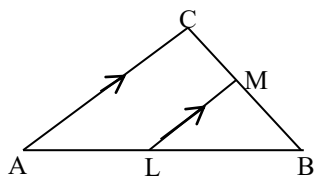
Hint: $\overrightarrow{OL} = \overrightarrow{OA} + \overrightarrow{AL}$ and $\overrightarrow{AL} = \frac{1}{2}\overrightarrow{AB}$

i. $L(1, 2)$ ii. $M(5.5, 0)$

iii. $\overrightarrow{LM} = \begin{pmatrix} 4.5 \\ -2 \end{pmatrix}$ $\overrightarrow{AC} = \begin{pmatrix} 9 \\ -4 \end{pmatrix}$

$\overrightarrow{AC}$ is parallel to $\overrightarrow{LM}$ in the same direction and the length of $\overrightarrow{AC}$ is twice that of $\overrightarrow{LM}$

11. 8.8hrs   ii. 4800km

O/L MATHS November 1983

1. a. $P = \{17, 19, 23, 29, 31, 37, 41, \ldots\}$
   $Q = \{11, 13, 17, 19, 23, 29\}$;
   $P \cap Q = \{17, 19, 23, 29\}$

2. a. 1221141_5 b. 15.3%

3. a. i. $x = \frac{-3}{4}$ ii. 14   b. $30m/s$

4. i. -7.5
   ii. $\frac{-30}{(2-x)(2+x)}$
   The expression is not defined when
   $x \neq -2, 2$
   iii. $\{x: x = -3, 3\}$

5. a. 9 sides
   Hint: Use the formula $180(n - 2) = 1260$
   b.

Grade	Sector angle
A	42°
B	90°
C	156°
D	72°
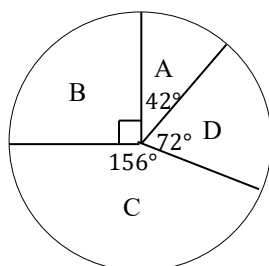
6.
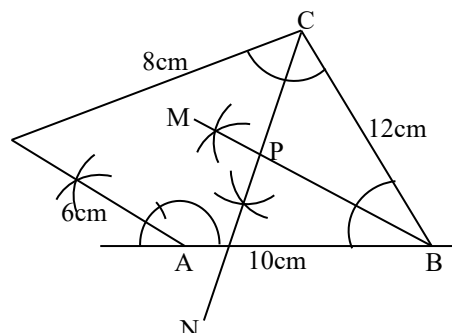
BM is the angle bisector of angle ABC. CN is the angle bisector of angle BCD.
P is the point of intersection BM and CN.
iii. $|DC| = 8cm, |CB| = 12cm,$
$|BD| = 15.5cm$

7. i. Table for the relation $y = 4x^2 - 8x - 21$

x	-2	-1.5	-1.0	0.0	0.5	1
y	11	0	-9	-21	-24	-25

1.5	2.0	2.5	3.0	3.5	4.0
-24	-21	-16	-9	0	11

ii.
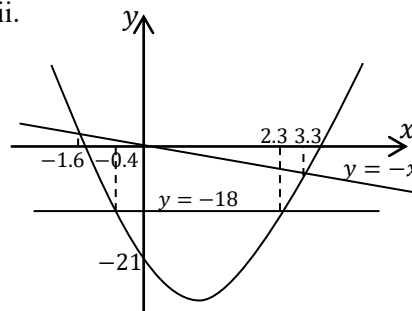
iii. Hint:
a. $4x^2 - 8x = 3$ is equivalent to
$4x^2 - 8x - 21 = -18$
Draw the graph of $y = -18$
Truth set $= \{x: x = -0.4, 2.3\}$
b. $4x^2 - 7x - 21 = 0 \Leftrightarrow$
$4x^2 - 8x - 21 = -x$
Draw the graph of $y = -x$
Truth set $= \{x: x = -1.6, 3.3\}$

8. iii. $3y = 2x - 7$

9. i. Initial velocity is $20km/h$
   ii. a. $38.4km/h$ b. $106.67km/h$

10. ii. 57   iii. 0.9

11. Let AN and BM be the vertical electric Poles A and B respectively. Let CQ be the distance of C from the road.
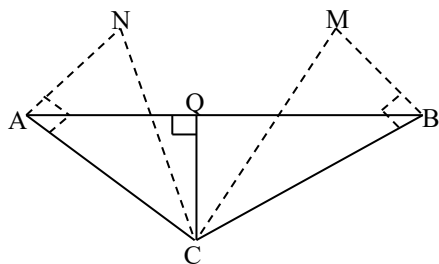
a. $|AC| = 69.1m$ $|BC| = 61.2m$

b. $44.6°$ c. $|XY| = 97.7m$

O/L MATHS June 1984

1. a. i. $2 \le x \le 6$ ii. $2 \le x \le 6$

The property is that $\cap$ is distributive over $\cup$

b. i. $\binom{2}{8}$ ii. $\binom{2}{8}$

The property is that '+' of vectors is associative.

2. a. i. $-\frac{8}{3} + \frac{2}{3}\sqrt{3}$ ii. $3 - \frac{1}{2}\sqrt{2} = 2.2929$

b. i. $\{-2.5 < x < 0.25\}$

ii.
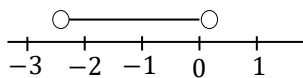
3. $(x, y) = (5, 3)$

4. i.

$\otimes$	0	1	2	3	4
0	0	0	0	0	0
1	0	1	2	3	4
2	0	2	4	1	2
3	0	2	1	4	2
4	0	4	1	2	1

$\oplus$	0	1	2	3	4
0	0	1	2	3	4
1	1	2	3	4	0
2	2	3	4	0	1
3	3	4	0	1	2
4	4	0	1	2	3

ii. a. $\{x: x = 0, 3\}$ b. $\{x: x = 2\}$

5. i. $6h(12 - \pi R^2)$ ii. 1.16

6.

7. i. Table for the relation $y = x^2 - 5x$

x	-2.5	-2.0	-1.5	-1.0	-0.5
y	-3.1	2.0	4.1	4.0	2.4

0.0	0.5	1.0	1.5	2.0	2.5
0.0	-2.4	-4.0	-4.1	-2	3.1
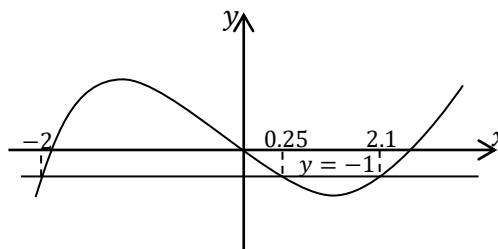
ii. a. Least of value of y is -4.3

b. $\{x: x = -2, 0.25, 2.1\}$

8.
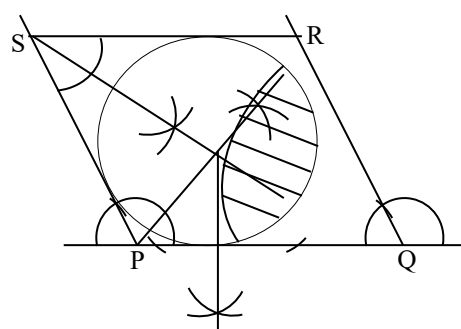
9. i. 22   ii. $\frac{1}{9}$

11. i. 7.36cm   ii. 9.75   iii. $216.7 cm^2$

O/L MATHS November 1984

1. i. $P \cap Q = \{x: x \text{ is a multiple of } 6\}$

ii.
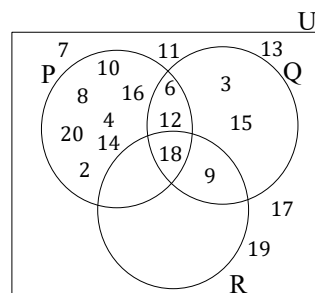
iii. a. $P \cap Q \cap R' = \{6, 12\}$

b. $P' \cap Q \cap R' = \{3, 15\}$

iv. $\frac{7}{20}$

2. a. $i = 1, k = -2$ b. $\{x: 11.5 \le x \le 14\}$

4.

$\otimes$	0	1	2	3	4	5	6
0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6
2	0	2	4	6	1	3	5
3	0	3	6	2	5	1	4
4	0	4	1	5	2	6	3
5	0	5	3	1	6	4	2
6	0	6	5	4	3	2	1

a. $\otimes$ is commutative because multiplication is commutative.

b. 1   c. $\{n: n = 6\}$

5. i. $43.56cm^2$ ii. 3.96%

7.

x	-1	0	0.5	1	1.5
y	4	0	-0.83	-1.2	-1.25

2	2.5	3	4	5
-1	-0.58	0	1.5	3.33
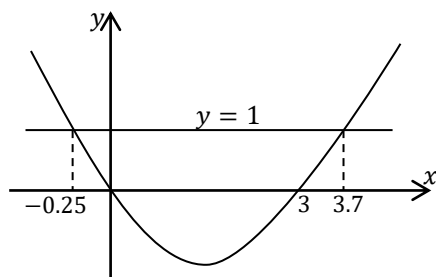
ii. 1.2 iii. $\{x: x = -0.25, 3.7\}$

8. i. a. The locus P are the two semi-circular arcs with QR as a common chord.
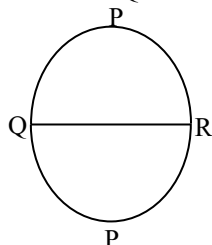
b. The lines AB and CD are parallel to QR and each is at a distance of h from it. For triangle QPR to have a constant Area. The possible positions of P are A, B, C and D.
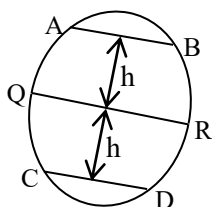
9. ii. 42 iii. $\frac{71}{120}$

10. a. i. $B(-1, 5)$, $C(0, 8)$, $D(3, 7)$

ii. T is the reflection in the x-axis.

11. a. i. $RT = 0.980km$ ii. $RQ = 2.42km$

iii. $PQ = 2.80km$

iv. Angle of elevation $= 68°$

O/L MATHS June 1985

1. $U =$ {Universal set}

Let $G =$ {General Science students}

$C =$ {Commerce students}

$A =$ {Accountant students}

a.
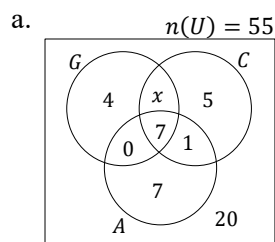
b. i. 11   ii. 11

2.

$\oplus$	1	3	5	7
1	2	4	6	8
3	4	6	8	1
5	6	8	1	3
7	8	1	3	5

$\otimes$	1	3	5	7
1	1	3	5	7
3	3	0	6	3
5	5	6	7	8
7	7	3	8	4

c. 1   ii. $\{n: n = 1, 7\}$

3. a. $1 + \frac{1}{2}\sqrt{7}$ b. 0.00932

4. Length of EG $= 13cm$

5. a. 113031 b. i. 12.2 ii. $351°$

7. Table for the relation $(x - 1)(y - 1) = 6$

x	2	2.5	3	4	5	6	7
y	7	5	4	3	2.5	2.2	2
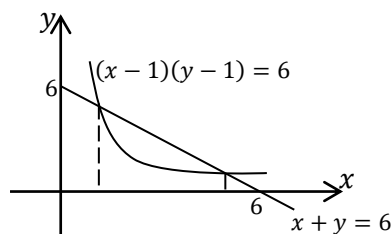
8. a. 80km from A

b. Brakatue at 12:34 pm. Ojo at 12 pm.

9. b. median is 42   c. Pass mark is 34

10. c. The two coincident points are $P(-1, 2)$ and $R_3(-1, 2)$

d. Reflection in the line $y = x$

11. a. $\alpha = 67.0°$ b. $\beta = 71.0°$

c. $248cm^3$

O/L MATHS November 1985

1. No. of cars which failed= 48

Let U={cars}

B={cars with faulty brakes}

S={cars with faulty steering}

L={cars with faulty light}

Then $n(U) = 48, n(B \cap S) = 7$

$n(B \cap S \cap L) = 4$

a. 22   b. 32

2. a. 0.9   b. $x = 8$

3. a. $\binom{13}{8}$ b. 3.0×10^{-2} c. $p = \frac{1}{3}$

5.

Commodity	Sector angle
Food	144°
Rent	65°
Car maintenance	90°
Savings	43°
Taxes	18°

b. Le 744.00

7. a

x	−2	−1.5	−1	−0.5	0
y	−4	−1.75	0	1.25	2

1	1.5	2	2.5	3
2	1.25	0	−1.75	−4

c. The greatest value of y is 2.3 and it occurs

   at $x = 0.5$

d. $\{x: x - 0.4, 2.4\}$

8. b. i. 8.26cm   ii. 11.2km   iii. 2km

10. c. Equation of PQ is $y = -x + 2$

11. a. 3520km   b. 10900km   c. 18.1hr

O/L MATHS June 1986

1. b. $P = \{1, 2, 3, 4, 6, 9, 12, 18, 36\}$;

   $Q = \{7, 8, 9, 10, \dots\}$

   $P \cap Q \cap R = \{9\}$

2. a. $x = 3, y = 4,$ $\sqrt{x^2 + y^2} = 5$

b. i. $\overrightarrow{QR} = \binom{1}{-2}$

   ii. $\overrightarrow{ZM} = -3\overrightarrow{QR}$

   $\overrightarrow{ZM}$ is parallel to $\overrightarrow{QR}$ in the opposite

   direction and three times as long.

3. a.

Item	Expenses
Food	180°
Housing	48°
Clothing	48°
Tobacco and drinks	68°
Entertainment and books	16°

b. 50%

4. a. $x < 27$

b.

$\otimes$	1	5	8	12
1	1	5	8	12
5	5	12	1	8
8	8	1	12	5
12	12	8	5	1

i. $\{n: n = 8\}$ ii. $\{n: n = 5, 8\}$

5. i. $\binom{3.5}{-0.5}$ ii. $\overrightarrow{QR} = 5$ units

7. c. $y = -x + 5$

8. a.

x	−2.0	−1.5	−1.0	−0.5	0	0.5
y	17	13.75	11.00	8.75	7	5.00

1.0	2.0	3.0	4.0	4.5	5.0
5.00	5.00	7.00	11.00	13.75	17.00
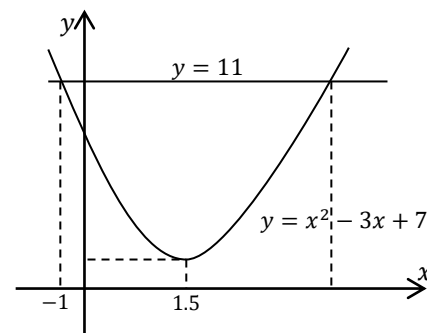
c. i. $\{x: x = -1, 4\}$ ii. $(1.5, 4.7)$

   iii. $x = 1.5$

9. a. $\left\{x: x = 17, \frac{-17}{3}\right\}$ b. 18.8cm

10. a.

Marks less than	Cumulative Frequency	
	School A	School B
10.5	2	0
20.5	6	2
30.5	13	8
40.5	27	18
50.5	52	33
60.5	72	61
70.5	83	83

80.5	88	92
90.5	90	95

c. For School A : 14.4%

For School B: 18.18%

O/L MATHS November 1986

1. a. i.

*	1	3	5	6
1	3	5	0	1
3	5	4	3	6
5	0	3	6	4
6	1	6	4	3

ii. α. $\{n:n=5\}$ β. $\{m:m=3\}$

2. a. $3x=2y-6$ b. 11100_3

3. a. $\begin{pmatrix} -3 \\ 0 \end{pmatrix}$ b. $\{x:x<-12\}$

4. a.

Ingredients	Sector angle
Flour	36°
Margarine	144°
Sugar	27°
Eggs	90°
Baking powder	18°
Miscellaneous	45°

b. 7.5%

5. a.
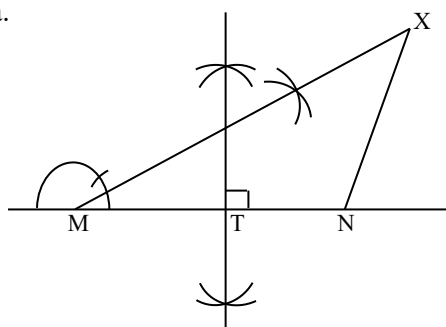
b. $|TX| =$

6. a. 25   b. ¢8500

7. Table for the relation $y = \dfrac{3x^2 - 8x}{3x + 8}$

x	−2	−1	0	1	2	3
y	14	2.2	0	−0.45	−0.29	0.18

d. $(0,0); (2.1, -0.3)$

8. a. $\dfrac{39}{7}\sqrt{7}$ b. $h = \sqrt{a^2 - r^2}$

c. i. $x = -1$ ii. $x = 12$ or 5

9. a. Median $= 48$ d. $\dfrac{26}{45}$

10. d. $\dfrac{2}{5}$

e. Reflection in the line $y = -x$ followed

by rotation 180° about the origin.

11. a. 4760km   b. 5313.3km   c. 13.3hrs

O/L MATHS June 1987

1. a. i. $\dfrac{14}{3}$ ii. $\dfrac{-4}{3}$ iii. $\dfrac{-7}{2}$ b. 1

2. a. $r = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$

b. Let the number of oranges be x, then the number of mangoes is $2x$.

i. $6 \le 2.5x + 4x \le 78 \Leftrightarrow \dfrac{12}{13} \le x \le 12$

ii.
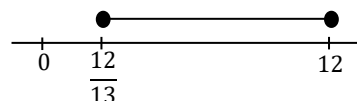
3. a. i.

∩	X	Y	Z	S
X	X	Y	Z	S
Y	Y	Y	S	S
Z	Z	S	Z	S
S	S	S	S	S

ii. $X \cap Y \cap Z = S$

4. a. $\dfrac{13}{2}$ b. i. $R = \sqrt{\dfrac{n}{p-k}}$ ii. 0.71

5.
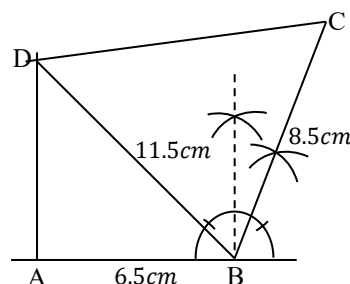
8. a. i. Table for the relation $y = 1 + 6x - x^2$

x	0	1	2	3	4	5	6
y	1	6	9	10	9	6	1

ii. Table for the relation $y = 11 - x$

x	0	1	2	3	4	5	6
y	11	10	9	8	7	6	5
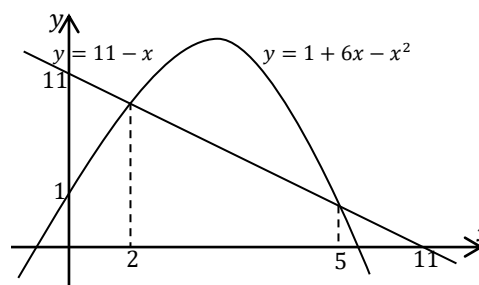
b. i. The greatest value of $1 + 6x - x^2$ is 10

ii. $\{(2,9), (5,6)\}$

9. a. $C = 3 + \dfrac{300}{n}$ i. ₦3.60   ii. 50

   b. $(p, q) = (3, 2)$

10. b. 6.275   c. $\dfrac{1}{6}$

O/L MATHS June 1988

1. Let U ={Sixth form teachers}

   M ={Maths teachers}

   P ={Physics teachers}

   C ={Chemistry teachers}

   Then $n(U) = 12, n(M) = 6, n(P) = 5$

   $n(C) = 4, n(M \cap P) = 2, n(M \cap C) = 0$

   Also let $n(P \cap C) = x$

   The Venn diagram for the information given

   is shown below.

   a.

$n(U) = 12$, $n(M) = 6$, $n(P) = 5$, $n(C) = 4$; regions: 4, 2, $3 - x$, x, $4 - x$
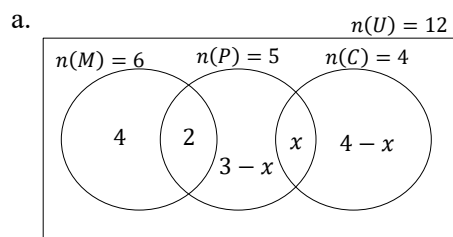
   b. From the Venn diagram, $x = 1$

      i. 1   ii. 2

2. a.

*	1	2	3	4
1	3	4	0	1
2	4	1	3	0
3	0	3	1	4
4	1	0	4	3

   b. i. 1   ii. $\{n : n = 2, 4\}$

3. a. i. $\overrightarrow{OC} = \begin{pmatrix} 6 \\ 8 \end{pmatrix}$

      ii. The $\overrightarrow{OC}$ is drawn below
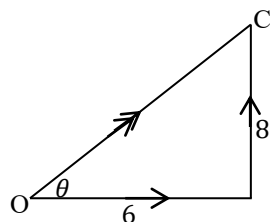
4. a. 58_{10} b. -7

5.
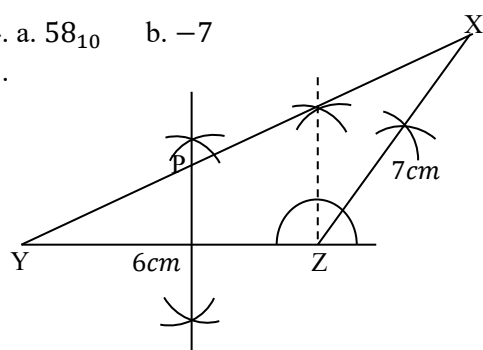
7. a. Table for the relation $y = x^2 - 4x - 21$

x	-4	-3	-2	-1	0	1
y	11	0	-9	-16	-21	-21

2	3	4	5	6	7	8
-25	-24	-21	-16	-9	0	11

   b.
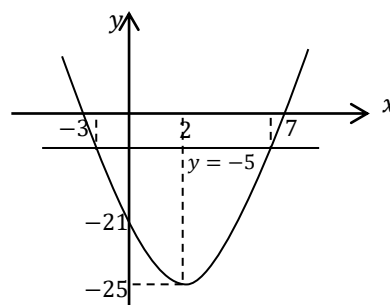
   c. i. -25 ii. $x = 2$

      iii. $\{x : x = -2.6, 6.4\}$

         Hint: $x^2 - 4x - 16 = 0 \Longleftrightarrow$

         $x^2 - 4x - 21 = -5$

8.
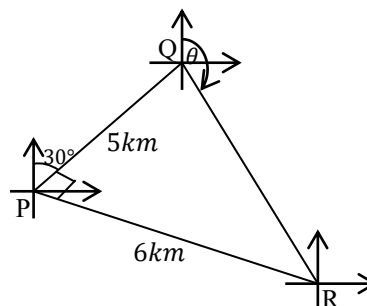
   a. $|QR| = 7.81 km$ b. $\angle PQR = 50.2°$

   b. $\theta = 160°$

11. a. The longitude of T is 7.8°W

    b. 560km/h

    Hint: Let r = radius of latitude 15°N,

    then r = Rcos 15°

    Use the formula

    Arc length TQ $= \dfrac{\theta}{360°} \times 2\pi r = 3000$ and

    solve for θ

O/L MATHS November 1988

1. a. H ={Histor} G = {Geography}

   $n(H) = 300, n(G) = 360$

   Let $n(H \cap G) = x$

$n(U) = 500$, $n(H) = 300$, $n(G) = 360$; regions: $300 - x$, x, $360 - x$
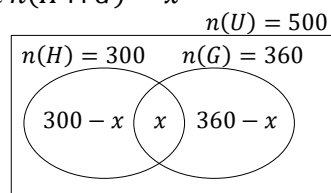
The Venn diagram is as shown. 160 students took both subjects.

2. a.

⊕	1	5	7	11
1	2	6	8	0
5	6	10	0	4
7	8	0	2	6
11	0	4	6	10

⊗	1	5	7	11
1	1	5	7	11
5	5	1	11	7
7	7	11	1	5
11	11	7	5	1

b. i. $7 \oplus 5 = 0$ ii. $\{n : n = 1, 5, 7, 11\}$

3. a. i. $\underline{r} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ ii. $|\underline{r}| = \sqrt{5}$ units   b. $\frac{9}{2}$

4. a. 6.9   b. $\left\{ x : x \geq \frac{13}{2} \right\}$

5. b. ₦80,000.00

7. a. The table for the relation

$$y = \frac{1}{2}(2x - 1)(x + 1)$$

x	−3.5	−3	−2	−1	−0.5	0	1	2
y	6	3.5	0	−1.5	−1.5	−1	1.5	6
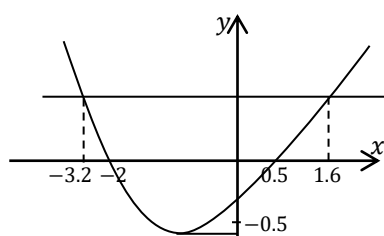
c. i. $-2 < x < 0.5$ ii. -0.75
   iii. $\{x : x = -3.2, 1.6\}$

8. a.
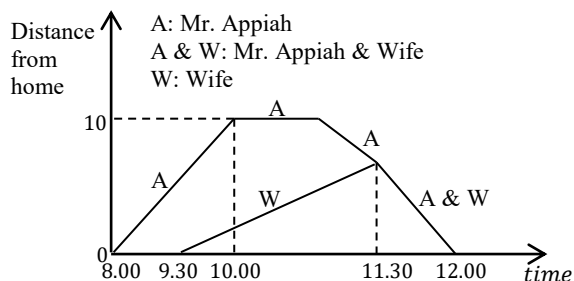
b. i. 10:00am
   ii. 11:30am, 6km from the house
   iii. 12km/hr

9. c. i. 76.5   ii. $\frac{9}{20}$

10. c. Translation by the vector $\begin{pmatrix} -6 \\ -2 \end{pmatrix}$ followed by reflection in the line $y = -x$

11. a. 37.6   b. 22.6   c. 42.6°

O/L MATHS June 1989

1. b. P = {1, 2, 3, 6, 7, 14, 21, 42}
   Q = {1, 2, 3, 6, 9, 18, 27, 54}
   i. $P \cap Q = \{1, 2, 3, 6\}$ ii. 6

2. a. 1   b. i. $\{k : k = 2\}$ ii. $\{k : k = 32\}$

3. a. $x = \frac{4.8x}{y}$ is the formula connecting x, y and z. $y = 10$
   b. {3, 4}

4. a. $(k, m) = (6, 1)$ b. $7\sqrt{5}$

5. a.

Commodity	Sector angle
Food	108°
Clothing	18°
Fuel and light	90°
House rent	27°
Miscellaneous	63°
Savings	54°

b. 25%

7. Table for the relation $y = 4 + \frac{1}{2}x - \frac{1}{3}x^2$

x	−3	−2	−1	0	1
y	−0.5	1.7	3.2	4	4.2

2	3	4
3.7	2.5	0.7

c. i. $k = 3.4$ ii. $x = 0.7$
   iii. $\{x : x = -1.8, 3.3\}$

8.
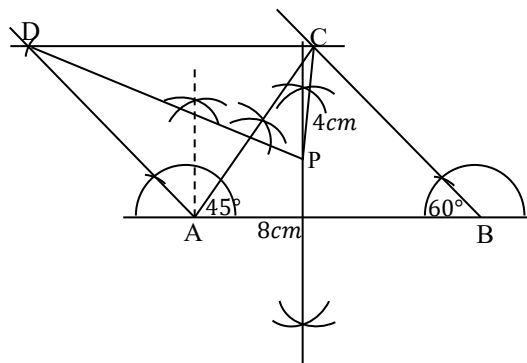
$|PD| = 7.9cm$

9. c. 90° anticlockwise about the origin

10. a. ii.

Marks less than	Cumulative frequency
20.5	5
30.5	11
40.5	18
50.5	22

60.5	27
70.5	31
80.5	36
90.5	38
100.5	40

b. i. 44.5   ii. 29

11. a. $410cm^2$ ii. 10.4cm   iii. $952cm^2$

b. ₦10.26

O/L MATHS June 1990

1.

⊕	0	1	2	3	4
0	0	1	2	3	4
1	1	2	3	4	0
2	2	3	4	0	1
3	3	4	0	1	2
4	4	0	1	2	3

i. 3   ii. $\{n: n = 4\}$

2. a. $\{x: x = 7\}$

3. Let A = {Arts students}

B = {Biology students}

C = {Chemistry students}

$n(U) = 35$

$n(A) = 24$ $n(C) = 20$

11

6

6

3

4

5

10

$n(B) = 22$

27 students study one subject only.

4. a. $\frac{27}{8d^6}$ b. $\left\{x: x < \frac{-17}{11}\right\}$

5. a. $d = \sqrt{\frac{kl}{R}}$ b. 0.29

7. a. Table for the relation $y = x^2 - 3x - 4$

x	-1.5	-1	0	1	2
y	2.8	0.0	-4	-6	-6

3	4	4.5
-4	0	2.8

c. i. $\{x: x = -1, 4\}$ ii. $\{x: x = -1.2, 4.2\}$

iii. -6.3

8. a.

Marks less than	Cumulative Frequency
9.5	2
19.5	9

29.5	17
39.5	30
49.5	54
59.5	84
69.5	90
79.5	95
89.5	98
99.5	100

b. i. 48   ii. 36   iii. 44.5

9. a. $\frac{1}{5}\sqrt{5} + \frac{1}{2}\sqrt{2}$

b.

i. $|PR| = 14cm$ ii. $9.7cm$

11. a. A = $\{-5, -3, -1, 1, 3, 5, ...\}$

b. $B \cap C = \{0\}$

c. B∪C={-4,-3,-2,-1,0,1,2,3,4,5,6,7,8,9}

$A \cap B = \{2, 4, 6, 8\}$, $A \cap C = \{-4, -2\}$

O/L MATHS June 1991

1. Let U = {Students}, V = {Volley}

F = {Football}, H = {Hockey}

Then $n(U) = 50, n(V) = 21, n(H) = 18$

$n(F) = 24, n(F \cap V \cap H) = 5$

$n(F \cap V' \cap H') = 9$, $n(V \cap F' \cap H') = 3$

$n(H \cap V' \cap F') = 2$, $n(F \cap V \cap H') = 6$

Hint: Use the Venn diagram shown below to obtain three equation in x, y and z. Solve these equations to find the values of x, y and z.

a.

$x = 4, y = 7, z = 14$

b. i. 17   ii. 14

2. a. i. $\frac{25}{12}$ and $\frac{25}{12}$ ii. 0

3. $|OL| = 5.2cm$

4. a. R(8, 15)

   b. i. $|OR| = 17$ units   ii. 62°

5. a. $P = \frac{4S^2}{R}, P = 80$ b. 275_8

6. a. Table for the relation $y = (x + 1)(3 - x)$

x	-2	-1	0	1	1.5
y	-5	0	3	4	3.75
	2	2.5	3	3.5	
	3	1.75	0	-2.25	

b.
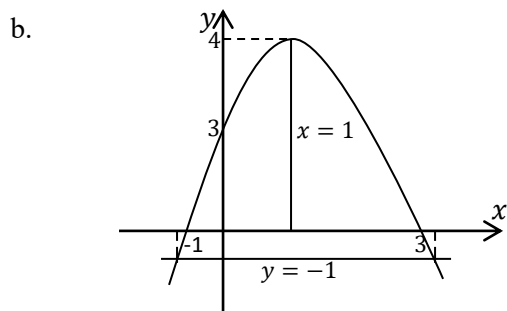
c. i. $\{x: x = -1.3, 3.2\}$ ii. 4

   iii. $x = 1$ iv. $1 < x < 3.5$

9. Hint: L_1 is the angle bisector of $\angle BAC$

   L_2 is the perpendicular bisector of AB,

   radius $4.5cm$
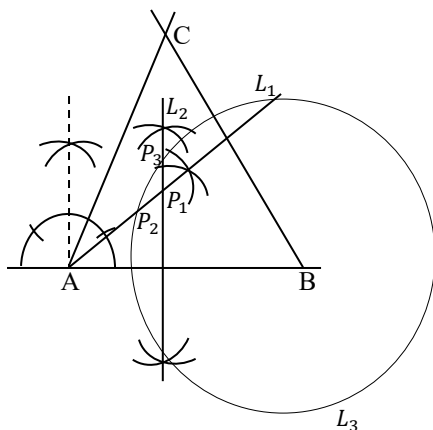
   c. i. $|P_1P_2| = 1.6cm$ ii. $\angle P_1P_2P_3 = 20°$

10. c. 76.8

11. a. $2m$ b. $3.4m^2$ c. 14°

O/L MATHS November 1991

1. a. i. $(A \cap B)' = \{7, 9, 10\}$

   ii. $A' \cup B' = \{7, 9, 10\}$

      From the answers of (i) and (ii).

      $(A \cap B)' = A' \cup B'$

b. i. $D(12) = \{1, 2, 3, 4, 6, 12\}$

   $D(20) = \{1, 2, 4, 5, 20\}$

   $D(12) \cap D(20) = \{1, 2, 4\}$

   ii. $r = 60$

2. a. i. 17   ii. 192   b. $\{a: a = 0\}$

3. a. i. $\underline{r} = \begin{pmatrix} 3 \\ 9 \end{pmatrix}$ ii. $|\underline{r}| = 3\sqrt{10}$ units

   b. 9×10^{-9}

4. a. $\{p: p = 45°\}$

   b. $\tan y = \frac{7}{\sqrt{15}} = 1.81$

      $\cos x = 1 - 1.81$ $\{x: x = 144°\}$

5. a. $x = 5$ b. $Q = 4$

6. a. Table for $y = 3x^2 - 2x - 8$

x	-3	-2	-1	0	1	2	3
y	25	8	-3	-8	-7	0	3
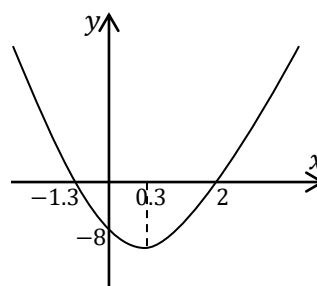
c. i. $\{x: x = -1.3, 2\}$

   ii. The least value of y is -8.3 and it

      occurs at $x = 3$

   iii. $-1.3 < x < 2$

10.
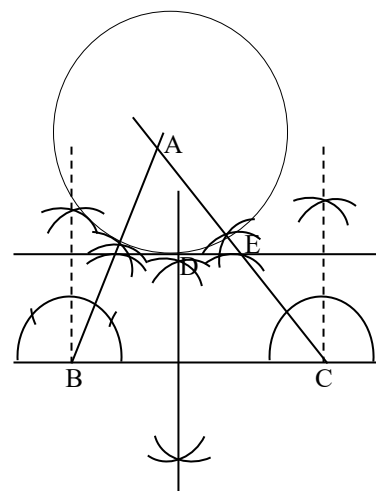
$|BD| = 3.8cm$ $|EC| = 2.9cm$

O/L MATHS June 1992

1. Let P = {Passports}
   H = {Health Certificate}
   C = {Currency}
   Then $n(P) = 12, n(H) = 14$
   $n(C) = 11, n(P \cap H) = 6, n(P \cap H) = 6$
   $n(H \cap C) = 7$
   Let $n(C \cap P \cap H) = x$
   a. Using the Venn diagram below, $x = 4$

$$n(U) = 22$$

$n(P) = 12$ $n(C) = 11$

x $6 - x$ $x - 2$

x

$6 - x$ $7 - x$

$x + 1$

$n(H) = 14$
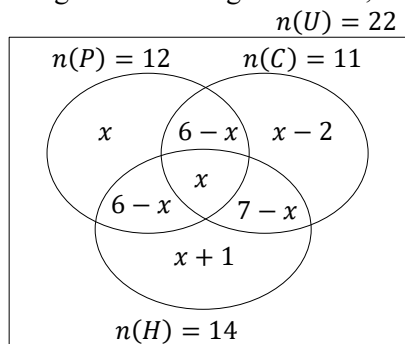
  b. i. 4   ii. 7

2. a.

$\oplus$	3	6	9	12
3	6	9	12	0
6	9	12	0	3
9	12	0	3	6
12	0	3	6	9

$\otimes$	3	6	9	12
3	9	3	12	6
6	3	6	9	12
9	12	9	6	3
12	6	12	3	9

  b. i. 3   ii. $\{n: n = 3, 9\}$

3. a. i. Q(2, 2)   ii. 323°   b. $x = 60°$

4. a. $u = \dfrac{wv - 2fxg}{w}$ b. -20

5. a. The locus of z are two semicircular arcs, with XY as a diameter. (The points X and Y are excluded). The locus of z is shown below.

Locus of x

X   Y

Locus of x

  b. $|YZ| = 7.1cm$

7cm   7.1cm

X   10cm   Y
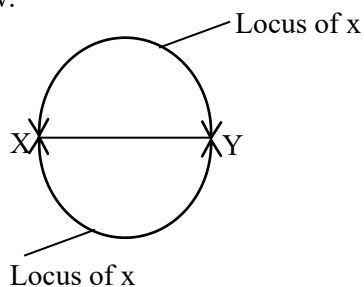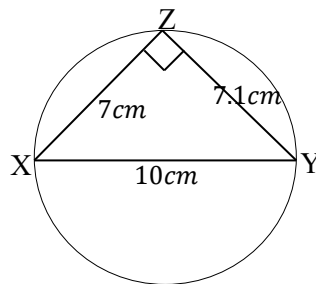
7. Table for the relation $y = x^2 - 4x + 5$

x	-2	-1	0	1	2
y	17	10	5	2	1

3	4	5	6
2	5	10	17

$y = x^2 - 4x + 5$

7.6

3.5

3

$y = x + 3$

-3 0.4   2   4.6

  d. i. $x = 2$ ii. $\{0.4, 4.6\}$

8.

L   C

000°

42°

B

7km

52°

A
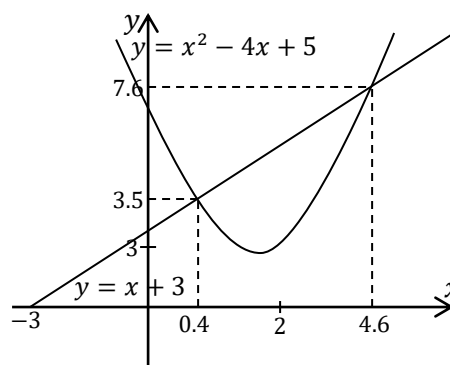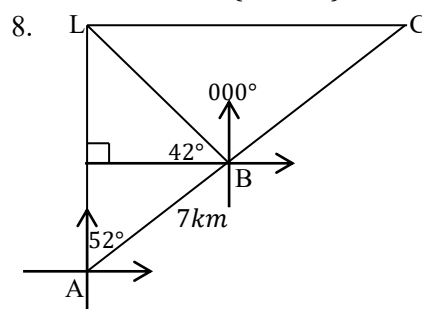
  A is the initial position of ship X, B is the position of the ship after 20 minutes.
   i. 9.28km   ii. 43.2mm   iii. 11.9km

9. i. 55.5   ii. 72.5

11. a. 14cm   b. i. 60°   ii. 51°   c. $517cm^2$

O/L MATHS November 1992

1. a. $\{3, 6, 9\}$

2. a.

$*$	0	1	2	3	4
0	0	1	2	3	4
1	1	4	2	0	3
2	2	2	2	2	2
3	3	0	2	4	1
4	4	3	2	1	0

$\oplus$	0	1	2	3	4
0	2	2	2	2	2
1	2	3	4	0	1
2	2	4	1	3	0
3	2	0	3	1	4
4	2	1	0	4	3

b. i. 4   ii. 3

4. a. $\overrightarrow{AQ} = \overrightarrow{AC} + \overrightarrow{CQ}$ ……..(1)

$\overrightarrow{AQ} = \overrightarrow{AB} + \overrightarrow{BQ}$ ………..(2)

Adding (1) and (2) gives

$2\overrightarrow{AQ} = \overrightarrow{AC} + \overrightarrow{AB} + \overrightarrow{CQ} + \overrightarrow{BQ}$

Because Q is the midpoint of BC,

$\overrightarrow{CQ} + \overrightarrow{BQ} = 0$

So $2\overrightarrow{AQ} = \overrightarrow{AC} + \overrightarrow{AB}$

b. $R_2 = \frac{R_1 R}{R_1 - R}$; $R_2 = 120$ ohms

5. a. 124_7 b. $\frac{1}{3}\sqrt{6}$

7. a.

x	0	0.5	1	1.5	2
y	3	0.75	-1	-2.25	-3

3	4	4.5	5
-3	-1	0.75	3

b.
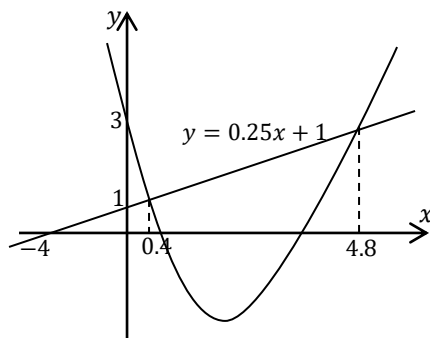
c. i. $\{x: x = 0.4, 4.9\}$ ii. $(2.5, 3.25)$

iii. $x = 2.5$

8. b. i. 50.5   ii. 0.67   iii. 70.5

11. a. 5651km   b. 5920km   c. 6928

O/L MATHS June, 1993

1. a.

$\otimes$	2	3	5	7
2	4	6	2	6
3	6	1	7	3
5	2	7	1	5
7	6	5	3	1

$\oplus$	2	3	5	7
2	4	5	7	1
3	5	6	0	2
5	7	0	2	4
7	1	0	4	6

b. i. 2   ii. $\{n: n = 3, 7\}$

2. b. $\{x: x \le -4\}$
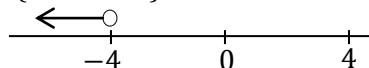
3. a. 2.4×10^4 b. 507_8

4. a. $x = \frac{3}{2}$ or $x = 4$

5. a. 5   b. 4   c. 14

6. a.

x	-4	-3	-2	-1	0
y	-2.0	-0.5	0	0.25	0.4

1	2	3	4	5
0.5	0.57	0.63	0.66	0.70

b.
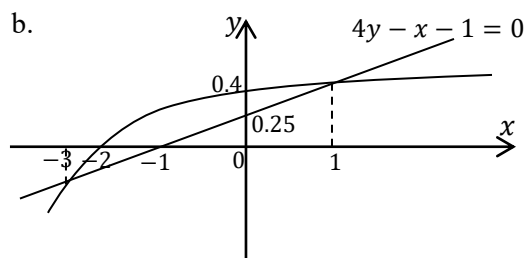
d. i. $\{x: x = -3, 1\}$ ii. $\{x: x = -3.8\}$

7. a. $\binom{6}{8}, \binom{-10}{0}, \binom{4}{-8}$ b. $\overrightarrow{XL} = \binom{-2}{4}$

YL is the perpendicular bisector of XZ.

O/L MATHS November 1993

1. a.
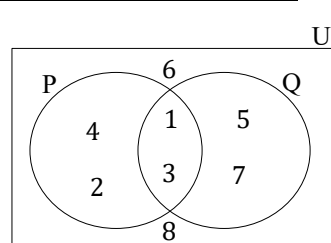
b. i. $\{2, 4, 6, 8\}$ ii. $\{1, 2, 3, 4, 5, 7\}$

2. a.

$\otimes$	1	3	5	7
1	1	3	5	7
3	3	1	7	5
5	5	7	1	3
7	7	5	3	1

b. i. $\{n: n = 5\}$ ii. $\{n: n = 1, 3, 5, 7\}$

3. a. 8   b. 2.8

4. $|RX| = 8.3cm$

[Hint: L is the angle bisector of angle PQR]

5. 0.2

7. a. Table for the relation $y = -3 - x^2$

x	-5	-4	-3	-2	-1	0
y	-28	-19	-12	-7	-4	-3

1	2	3	4	5
-4	-7	-12	-19	-28

Table for the relation $y = x^2 - 4x + 10$

x	-3	-2	-1	0	1	2
y	31	22	15	10	7	6

3	4	5	6	7
7	10	15	22	31

b.
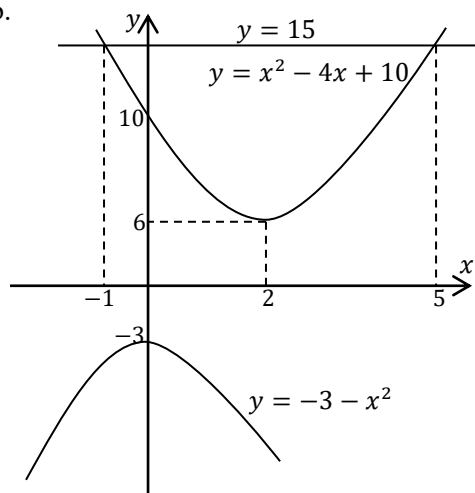
c. i. Maximum point is $(0, -3)$;

Minimum point $(2, 6)$

The equation of the line joining the minimum point to the maximum point is $9x - 2y - 6 = 0$.

8. b. $A(3, 2)$ $B(-1, 5)$ $C(4, 6)$

c. i. Reflection in the x-axis

ii. $|A_1 A_2| = 5\sqrt{2}$ units

10. a. i. 124km   ii. 303°

11.
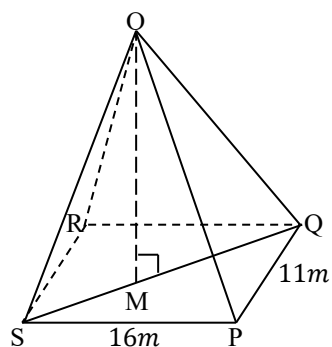
a. 19.4m   b. 22m   c. 66°   d. $1291m^3$

Hint: Angle OQS = angle OQM

SSSCE November 1993

1. a. 10   b. 760   c. $\frac{3}{5}$

2. a.
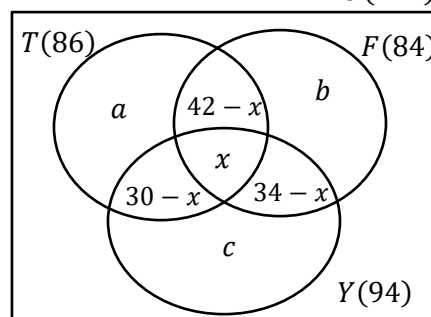
b. $(8 + x) + (30 + x) + (14 + x) + (30 - x) + (42 - x) + (34 - x) + x = 74$

$x = 16$

c. $\frac{58}{174} = \frac{1}{3}$

3. 8

4. a. $B(-1, 4)$ $C(8, 4)$ b. $\overrightarrow{AM} = \begin{pmatrix} -0.5 \\ -3 \end{pmatrix}$

5. a. $32.31m$ b. 42°

6.
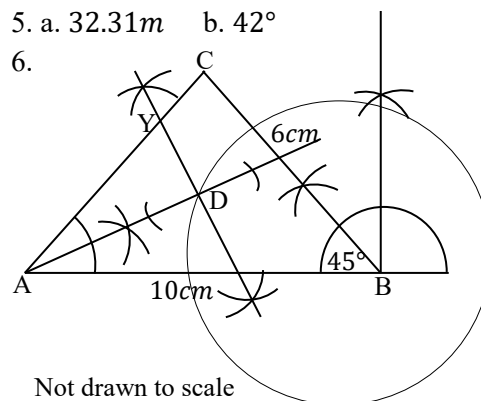
Not drawn to scale

d. $|AY| = 6.1cm$

7. a. 0.7534

b. i. ¢60 million ii. ¢8 million

iii. ¢96 million   iv. 1.50%

8. a.

x	0	1	2	3	4	5	6	7	8
$12 - x$	12	11	10	9	8	7	6	5	4
$8 - x$	8	7	6	5	4	3	2	1	0
y	0	77	120	135	128	105	72	35	0

b.

$y = x(12 - x)(8 - x)$

$y = 100$
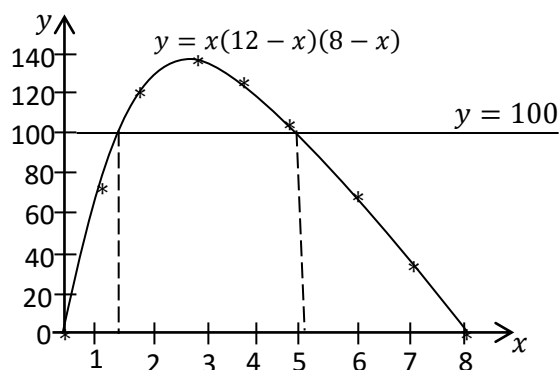
c. $1.5cm$ and $5.1cm$ d. $3.2cm$

9. i. $133°$ ii. $5m$ (nearest metre)

10. b. $A'(-6, -8)$ $B'(-2, -5)$ $C'(-7, -2)$

   c. $A''(-8, 6)$ $B''(-5, 2)$ $C''(-2, 7)$

   d. i. 90° clockwise or 270° anticlockwise
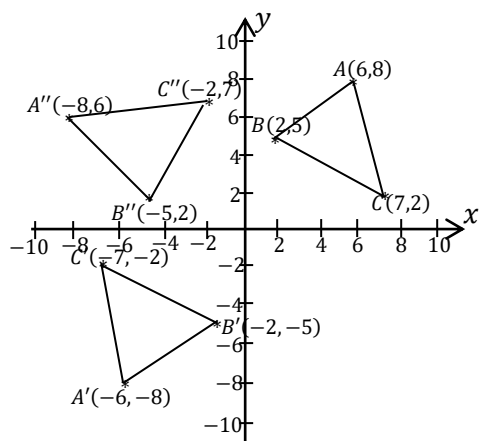
11. a. i. 26000 ii. 34000

   b. i.

Age	Frequency	CF	Upper Class Boundary
$0 - 4$	2	2	4.5
$5 - 9$	3	5	9.5
$10 - 14$	6	11	14.5
$15 - 19$	15	26	19.5
$20 - 24$	12	38	24.5
$25 - 29$	7	45	29.5
$30 - 34$	4	49	34.5
$35 - 39$	1	50	39.5

   ii. 19.5 years

12. a. $169°$ b. $50.2cm$ c. $15.0cm$

   d. $1004cm^3$

June 1994

2.
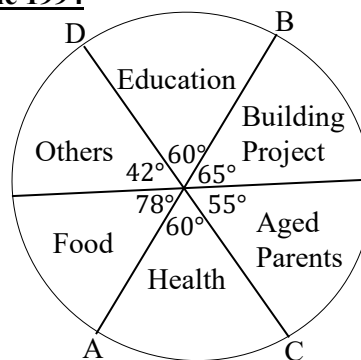
   a. ¢72,000.00   b. ¢8,400.00   c. 38.4%

3. a. i. $\overrightarrow{AC}$ is parallel to $\overrightarrow{BD}$

   ii. $\overrightarrow{AD}$ is perpendicular to $\overrightarrow{BD}$

4. ii. $4cm$

5. a. 2^{15} b. $\{x : x < 2\}$

6. a.   b. $n = 6$

7. a.

x	-4	-3	-2	-1	0	1
y	-20	-9.5	-2	-2.5	4	2.5

2	3	4
-2	-9.5	-20

b.
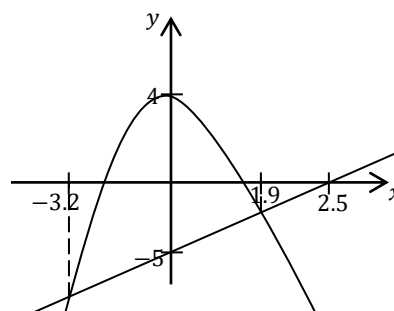
   c. i. 4   ii. $x < -1.6$ or $x > 1.6$

   iii. $\{x : x = -3.2, 1.9\}$

8. b. $60 - 69$ c. 65.9

9. a. $4970km$ b. 81%   c. $76°S$

10. a. $20cm^2$ b. $7986cm^3$ c. $968cm^3$

SSSCE November 1994

1. a. $\frac{3}{4}$ or 0.75   b. 29

2. a. 1111221_3

   b. i.

$\otimes$	1	2	3	6
1	1	2	3	6
2	2	4	6	5
3	3	6	2	4
6	6	5	4	1

ii. $\{n: n = 3\}$

3. a. i. $\{2, 3, 7\}$ ii. $\{2, 3, 7\}$

$(P \cap Q)' = P' \cup Q'$

b. 4

4. a. 27   b. $\{x, y: x = -3, y = -6\}$

5. a. $X = \frac{6Z}{\sqrt[3]{Y}}$ b. $Y = 125$

6.
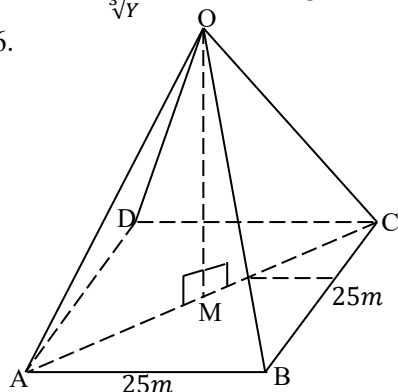
Hint: In triangle AMO, OM represents the height of the pyramid OABCD.

$|AM| = \frac{1}{2}|AC|$

Using the Pythagoras theorem, the height of the pyramid is 24.2m

a. $24.24cm$ b. $5050cm^3$
c. $53.9°$ d. $1363.5cm^2$

7. a.

Class Boundaries	Freq. (f)	Class Midpoint (x)	fx
59.5-64.5	2	62	124
64.5-69.5	3	67	201
69.5-74.5	6	72	432
74.5-79.5	11	77	847
79.5-84.5	7	82	574
84.5-89.5	8	87	696
89.5-94.5	2	92	184
94.5-99.5	1	97	97
	$\Sigma f = 40$		$\Sigma fx = 3155$

b. i. Mean $(\bar{x}) = 78.88$ ii. $\frac{29}{40}$

8. b. i. $Q(4, 6)$ $R(6, 2)$
ii. $P'(-2, 2)$ $Q'(-4, 6)$ $R'(-6, 2)$
iii. $P''(-2, -2)$ $Q''(-4, -6)$ $R''(-6, -2)$

c. i. Reflection in the x-axis

ii. $\overrightarrow{P'R'} = \begin{pmatrix} -4 \\ 0 \end{pmatrix}$

9. a.
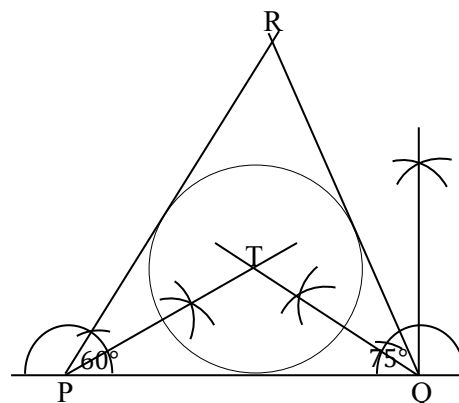
c. radius $= 3.0cm$

10. a. ¢10,976,000.00
b. 12.87%

11. a.

x	-2	-1	0	1	1.5
y	-5	0	3	4	3.75

2	2.5	3	3.5	4
3	1.75	0	-2.25	-5

b.
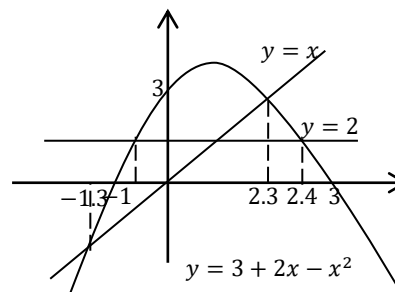
d. i. $x = -1.3, 2.3$
ii. $x = -0.4, 2.4$

12. a. i. 13km   ii. 206°   b. 8km

O/L November 1994

1. a. i. $\{t, q\}$ ii. $\{p, q, r\}$ iii. $\{p, q, r, s, t\}$
b. i. $p = A \cap B \cap C$ ii. $q = A \cap C \cap B'$
$t = A \cap B' \cap C'$

2. a.

$\oplus$	0	1	2	3	4	5	6
0	0	1	2	3	4	5	6
1	1	2	3	4	5	6	0
2	2	3	4	5	6	0	1
3	3	4	5	6	0	1	2
4	4	5	6	0	1	2	3
5	5	6	0	1	2	3	4
6	6	0	1	2	3	4	5

$\otimes$	0	1	2	3	4	5	6
0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6
2	0	2	4	6	1	3	5
3	0	3	6	2	5	1	4
4	0	4	1	5	2	6	3
5	0	5	3	1	6	4	2
6	0	6	5	4	3	2	1

b. i. 3   ii. 5   iii. 2

3. a. i. $\begin{pmatrix} 3 \\ -6 \end{pmatrix}$ ii. R$(0, 8)$ b. $\{x : x \le 4\}$

4. a. $\angle CAB = 40°$, $\angle ACB = 72°$, $\angle ABC = 68°$

  b. $20.6cm$

5. a. $(5x - 4y - 5)(5x + 4y + 1)$

  Hint: Difference of two squares

6.a. $C = a + bnw$, where a and b are variation
  constants
    i. $C = 10000 + 100nw$ ii. ¢130,000.00
  b. ¢915.00

7. a.

x	-2	-1	0	1	2	3
y	20	13	8	5	4	5

4	5	6
8	13	20
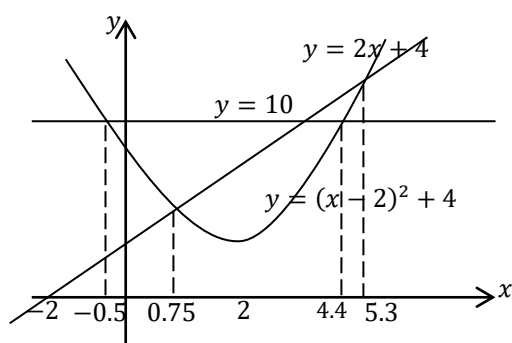
d. i. $\{x : x = 0.75, 5.3\}$ ii. $\{x : x = -0.5, 4.4\}$

8. c. i. 46.5   ii. 42%

9. b. $\angle CDB = 121°$ ii. $5cm$

10. b. ii. $A_1(-6, 0)$, $B_1(-12, 0)$, $O_1(-2, -6)$
    iii. $A_2(-2, -3)$, $B_2(-5, -3)$, $O_2(0, -6)$
  d. 13.5 sq. units

11. a. i. $12m$ ii. $14.8m^2$ b. $23.63m^2$

O/L November 1995

1. a.
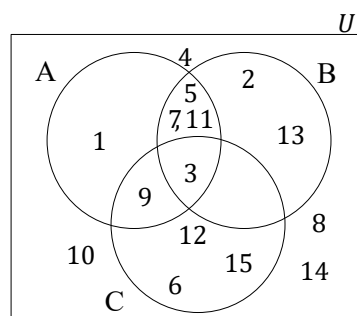
  b. i. $\{2, 3, 4, 6, 8, 9, 10, 12, 13, 14, 15\}$
    ii. $A' \cup (B \cap C) =$
    $\{2, 3, 4, 6, 8, 9, 10, 12, 13, 14, 15\}$
    $P(A'(B \cap C)) = \frac{2}{3}$

2. a.

$\otimes$	1	5	7	11
1	1	5	7	11
5	5	1	11	7
7	7	11	1	5
11	11	7	5	1

  b. i. $1 \otimes 5 = 5 \otimes 1 = 5$;
    $1 \otimes 7 = 7 \otimes 1 = 7$;
    $1 \otimes 11 = 11 \otimes 1 = 11$;
    $5 \otimes 7 = 7 \otimes 5 = 11$;
    $5 \otimes 11 = 11 \otimes 5 = 7$;
    $7 \otimes 11 = 11 \otimes 7 = 5$;
    So $\otimes$ is commutative
    ii. $\{1, 5, 7, 11\}$

3. a. $-\frac{1}{3}$ b. i. ¢250.00   ii. ¢362.50

4. b. ¢2,400.00

5. a. $x = 3, y = 2$ b. 50km

6. a. i. 1.5849   ii. 0.4679

  b. i. $L = \frac{15}{x} + 2x$. L is the perimeter of the
    rectangle.
    ii. length $= 5cm$, width $= 1.5cm$

7. a.

x	-4	-3	-2	-1	0	1	2	3
y	5	0	-3	-4	-3	0	5	12

  b.
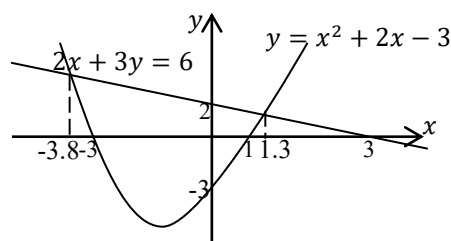
d. i. $x = -1$ ii. $\{x : x = -3.8, 1.3\}$

iii. $(-1, -4)$

8. iv. $|OR| = 4.1$

9. a. $\overrightarrow{OP} = \begin{pmatrix} 4 \\ 1 \end{pmatrix}$, $\overrightarrow{OQ} = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$, Using the

equation $\overrightarrow{TR} = \overrightarrow{TP} + \overrightarrow{PQ} + \overrightarrow{QR}$

$\overrightarrow{TR} = \begin{pmatrix} -8 \\ -4 \end{pmatrix}$

b. i. $\overrightarrow{AB} = \begin{pmatrix} 5 - p \\ 7 - q \end{pmatrix}$, $\overrightarrow{DC} = \begin{pmatrix} 3 \\ 1 \end{pmatrix}$. Because

ABCD is a parallelogram, $\overrightarrow{AB} = \overrightarrow{DC}$, so

$p = 2$ and $q = 6$

ii. $|AC| = \sqrt{13}$ units

10. c. i. 129   ii. 10

11. a. 25310km   b. 3797km   c. 4357km

SSSCE November 1995

1. a. 3.6×10^2 b. 6.832

2. a.

$\oplus$	0	1	2	3	4
0	0	1	2	3	4
1	1	2	3	4	0
2	2	3	4	0	1
3	3	4	0	1	2
4	4	0	1	2	3

$\otimes$	0	1	2	3	4
0	0	0	0	0	0
1	0	1	2	3	4
2	0	2	4	1	3
3	0	3	1	4	2
4	0	4	3	2	1

b. i. $(2 \otimes 4) \oplus 4 = 3 \oplus 4 = 2$

ii. $(4 \oplus 4) \otimes 2 = 3 \otimes 2 = 1$

3.
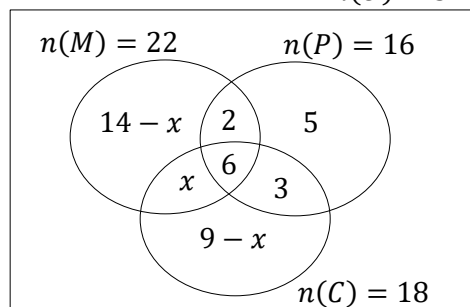
a. 2   b. 14   c. 12

4. ¢112,394.24

5.
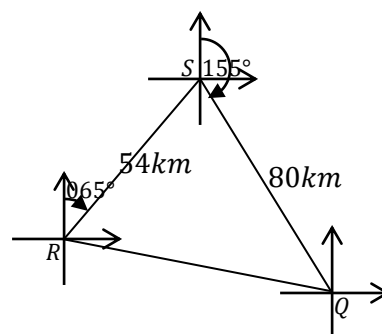
a. 96.5km   b. 121°

6. a. ¢674,660.67   b. ¢9,856,000.00

c. 44.94%

7. a.
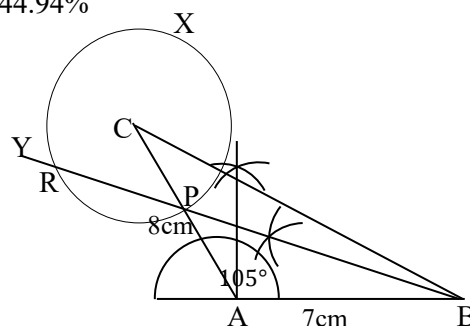
b. $|BC| = 12cm$ $|PR| = 8.9cm$

8. a. i. $R = 450 + 0.2V^2$ ii. 1730N

b. 3

9. a. i. $\overrightarrow{QR} = \begin{pmatrix} 1 \\ -4 \end{pmatrix}$ $\overrightarrow{TS} = \begin{pmatrix} 5 - x \\ 4 - y \end{pmatrix}$

QRST is a parallelogram so $\overrightarrow{QR} = \overrightarrow{TS}$

$x = 4, y = 8$

ii. $\overrightarrow{RS} = \begin{pmatrix} 3 \\ 2 \end{pmatrix} = \left(\sqrt{13} \, units, 056° \right)$

b. $x = 1, y = 2$

10. b. $A_1(5, 9)$ $B_1(7, 2)$ $C_1(11, 1)$

c. $A_2(5, -11)$ $B_2(3, -8)$ $C_2(7, -7)$

d. $A_3(-7, 5)$ $B_3(-4, 3)$ $C_3(-3, 7)$

e. -1.57

11.

Marks	Freq.	Marks less than	Cumulative Freq.
0 – 9	4	9.5	4
10 – 19	7	19.5	11
20 – 29	5	29.5	16
30 – 39	10	39.5	26
40 – 49	13	49.5	39
50 – 59	20	59.5	59
60 – 69	15	69.5	74
70 – 79	13	79.5	87
80 – 89	5	89.5	92
90 – 99	1	99.5	93

c. i. 53   ii. $\frac{11}{93}$

12. a. 24°   b. 30.5cm

June 1996

1. a. i.
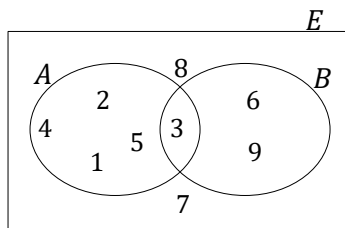
ii. 32

iii. $A \cap B = \{3\}$

$A \cup B = \{1, 2, 3, 4, 5, 6, 9\}$

b. 144

2. a.

$\otimes$	2	3	4	5
2	4	0	2	4
3	0	3	0	3
4	2	0	4	2
5	4	3	2	1

b. i. 4   ii. $\{n: n = 3, 4\}$

3. a. $r = \frac{b}{n(a-2b)}$ b. $x > 3$
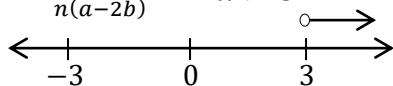
4. b. 33.3%

5. a. $y = \frac{900}{x^2}$ b. $x = 6$ c. $y = 4$

6. a. i.

b. i. ¢400.00   ii. ¢1,400.00

7. a.

x	-3	-2	-1	0	0.5	1
y	22	9	0	-5	-6	-6

1.5	2	3	4	5
-5	-3	4	15	30

b.
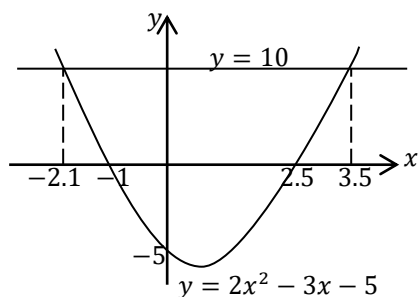
c. i. $x = -1$ or 2.5   ii. $x = -2.1$ or 3.5

8. c. Reflection in the line $y = x$

9. a. $\overrightarrow{PQ} = \binom{6}{8}$, $\overrightarrow{QR} = \binom{-10}{0}$,

$\overrightarrow{PR} = \binom{-4}{8}$

b. Since $|PQ| = |QR|$, triangle PQR is isosceles

c. i. $4x - 3y = 13$ ii. $(-1, 1)$

10. a. 75.5   b. 67.5   c. $\frac{3}{16}$

11. a. 17cm b. 73°   c. 1251cm^2

SSSCE November 1996

1.
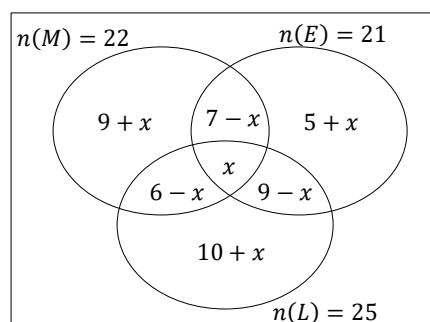
a. 4   b. 10   c. 14

2.

Subject	No. of students	Angle of Sector
Mathematics	45	$\frac{45}{180} \times 360°$ $= 90°$
Physics	39	$\frac{39}{180} \times 360°$ $= 78°$
Chemistry	28	$\frac{28}{180} \times 360°$ $= 56°$
Biology	14	$\frac{14}{180} \times 360°$ $= 28°$
Economics	36	$\frac{36}{180} \times 360°$ $= 72°$
History	18	$\frac{18}{180} \times 360°$ $= 36°$
Total	180	$= 360°$
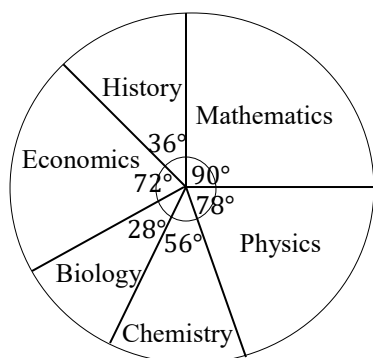
3. a. $8.6cm$ b. $8.0cm$

4. a. $F = \frac{2Mm}{d^2}$ b. $\sqrt{2}m$

5. a. $25°$
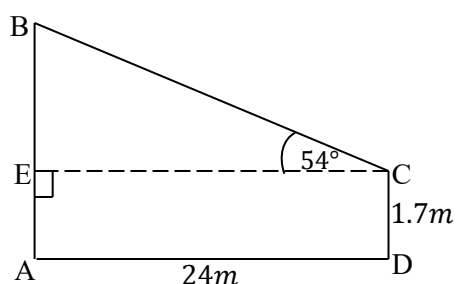
b. $34.7m$

6. a. $¢42,049,152.00$

   b. i. $Ato = ¢900,000.00$

       $Oko = ¢720,000.00$

       $Edem = ¢1,080,000.00$

    ii. 30%

7. a.

x	-5	-4	-3	-2	-1
y	14	6	0	-4	-6

0	1	2	3	4
-6	-4	0	6	14
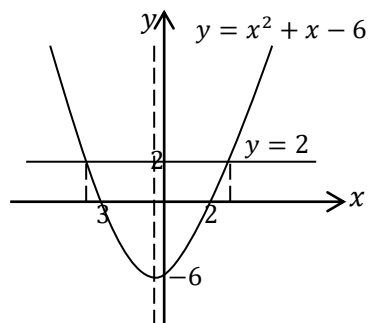
c. i. $x = -\frac{1}{2}$

   ii. $\{x : x = -3.3, 2.4\}$

   iii. $(-0.5, 2.4)$

8. a. i. $m = 2$ and $n = 3$

ii. $|d| = 3\sqrt{13} units$

   b. $(-1, -16)$

9. a. i. $\frac{1}{5}\sqrt{5} + \frac{1}{2}\sqrt{2}$ ii. $14 + \frac{18}{5}\sqrt{5}$

   b. $7, 9, 11$

10. b. ii. $A_1(-2, 2)$, $B_1(-6, 2)$, $C_1(-8, 8)$

       $D_1(-4, 8)$

    iii. $A_2(-2, -2)$, $B_1(-6, -2)$,

       $C_2(-8, -8)$, $D_2(-4, -8)$

    iv. $A_3(2, 2)$, $B_3(6, 2)$, $C_3(8, -4)$,

       $D_3(4, -4)$

   c. $y = 8$

11. a.

Mark	Frequency	Class Boundary
$11 - 20$	5	$10.5 - 20.5$
$21 - 30$	21	$20.5 - 30.5$
$31 - 40$	15	$30.5 - 40.5$
$41 - 50$	43	$40.5 - 50.5$
$51 - 60$	10	$50.5 - 60.5$
$61 - 70$	14	$60.5 - 70.5$
$71 - 80$	7	$70.5 - 80.5$
$81 - 90$	3	$80.5 - 90.5$
$91 - 100$	2	$90.5 - 100.5$
	$\Sigma f = 120$	

b. 45 c. $41 - 50$ or $40.5 - 50.5$

d. $\frac{77}{120}$

12.
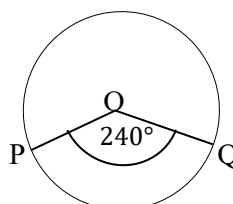
a. $31.43cm$
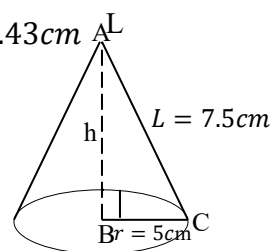
b. i. $5.6cm$ ii. $146.4cm^3$

JUNE 1997

$$n(U) = 40$$
$$n(C) = 18 \quad n(D) = 20$$
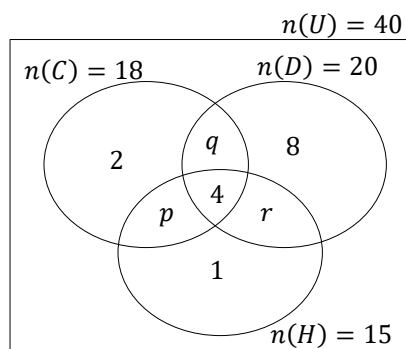
The equations are
$$p + r + 5 = 15$$
$$p + r + 12 = 20$$
$$p + q + 6 = 18$$
Solving the equations simultaneously,
$$p = 7, \ q = 5, \ r = 3$$

a. 5   b. 10

2. a. $25 - 50\sqrt{5}$, Here $a = 25, b = -50$,
$c = 5$
  b. 5×10^{33}

3. a. 36   b. $x \leq -1$
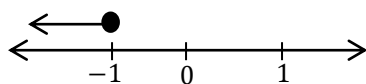
4.

$\otimes$	1	5	9	10
1	1	5	9	10
5	5	3	1	6
9	9	1	4	2
10	10	6	2	1

a. i. {9}   ii. {9}   b. 10

5. b. 43%

7. a.

x	-4	-3	-2	-1	0	1	2	3
y	10	4	0	-2	-2	0	4	10

b.
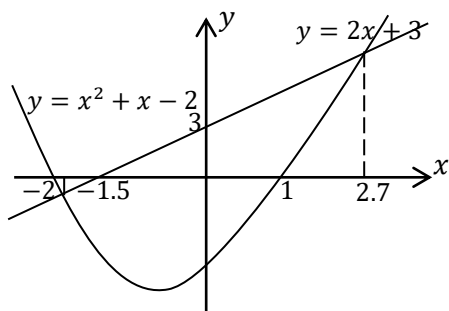
c. i. $x = -2$ or 1   ii. $x = -1.8$ or 1.8

8.
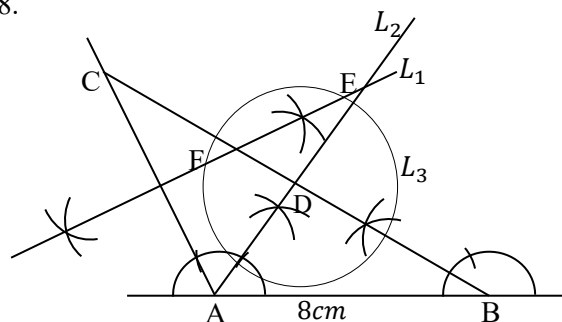
$|FE| = 2.4cm$

9. b. i. R(4, 6), Q(5, 3), S(2, 4)
   ii. $P_1(1, -2), Q_1(3, -5), R_1(6, -4)$
   $S_1(4, -2)$
   iii. $P_2(-1, -2), Q_2(-3, -5), R_2(-6, -4)$
   $S_2(-4, -2)$

c. $\overrightarrow{P_1 P_2} = \begin{pmatrix} -2 \\ 0 \end{pmatrix}$

10. a. TABLE
  b. i. 6   ii. $\frac{3}{5}$ c. 5.7

11. a. 4792.4   b. 8.87 hrs   c. 4603.34km

SSSCE November 1997

1. a. i. $A' = \{odd\ integers\}$
   ii. $A' \cap B = \{1, 3, 5, 7, 9\}$

  b.
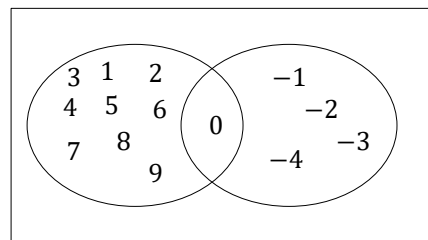
2. a. $1\frac{2}{3}$ b. 46.4

3. a. $V = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$ b. Q(2, 2)
  c. $\overrightarrow{P'Q'} = \begin{pmatrix} -3 \\ 0 \end{pmatrix}$ d. $\left| \overrightarrow{P'Q'} \right| = 3$ units

4. $m = 4, n = 1$

5.
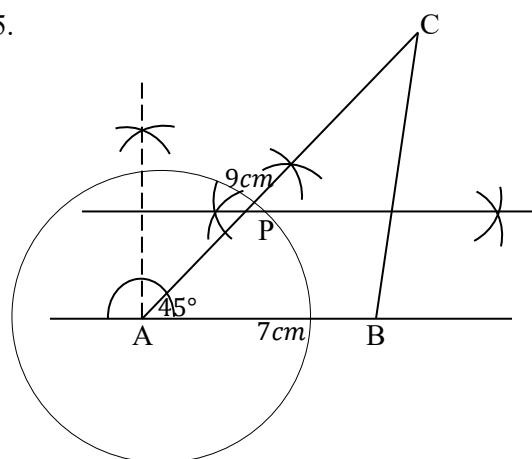
$|PB| = 4.1cm$

6. a. i. $\angle ADC = 100°$ ii. $\angle ABC = 80°$

iii. $\angle CAD = 21°$
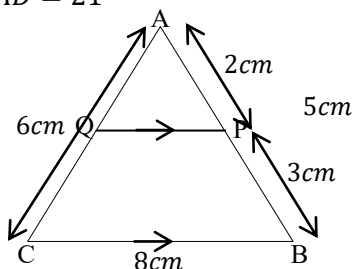
b. i. $|PQ| = 3.2cm$ ii. $|QC| = 3.6cm$

Hint: Δs APQ and ABC are similar

So $\dfrac{QP}{CB} = \dfrac{AP}{AB} = \dfrac{AQ}{AC}$

7. a. $x = 125,\ y = 65$

b. i. ¢90,000.00   ii. 16.67%

8. a. 13.57   b. $C = 700 + \dfrac{360}{n}$ $n = 8$

9. b. 5m   c. $\dfrac{7}{15}$

10. a.

x	-1	0	0.5	1	2
$2x(x-1)$	4	0	-0.5	0	4
$x+3$	2	3	3.5	4	5
y	2	0	-0.14	0	8

x	3	4	5	6
$2x(x-1)$	12	24	40	60
$x+3$	6	7	8	9
y	2	3.43	5	6.67

b.
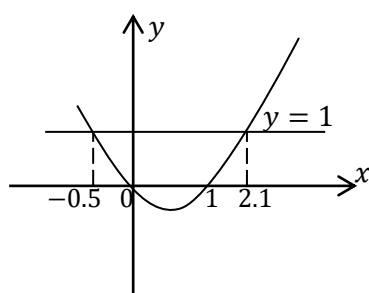
c. i. $0 < x < 1$ ii. $\{x: x = -0.5, 2.1\}$

11. b. ii. $A_1(4,-2)$ $B_1(-1,-1)$ $C_1(3,2)$

iii. $A_2(-8,4)$ $B_2(-7,1)$ $C_2(-4,3)$

iv. $A_3(-4,-8)$ $B_3(-1,-7)$

$C_3(-3,-4)$

v. 90° anticlockwise or 270° clockwise rotation about the origin.

12. a. 5cm   b. 7cm   c. 59°

1. a. i. Not valid   ii. Valid   iii. Not valid

b. $x = 5$

2. a. $\dfrac{16}{9}$ b. $x \le 3$
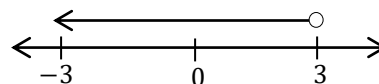
3. a. $k = 6$ b. i. $\angle XZY = 55°$

ii. $\angle WXZ = 25°$

4. a. $r = \dfrac{P(1-t^2)}{1+t^2}$ b. $r = -8$

5. a. $84m$ b. $283m^2$

6. a. $\dfrac{x}{y} = \dfrac{2}{3}$ b. 0.2

7. a. i. $q = 60°$ ii. $x = 30°$ iii. $\angle QRS = 90°$

8. a. i. ¢1,080,000.00   ii. ¢72,000.00

b. ¢216,000.00

9. a.
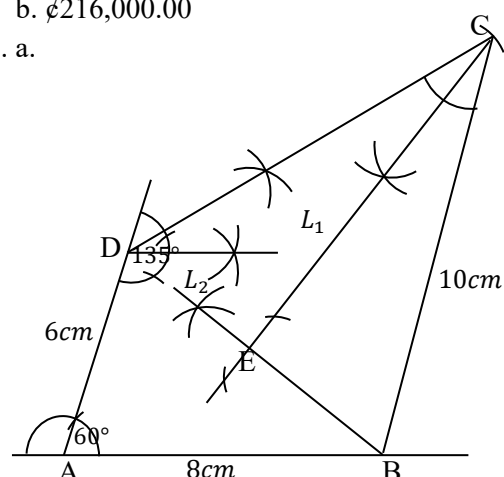
b. ii. $|DE| = 4cm$

10. a.

x	-3	-2	-1	0	1
y	-35	-14	1	10	13

2	3	4	5
10	1	-14	-35

b.
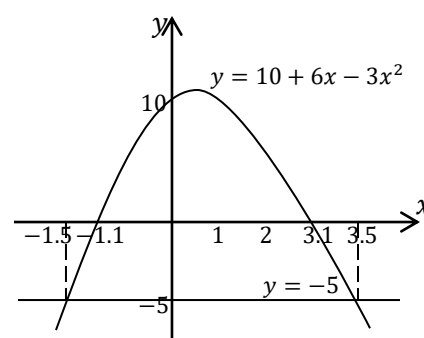
c. i. $x = -1.1, 3.1$ ii. $x = -1.5, 3.5$

d. $x = 1$

11. a.

$|PR| = 5km$

b.

Hint: $|BD| = x \tan 48°$

Also $|BD| = (50 - x) \tan 30°$

$|BD| = 19m$
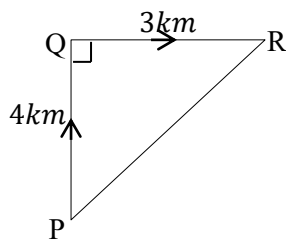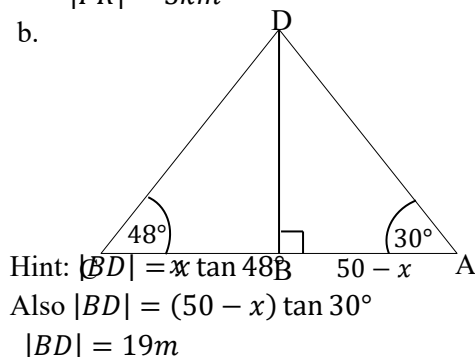
12. a.

A/B	1	2	3	4	5	6
1	1,1	1,2	1,3	1,4	1,5	1,6
2	2,1	2,2	2,3	2,4	2,5	2,6
3	3,1	3,2	3,3	3,4	3,5	3,6
4	4,1	4,2	4,3	4,4	4,5	4,6
5	5,1	5,2	5,3	5,4	5,5	5,6
6	6,1	6,2	6,3	6,4	6,5	6,6

b. i. $(1, 4), (2, 3), (3, 2), (4, 1)$

ii. $(5, 6), (6, 5), (6, 6)$

c. i. $\frac{1}{9}$ ii. $\frac{1}{12}$

SSSCE November 1999

1. a. $H = \{Hardworking\ people\}$

$C = \{Careless\ students\}$

$S = \{Students\}$
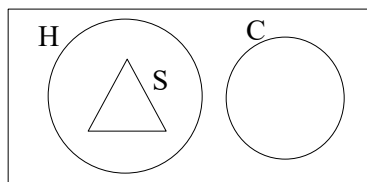
α. Valid   β. Not valid   γ. Valid

b. i. $A' \cap B = \{9,18\}$

ii. $(A' \cap B)' = \{1,2,3,4,6,12,36\}$

2. a. $m = \frac{n(q-p)}{3q-5p}$ b. 6×10^{-30}

3. a.

⊗	2	3	4	5	6	7
2	4	6	0	2	4	6
3	6	1	4	7	2	1
4	0	4	0	4	0	4
5	2	7	4	1	6	3
6	4	2	0	6	4	2
7	6	5	4	3	2	1

b. i. $n = \{3, 5, 7\}$ ii. 2

4. a. $\overrightarrow{AB} = \begin{pmatrix} 4 \\ -4 \end{pmatrix}$ $\overrightarrow{DC} = \begin{pmatrix} 5 - x \\ 0 - y \end{pmatrix}$

$\overrightarrow{AB} = \overrightarrow{DC}$

$x = 1, y = 4$

The coordinates of D is $(1, 4)$.

b. $|\overrightarrow{DB}| = \sqrt{26}$ units

5. b. $|BD| = 5.1cm$

6. a. $36 + 9\sqrt{3}$

b. i. $y = 2.8 + 0.8x^2$ ii. $y = 15.6$

ii. $x = \pm\frac{1}{2}\sqrt{11}$

7. a. $36cm^2$

b. i. $\angle ADC = 115°$ ii. $\angle CAD = 40°$

8. a. ¢1,250,700   b. ¢422,500   c. 30%

9. a.

x	-2	-1.5	-1	0	1
y	5	2.25	0	-3	-4

2	2.5	3	3.5	4
-3	1.75	0	2.25	5

b.
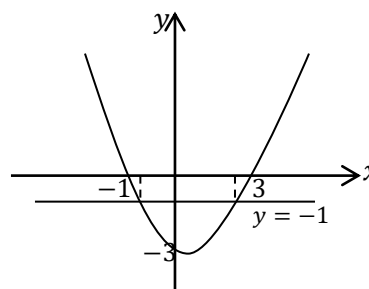
c. i. The truth set is $\{x: x = -0.73, 2.75\}$

ii. $x = 1$ iii. $-1 < x < 3$

10.
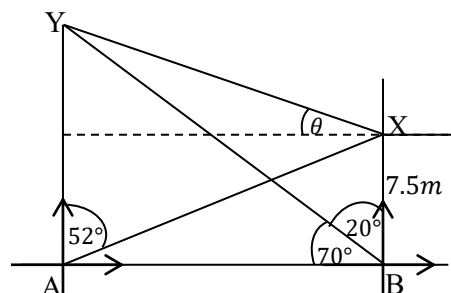
a. $|AB| = 9.60m$ b. $|AY| = 26.4m$

c. $\overrightarrow{XY} = \begin{pmatrix} -9.6 \\ 18.9 \end{pmatrix}$

d. $|XY| = 21.2m$, Bearing = 333°

11. b. i. First quartile, $Q_1 = 7.25$

Third quartile, $Q_3 = 19.75$

ii. 19%

12. a. i. $4.03m$ ii. $44.3m^2$ iii. $47.1m^2$

b. ¢41,130.90

SSSCE November 2000

1. a. $P = \{18, 21, 24, 27, 30, 33, 36\}$

$Q = \{18, 24, 36\}$

$R = \{18, 20, 22, 24, 26, 28, 30, 32, 34, 36\}$

b. i. $P \cap Q = \{18, 24, 36\}$

ii. $Q \cap R = \{18, 24, 36\}$

iii. $P \cap R = \{18, 24, 30, 36\}$

c. $P \cap Q = Q \cap R$

2. a. Hint: $5R^2 = (27.45)^2 - (22.55)^2$

$R = \pm 7$

b. $30 + 19\sqrt{15}$

3. Hint: If $\log A = \log B$, then $A = B$

$x = 8$

4. a. $V = \frac{5.4MT}{6T-37}$ or $\frac{-5.4MT}{37-6T}$

b. $V = 1.701 \times 10^8$

5. a.

Month	No. Sold	Sector angle
January	7,100	50°
February	7,668	54°
March	10,366	73°
April	9,940	70°
May	8,236	58°
June	7,810	55°
Total	51,120	360°

b. 15%

6. b. ii. $P_1(-2,2)$, $Q_1(-6,2)$, $R_1(-6,6)$

$S_1(-2,6)$

iii. $P_2(6,-6)$, $Q_2(10,-6)$, $R_2(10,-2)$

$S_2(6,-2)$

iv. $P_3(-2,-2)$, $Q_3(-6,-2)$, $R_3(-6,-6)$

$S_2(-2,-6)$

c. $\overrightarrow{P_2P_3} = \begin{pmatrix} -8 \\ 4 \end{pmatrix}$

7. a. Hint: Solve the equation

$I = \frac{600,000 \times 15 \times R}{4 \times 100} = 56,250$

$R = 2.5\%$

b. i. ¢38,125.00   ii. 86.4%

8. a. i. $C = a + bn$, where a and b are variation constants.

Solving the equations

$70,000 = a + 8b$

$90,000 = a + 10b$

$a = 10,000$ and $b = -10,000$

The formula connecting C and n is

$C = -10,000 + 10,000n$

ii. $C = $¢110,000

b. Hint: If the speed of A is V, then the speed of B is $\frac{8}{7}V$

Distance covered by A in $2hrs = 2V$

Distance covered by B in $2hrs$

$= 2 \times \frac{8}{7}V$

Total distance covered

$2V + \frac{16}{7}V = 300$

Solving for $V = 70kmh^{-1}$

Speed of $A = 70kmh^{-1}$

Speed of $B = 80kmh^{-1}$

9.
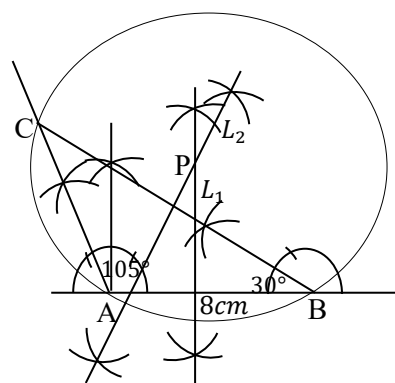
d. i. $|BC| = 11cm$ ii. Radius $= 5.7cm$

10. a. Area of plot $= \frac{1024000}{320} = 3200m^2$

Width $= \frac{3200}{80} = 40m$

b. i. Total area $= 504m^2$

ii. Cost of black soil =¢481698.00

Cost of labour $= $¢403200.00

Total cost $= $¢884,898.00

11. a.

Marks	Tally	Freq (f)	Class midpt (x)	fx
9.5-19.5	///	3	14.5	43.5
19.5-29.5	//	2	24.5	49.0
29.5-39.5	### //	7	34.5	241.5
39.5-49.5	### ### /	11	44.5	489.5
49.5-59.5	### ###	10	54.5	545.0
59.5-69.5	### //	7	64.5	451.5
69.5-79.5	### //	7	74.5	521.5
79.5-89.5	//	2	84.5	169.0
89.5-99.5	/	1	94.5	94.5
	Total	50		2605

b. ii. Mode = 47.5

c. Mean mark($\bar{x}$) = $\frac{\Sigma fx}{\Sigma f}$

$\bar{x} = \frac{2605}{50} = 52.1$

12. a. Sum of interior angles of a hexagon

$= (6 - 2)180°$

$= 720°$

Let α be the value of the equal angles,

then $\alpha + \alpha + 130° + 160° + 112° + 80° = 720°$

Solving $\alpha = 119°$

Hint: Sum of interior angles of n sided polygon is $(n - 2)180°$

b.
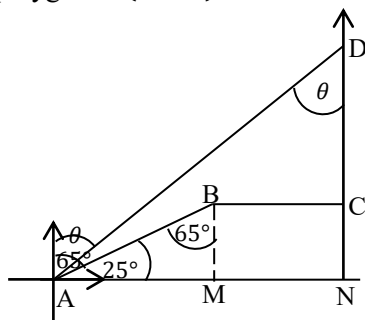
Hint: Use triangle ABM to find $|AM|$ and $|BM|$

Also in triangle AND,

$|AN| = |AM| + |MN|$ and $\tan\theta = \frac{AN}{DN}$

Bearing of D from A is 045°

SSSCE JULY 2001

1. a. {1, 2}, {1, 3}, {1, 4}, {2, 3}, {2, 4}, {3, 4}

b. i. $A \cap C = \{3, 5, 7, 11\}$

ii. $B \cap C = \{4, 6, 8, 10\}$

iii. $(A \cup B)' \cap C = \{9\}$

2. a. $\sqrt{0.0007} = \sqrt{7 \times 10^{-4}}$

$= \sqrt{7} \times 10^{-2} = 0.02646$

b.

$\oplus$	1	3	5	7
1	2	4	6	10
3	4	6	10	12
5	6	10	12	14
7	10	12	14	16

i. $x = 7$ ii. $n = 3$

3. a. $x = 4$ b. 0.1091

4. a. $441_{five} = 1321_{four}$ b. $x \leq -3\frac{2}{13}$

5. a. $y = 40$

6. a. $n = 10$

b. i. Let x represent the number of adults

Let y represent the number of children

Then $x + y = 500$

And $4000x + 2000y = 1600000$

Solving the above equations simultaneously gives

$x = 300, y = 200$

α. 300   β. 200

ii. α. ¢192,000.00   β. ¢32,000.00

7. c. $\overrightarrow{Q_2Q_3} = \begin{pmatrix} -4 \\ -14 \end{pmatrix}$

8. a. $\angle CQT = \angle RST$, alternate angles

$\angle QCT = \angle SRT$, alternate angles

$\angle CTQ = \angle RTS$, vertically opposite angles

ΔCQT and ΔRST are equiangular, hence they are similar

b. i. In ΔPQS, $\angle PSQ = 90°$

$\angle PQS = 90° - 65° = 25°$

$\angle RSQ = \angle CQT = 25°$

(Alternate angles)

c. In ΔCQR, $\angle QCR = 50°$ (angles at the centre of a circle is twice the angle at the circumference)

$\angle QCR = \angle CRS = 50°$, alternate angles

$\angle QRS = 180° - 65° = 115°$

(Angles in opposite segments add up to 180°)

$\angle CRQ = 115° - 50° = 65°$

9. a.

b. ii. $|AD| = 7.4cm$, $\angle ACD = 76°$

iii. $25cm^2$

10.

Marks	Tally	Freq. f	Midpt x	fx
10-19	//	2	14.5	29
20-29	////	4	24.5	98
30-39	##/ ##/ //	12	34.5	414
40-49	##/ /	6	44.5	267
50-59	/	1	54.5	54.5
60-69	##/ ///	8	64.5	516
70-79	##/	5	74.5	372.5
80-89	//	2	84.5	169
		$\Sigma f = 40$		$\Sigma fx = 1920$

c. i. Mode $= 35.5$

ii. Mean $= \dfrac{\Sigma fx}{\Sigma f}$

$= \dfrac{1920}{40} = 48$

11. a. Perimeter $= 400m$ b. $8582m^2$

12. a. $\tan \theta = \dfrac{3}{4}$

b.

i. $|BC| = 4.7m$

$|BQ| = (4.7 - 2)m = 2.7m$

Using ΔPCB, $\sin \theta = \dfrac{2.7}{5}$

$= 0.54$

So $\theta = 33°$

ii. $|AB| = 1.71m$

$|PB| = 4.209m$

$|PA| = |PB| - |AB| = 2.5m$

1. a.

b. i. 40%   ii. 70%   iii. 5%

2. a. $y = 361$ b. 6×10^{-7}

3. a. Multiplication modulo 7

$\otimes$	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	4	6	1	3	5
3	3	6	2	5	1	4
4	4	1	5	2	6	3
5	5	3	1	6	4	2
6	6	5	4	3	2	1

Addition modulo 7

$\oplus$	1	2	3	4	5	6
1	2	3	4	5	6	0
2	3	4	5	6	0	1
3	4	5	6	0	1	2
4	5	6	0	1	2	3
5	6	0	1	2	3	4
6	0	1	2	3	4	5

b. i. $n = 2, 5$ ii. 6

4. a.

b. $|PS| = 3cm$

5.

Score x	Freq. f	fx
4	3	12
5	2	10
6	5	30
7	4	28
8	6	48
	$\Sigma f = 20$	$\Sigma fx = 128$

a. Mean $(\bar{x}) = \frac{\Sigma fx}{\Sigma f}$

$= \frac{128}{20} = 6.4$

6. a. i. $\boldsymbol{b} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$ ii. $|\boldsymbol{d}| = 3\sqrt{5}$ units

 b. i. $x = 16km$

  ii. $|QS| = \frac{32}{3}\sqrt{3}\ km$

7. a. i. $\angle BCA = 72°$ ii. $\angle CAD = 36°$

  iii. $\angle CDA = 36°$

 b. i. $\angle DAT = 36°$ $\angle CAD = 36°$

  $\angle TAC = 2\angle CAD$ or $2\angle DAT$

  Hence AD bisects angle TAC

  ii. $\angle CAD = 36°$ and $\angle CDA = 36°$

  $\angle CAD = \angle CDA = 36°$

  ΔCAD is an isosceles triangle

  Hence $|CD| = |CA|$

8. a. ¢172,500   b. ¢3,038,000

 c. ¢782,25   d. ¢22.7%

9. a.

x	−3	−2	−1	0	1	2
y	−11	−3	3	7	9	9

3	4	5	6
7	3	−3	−11

 d. i. $x = -1.6, 4.5$ ii. $x = -1.2, 4.2$

  iii. $y = 9.2$

SSSCE JULY 2002

1. a. $6\frac{1}{4}$ b. $x < -\frac{1}{2}$
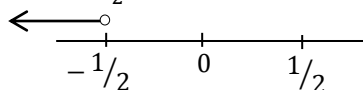
2. X works hard $\Rightarrow$X passes exams$\Rightarrow$X

 does not sleep in class.

 a. U = Students who work hard

  E = Students who pass their exams

  NS = Students who do not sleep in

Class
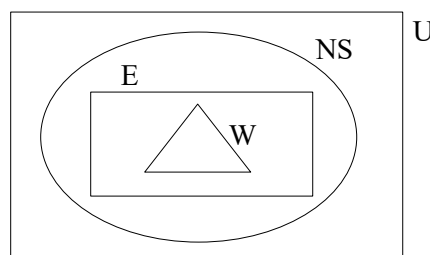
 b. i. Not valid ii. Not valid   iii. Valid

3. a. $x = 0.96$ b. $\left\{x : x = -\frac{3}{4}\ or\ 2\right\}$

4. a. 160   b. ¢187,500.00

5. a.
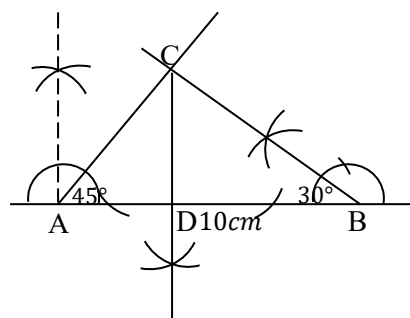
 b. $|CD| = 3.8cm$

6. a. ¢457.60   b. 17.8%

7. a. i.
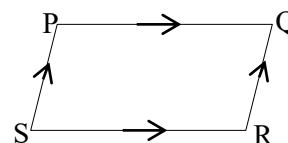
 Q is the point $(2, 2)$. Using the

 equation $\overrightarrow{PS} = \overrightarrow{QR}$, S is the point

 $(-5, -2)$

  ii. $|PR| = \sqrt{185}$ units or 13.0615 units

 b. i. $d = \frac{u^2}{u-f}$ ii. 84.5

8. a.

x	−3	−2	−1	0	0.5	1
y	−32	−13	0	7	8.25	8

1.5	2	2.5	3	3.5	4
6.25	3	−1.75	−8	−15.5	−25

 b.
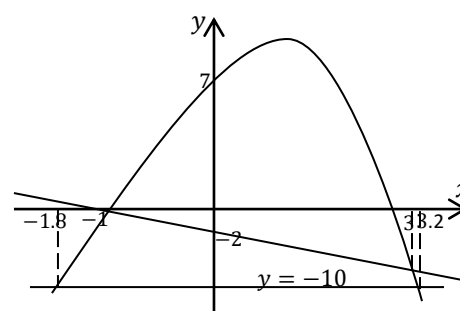
d. i. $x = -1, 3$ ii. $x = -1.8, 3.2$

9. a.

Marks (%)	Marks less than	Freq.	Cum. Freq.
$0 - 9$	9.5	2	2
$10 - 19$	19.5	5	7
$20 - 29$	29.5	8	15
$30 - 39$	39.5	18	33
$40 - 49$	49.5	20	53
$50 - 59$	59.5	15	68
$60 - 69$	69.5	5	73
$70 - 79$	79.5	4	77
$80 - 89$	89.5	2	79
$90 - 99$	99.5	1	80

b. i. Median $= 44\%$

  ii. 60th percentile $= 46.5$

c. 7 students passed with distinction. 8.75% of the students had distinction.

10. a. i. $5.74cm$ ii. $6.11cm$ iii. $15.3cm^2$

    iv. $3.53cm^2$

  b. i. $314.29cm^3$ ii. $282.86cm^3$

11. a. Let the numbers be x and y

    $x + y = 8$ ……..(1)

    $xy = -33$ ……..(2)

    Solving (1) and (2), simultaneously,

      $x = 11$ when $y = -3$;

      $x = -3$ when $y = 11$

  b. $h = 7.7m$ c. ₦2400.00

12. b. ii. $U_1(3, 7)$ $V_1(6, -7)$ $W_1(3, -3)$

    iii. $U_2(-4, 3)$ $V_2(-1, 6)$ $W_2(0, 3)$

  c. i. $14x + 3y - 63 = 0$ ii. 6 units

SSSCE November 2002

1. a.

$$n(M \cup N) = 40$$
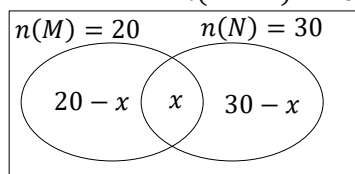
$n(M \cap N) = 10$

  i. $x = \dfrac{24\sqrt{t}}{s}$ ii. $x = 8$

2. a. $m_1 = \dfrac{3}{2}$

  For parallel lines, $m_1 = m_2$

  $3x - 2y = 0$ is the line parallel to the straight line $y = \dfrac{3}{2}x + 5$

  b. $x = 8$

3. a. $3 : 5 : 7$

  b. i. $m = \dfrac{-pn}{p-n}$ or $\dfrac{pn}{n-p}$ ii. $m = 340.9$

4. a. ¢27,191   b. $p = 5$ and $q = 2$

5. a. Let U = {people},

    H = {hardworking persons}

    S = {students},   C = {careless persons}
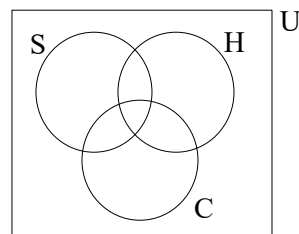
  b. i. Not valid (because if Jacob is in C, he cannot be in H)

    ii. Not valid (because if Zenzen is in H, he cannot be in C)

    iii. Valid (because Owusu is not in S, but he can be in H)

6. a. $565   b. $2076.67

7. b. i. $|OA| = 5.9cm$ ii. $\angle ACB = 42°$

8. a. i. $r = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$ ii. $m = \dfrac{7}{2}$ and $n = -\dfrac{3}{2}$

  b. i. B$(5, 0)$ C$(0, 8)$

    ii. Hint: $\overrightarrow{AB} + \overrightarrow{AC} = 2\overrightarrow{AD}$

    $\overrightarrow{OB} - \overrightarrow{OA} + \overrightarrow{OC} - \overrightarrow{OA} = 2(\overrightarrow{OD} - \overrightarrow{OA})$

    $\begin{pmatrix} 3 \\ 4 \end{pmatrix} = \begin{pmatrix} 3 \\ 4 \end{pmatrix}$

    Since L.H.S = R.H.S

    $\overrightarrow{AB} + \overrightarrow{AC} = 2\overrightarrow{AD}$

9. c. i. 72.5%   ii. 74.5%

10. a. $y = 0, 8\dfrac{1}{3}$

  b. i. $\angle QRS = 100°$ ii. $\angle QTS = 80°$

    iii. $\angle SQR = 21°$

11. a.

x	-5	-4	-3	-2	-1
y	-12	-5	0	3	4

0	1	2	3
3	6	-5	-12

b.
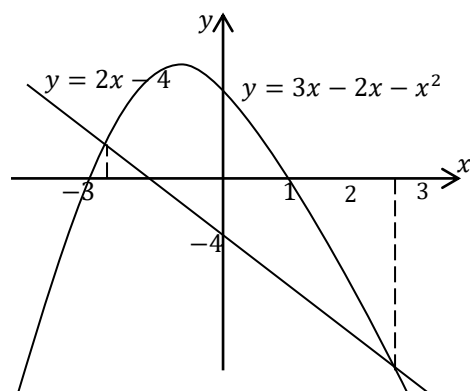
c. i. $x = -1$ ii. $\{x : x = -2.65, 2.55\}$

iii. $-3 < x < 1$

12. a. $36.87°$ b. $7.8cm$ c. $365cm^3$

d. $56.23°$

SSSCE JULY 2003

1. a. 1.5×10^{-1}

b. i. $4\sqrt{3} - 3\sqrt{2}$ ii. 2.69

2. a. $A \cap B = \{-3 < x < 2\}$
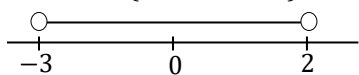
3. a. i. $¢250.00$ ii. $¢362.50$

b. $(2x - 3m)(y + 2a)$

Hint factorize by grouping

4. a. $P = \dfrac{32}{(Q+1)^2}$ b. $Q = -3, 1$

5. a. $x = 48°$ b. $C = \begin{pmatrix} 8.040 \\ 8.928 \end{pmatrix}$

6. a. 8 students   b. 18 students

7. a. 15   b. 3.03

8. a.

x	-2.25	-2.0	-1.5	-1.0	-0.5
y	3.58	1.0	-0.83	-1.0	-0.5

0	0.5	1	1.5
0.33	1.36	2.5	3.72

b.
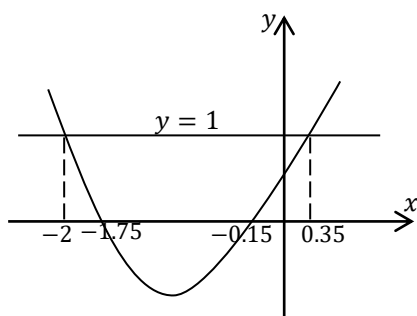
i. $x = -1.75, 0.15$ ii. $x = -2, 0.35$

9. a. $x = \frac{1}{2}, 1$ b. i. $\angle QPS = 100°$

iii. . $\angle QRS = 80°$ iii. . $\angle RQS = 75°$

10. a. $6.4cm$ b. i. $15cm$ ii. $24226cm^3$

11. b. ii. $P_1(6, 7)$ $Q_1(4, -2)$ $R_1(9, -4)$

iii. $P_2(-9, 6)$ $Q_2(-4, 4)$ $R_2(-6, 9)$

iv. $P_3(-3, 0)$ $Q_3(-5, -5)$ $Q_3(0, -3)$

c. Gradient $(m) = \frac{4}{7}$

12. a. i. $|TQ| = 25km$

ii. Quadrilateral ABCD is a trapezium

SSSCE November 2003

1. a.

$\otimes$	2	3	4	5	6
2	4	6	1	3	5
3	6	2	5	1	4
4	1	5	2	6	3
5	3	1	6	4	2
6	5	4	3	1	1

b. The truth set is $\{x : x = 2, 5\}$

2. a. 2.1×10^{-1} b. $\left\{x : x < \frac{7}{4}\right\}$

3. a. 2.1133 b. $¢140,400.00$

4. a.
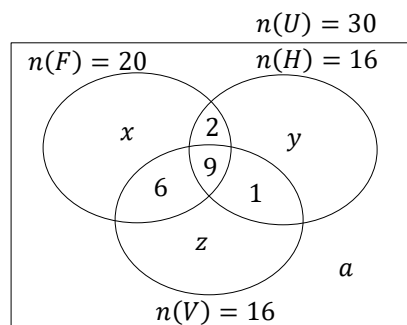
b. 18 students   c. $\frac{1}{6}$

5. a.

x	-2.0	-1.0	0	0.5	1.0
y	-5	0	3	3.75	4

1.5	2.0	2.5	3.0	3.5	4.0
3.75	3	1.75	0	-2.25	-5.00

b.
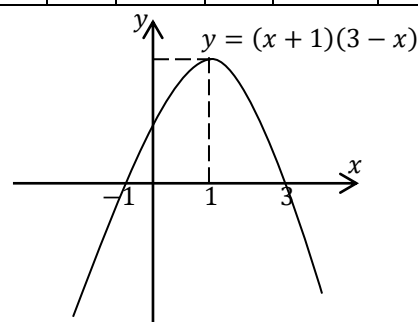
c. The greatest value of $(x + 13)(3 - x)$ is

4 and it occurs at $x = -1$

6. a. ¢146,500   b. 458 units

7. a. i.

Marks	Less than	Freq. f	Cum. Freq.
$1 - 5$	5.5	2	2
$6 - 10$	10.5	3	5
$11 - 15$	15.5	7	12
$16 - 20$	20.5	9	21
$21 - 25$	25.5	11	32
$26 - 30$	30.5	13	45
$31 - 35$	35.5	7	52
$36 - 40$	40.5	5	57
$41 - 45$	45.5	2	59
$46 - 50$	50.5	1	60

  b. i. 24.5%   ii. $60 - 15 = 45$ students

  iii. 37%

8. a. ¢110344.83   b. $\overrightarrow{PR} = (5km, 257°)$

9. a. i. $C = 10,000 + 75LB$

   ii. C = ¢160,000.00

  b. $\angle MLN = 29°$

10. a. $A^1(2, 0)$ $B^1(3, 3)$ $C^1(6, 7)$

   b. $A^{11}(2, 2)$ $B^{11}(4, 8)$ $C^{11}(10, 16)$

   c. $A^{111}(2, -1)$ $B^{111}(-1, 0)$

    $C^{111}(-5, 3)$

11. a. i. $P = n + p$ ii. 3.6%

  b. $576 kmh^{-1}$

12. a. 8cm   b. $56.57 cm^3$

   c. $146.5577 cm^2$

SSSCE JULY 2004

1. a. $x = 5$ b. $-\frac{24}{5} + \frac{4}{5}\sqrt{5}$

2. a. 6,500 votes   b. 780 votes

3. a. $x = 30°$ b. 0.0970

4. a. i. D(1, −1)   ii. $\overrightarrow{AD} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$

  b. $\overrightarrow{BC}$ and $\overrightarrow{AD}$ are equal and parallel vectors

5. a.
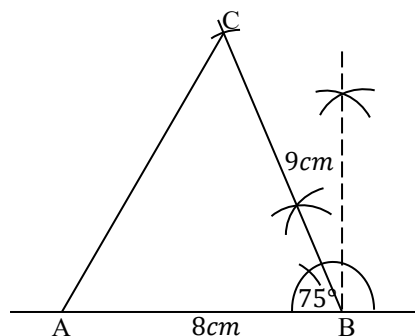
b. Angle BAC = 56°

6. a. i.

$\oplus$	2	3	5	7
2	4	5	7	0
3	5	6	8	1
5	7	8	1	3
7	0	1	3	5

$\otimes$	2	3	5	7
2	4	6	1	5
3	6	0	6	3
5	1	6	7	8
7	5	3	8	4

   ii. α. 1   β. $\{n : n = 2, 5\}$

  b. $3y - 2x - 7 = 0$

7. a. i. $y = $ ¢500.00   ii. $x = $ ¢2,000.00

   iii. ¢6,000.00

  b. $\left\{x : x = 2, \frac{4}{3}\right\}$

8. a.

Class Interval	Freq. f	Upper Class Boundary	fx
$1 - 10$	2	10.5	2
$11 - 20$	3	20.5	5
$21 - 30$	4	30.5	9
$31 - 40$	6	40.5	15
$41 - 50$	9	50.5	24
$51 - 60$	6	60.5	30
$61 - 70$	5	70.5	35
$71 - 80$	2	80.5	37
$81 - 90$	2	90.5	39
$91 - 100$	1	100.5	40

  c. i. 32   ii. 52

9. a. Let x be the total number of balls

   i. Number of red balls = 10

   ii. P(green balls) $= \frac{5}{18}$

  b. i.

x	−1	0	1	2	3
y	4	−2	−11	−8	−8

4	5	6
−6	−2	4

  ii.
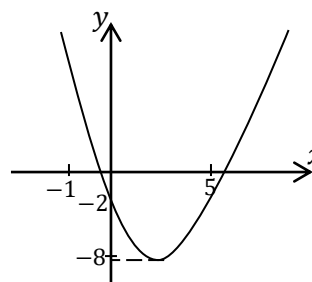
iii. Minimum value of $y = -8.3$

10.
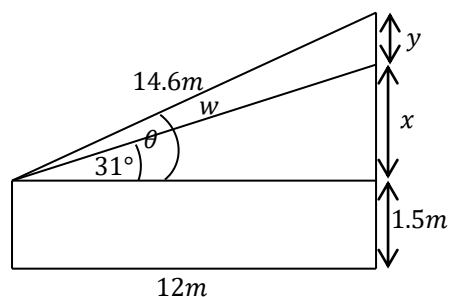
a. $35°$ b. $9.8m$ c. $8.7m$

11. a. $\angle TQR = 50°$ b. $\angle PSQ = 20°$

b. i. $r = 9.77cm$ ii. $429.2856cm^2$

12. b. ii. $P_1(2,4)$ $Q_1(8,8)$ $R_1(8,4)$

iii. $P_2(0,2)$ $Q_2(4,8)$ $R_2(0,8)$

iv. $P_3(-2,0)$ $Q_3(-8,4)$ $R_3(-8,0)$

c. $90°$ clockwise or $270°$ anticlockwise about the origin

SSSCE November 2004

1. a.
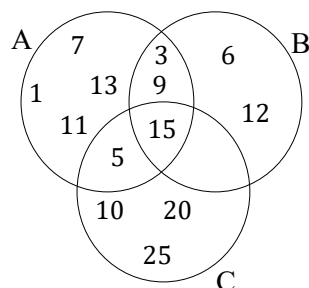
b. i. $\{15\}$ ii. $\{10,20,25\}$ iii. 10

2. ¢4,552,000

3. a. $3x + 2y + 6 = 0$ b. 10.8 units

4. a. ¢3,500,00   b. $x > 3.5$
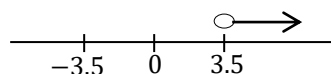
5. a. 13.566   b. 12 years

6. a. $x = 2$ and $y = -2$ b. 24

7. a. ¢16,000,000   b. ¢1,190,000

c. 22.3%

8. b. $5.0m$ c. $\frac{7}{15}$ or 0.4667

9. a.

x	-2	-1	0	1	2	3	4	5
y	-6	0	4	6	6	4	0	-6

b.
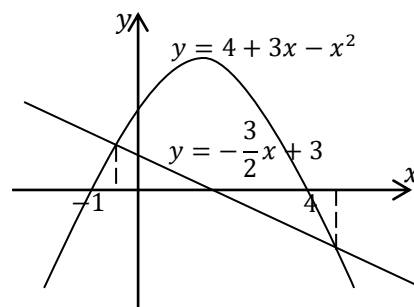
c. i. $x = -1, 4$ ii. $x = -0.15, 4.8$

iii. The maximum value is 6.2

10. a. $q = 10$ b. $\theta = 19.47°$

c.
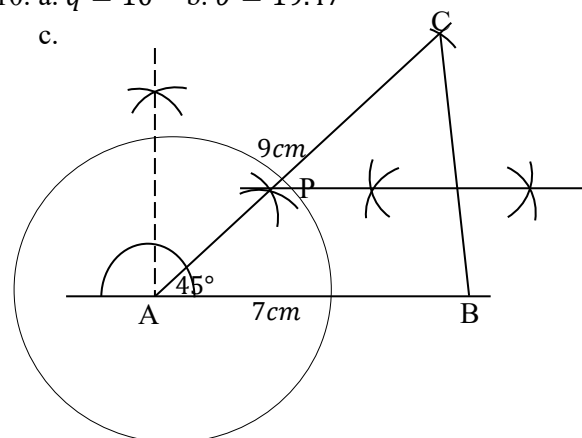
$|PB| = 4.1cm$

11. a. $15.3cm$ b. $13cm$ c. $48.9°$

d. $1107.9cm^3$

12. c. i. $y = -1$

ii. $90°$ anticlockwise or $270°$ clockwise rotation about the origin

iii. $A_3(-9,-8)$ $B_3(-3,-8)$

$C_3(-3,-2)$

SSSCE JULY 2005

1. a. i. The image of -1 and 3 are 1 and 5 respectively

ii. $x = 2$

b. $25°$

2. a. 2.778   b. ¢619,650,000.00

3. $w_2 = 24$ $r_3 = 3$

4. a. i. $\frac{7}{16}$ ii. $\frac{11}{48}$ b. $175cm^2$

5. a. i. $l = \frac{A-\pi r^2}{\pi r}$ ii. 15.67

b. 1300km

6. b. i. 24   ii. 2

7. a.

x	-3	-2	-1	0
y	6	2.5	0	-1.5

1	2	3	4	5
-2	-1.5	0	2.5	6

b.
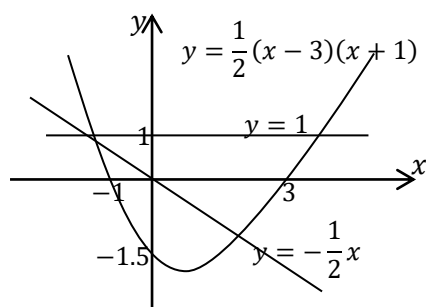
c. i. $x = -1.45, 3.45$ ii. $x = -1.3, 2.3$

8. a. $x = 5$

b. i. $\overrightarrow{PQ} = \begin{pmatrix} 6 \\ 8 \end{pmatrix}$ $\overrightarrow{QR} = \begin{pmatrix} -10 \\ 0 \end{pmatrix}$ $\overrightarrow{PR} = \begin{pmatrix} -4 \\ 8 \end{pmatrix}$

ii. $|\overrightarrow{PQ}| = 10$ units $|\overrightarrow{QR}| = 10$ units

$|\overrightarrow{PR}| = 4\sqrt{5}$ units

Since $|\overrightarrow{PQ}| = |\overrightarrow{QR}|$, it implies the

triangle isosceles

9. a.
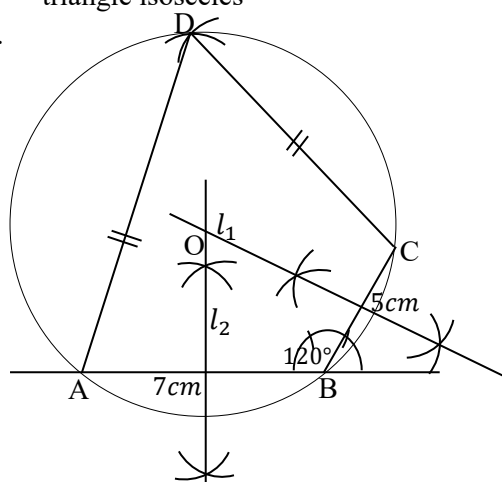
d. i. Angle BCD = 97°

ii. Radius of the circle = $5.9cm$

10. a. i.
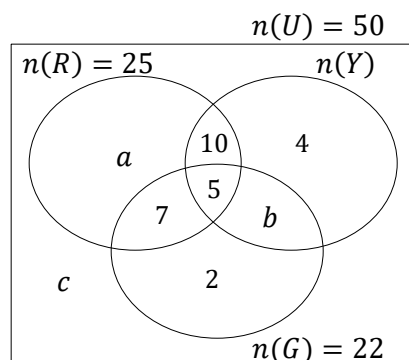
ii. 11 girls

b. ¢6,400

11. a. 3,905km

b. i. Angle OBC = 38°

ii. Angle COB = 104°

12.
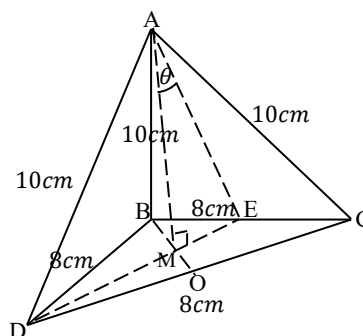
$|BM|$ is the $\frac{2}{3} \times$ height of ΔBCD

$= \frac{2}{3}|BO|$

a. $|BM| = 4.6cm$ b. $|AM| = 8.88cm$

c. 75.47°   d. $81.696cm^3$

SSSCE November 2005

1. a.

$\otimes$	3	5	7
3	1	7	5
5	7	1	3
7	5	3	1

b. i. 1   ii. $\{n: n = 3, 5 \text{ and } 7\}$

2. a. $Q = \{11, 12, 13, 14, 15\}$ b. $x = 17.2$

3. a. 15 sides   b. ¢800,000.00

4. a. 60 thousand litres   b. ¢80,400.00

5. $|EF| = 52.1cm$

6. a. i. ¢12,000,000.00   ii. ¢19,200,000

iii. ¢16,800,000

b. 12 apples cost ¢4,320 and 20 eggs cost

¢17,280

12 apples and 20 eggs will cost ¢21,600

7. a. $y + 2x = 1 \Longrightarrow y = 1 - 2x$

x	-6	0	2
y	13	1	-3

$y - 3x = 11 \Longrightarrow y = 11 + 3x$

x	-6	0	1
y	-7	11	14
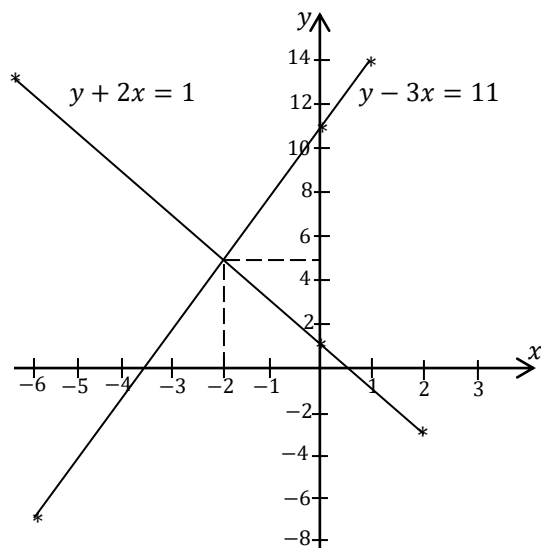
The point of intersection is $(-2, 5)$

b. $x = 4$ c. $|OC| = 5cm$

8. a.

Marks (%)	Freq. f	Marks less than	Cum. Frequency
$0 - 9$	8	9.5	8
$10 - 19$	10	19.5	18
$20 - 29$	14	29.5	32
$30 - 39$	28	39.5	60
$40 - 49$	46	49.5	106
$50 - 59$	25	59.5	131
$60 - 69$	17	69.5	148
$70 - 79$	9	79.5	157
$80 - 89$	2	89.5	159
$90 - 99$	1	99.5	160

b. i. Lower quartile = 32.5

Upper quartile = 54

Interquartile range = $54 - 32.5$

$\qquad\qquad = 21.5$

ii. 11.25%

9. a. $|\overrightarrow{BC}| = 10$ units

b. i.
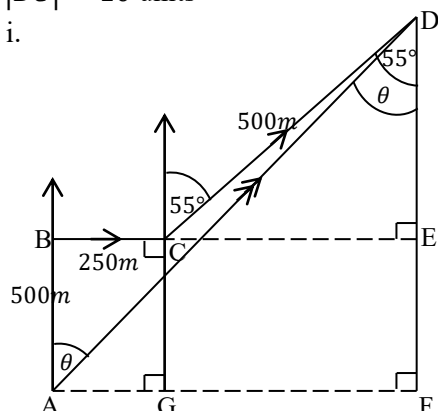
ii. $787m$ iii. $660m$ iv. $40°$

10. b. ii. $A_1(-6, 2)$ $B_1(-2, 4)$ $C_1(-6, 8)$

iii. $A_2(3, -1)$ $B_2(5, -5)$ $C_2(9, -1)$

iv. $A_3(2, -10)$ $B_3(4, -6)$ $C_3(8, -10)$

c. $|B_1 B_2| = 2\sqrt{34}$ units

11. a. i. Angle $SQN = 72°$

ii. Angle $MSQ = 52°$

b. i. Angle $PQR = 97°$

ii. Angle $QRS = 66°$

12. a. i. $875cm^2$ ii. $1562.5cm^3$

iii. $Q(10, 2)$

WASSCE June 2006

1. a. $x = -1$ b. $S = 4$

2. a. $(3x + 2)(2x - 3)$ b. ₦9.00

3. a. i. $\angle QPR = 58°$ ii. $\angle MQO = 75°$

b. 9 sides

4. a. 5.0×10^{-3} b. i. $63.2cm$ ii. $246.4cm^2$

5. a. i. $\frac{5}{12}$ ii. $\frac{11}{24}$ b. 9

6. a. $-\frac{1}{2}$

b.i.
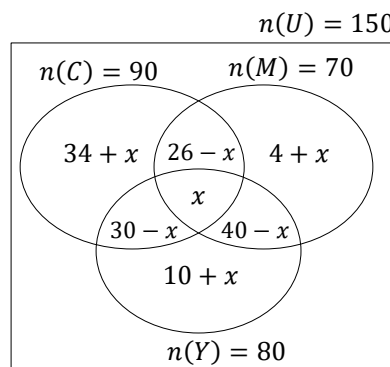
ii. 6   ii. 66

7. a. Le 39,130

b.
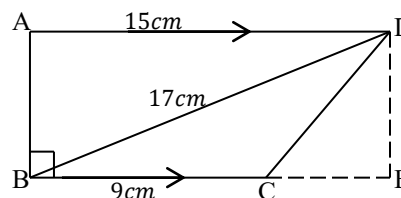
i. $|AB| = 8cm$ ii. $36cm^2$

iii. $|CD| = 10cm$ iv. $42cm$

8. a.
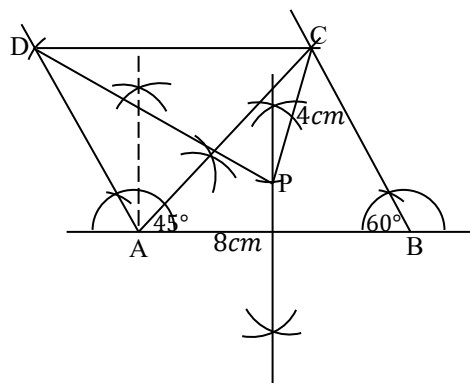
b. $|PD| = 7.9cm$

9. a.

⊗	2	3	5	7
2	4	6	2	6
3	6	1	7	5
5	2	7	1	3
7	6	5	3	1

b. i. $\{n: n = 7\}$ ii. $\{n: n = 3, 5, 7\}$

c. i. $Q = \{-2, -1, 2\}$

ii.
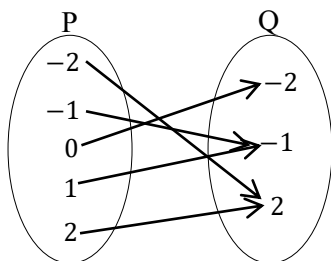
Alternatively, a graph of
$f(x) = x^2 - 2$ can be drawn
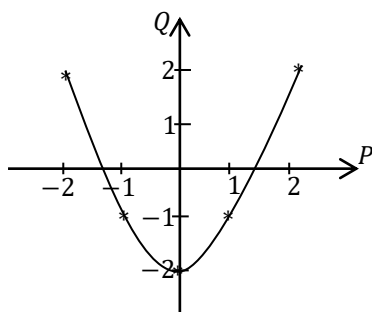
10. a.

x	-3	-2	-1	0
y	-29	-14	-3	4

1	2	3	4	5
7	6	1	-8	-21
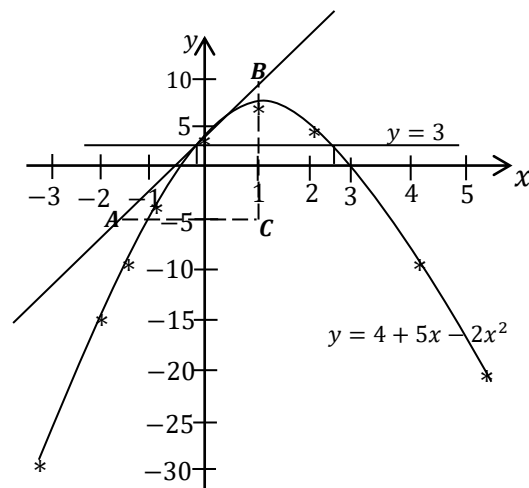
c. i. 1.25   ii. 5.0   iii. -0.2 and 2.7

11. a. $\angle TRK = 116°$

b. i. $z = x + y$ ii. $\angle STP = 121°$

c. 2

12. a. i. $\overrightarrow{BC} = n - m$

ii. $\overrightarrow{TA} = \overrightarrow{TC} + \overrightarrow{CA}$

$\overrightarrow{TA} = \frac{2}{3}\overrightarrow{BC} + \overrightarrow{CA}$

$\overrightarrow{TA} = \frac{2}{3}(n - m) - n$

$\overrightarrow{TA} = -\frac{1}{3}(2m + n)$

b. i. 13.5 units   ii. $r = \begin{pmatrix} -14 \\ 17 \end{pmatrix}$

13. a.

Marks	Marks less than	Freq.	Cumulative Freq.
$1 - 10$	10.5	2	2
$11 - 20$	20.5	5	7
$21 - 30$	30.5	9	16
$31 - 40$	40.5	10	26
$41 - 50$	50.5	12	38
$51 - 60$	60.5	5	43
$61 - 70$	70.5	4	47
$71 - 80$	80.5	3	50

c. i. 24.5   ii. $\frac{1}{25}$

WASSCE November 2006

1. a. Addition table in modulo 12

⊕	2	5	7	11
2	4	7	9	1
5	7	10	0	4
7	9	0	2	6
11	1	4	6	10

Multiplication table in modulo 12

$\otimes$	2	5	7	11
2	4	10	2	10
5	10	1	11	7
7	2	11	1	5
11	10	7	5	1

b. i. 4   ii. $n = 5$

2. a. $x = -4y$ $x = 2\frac{2}{5}$

  b. 19

3. $x = 5$

4. a. $(m - n - 3\sqrt{r})(m - n + 3\sqrt{r})$

  b. i. $x < 4$

   ii.

$$\begin{array}{ccc} & & \\ -4 & 0 & 4 \end{array}$$
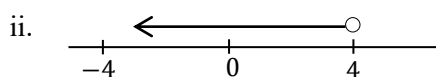
5. a. ¢900,000.00   b. ¢90,000.00

  c. ¢46.67%

6. a. i.

$n(U) = 100$
$n(H) = 50$ $n(S) = 65$
c 20 x
15   y
z
$n(B) = 40$
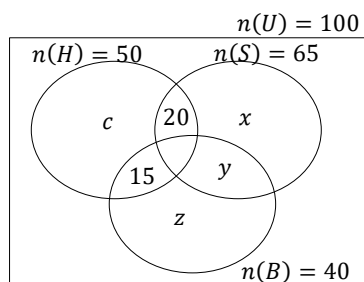
  ii. α. 30   β. 45   γ. 45

  b. 8cm

7. a.

x	-2.5	-2	-1	0
$2x^2$	12.5	8	2	0
$(x + 6)$	3.5	4	5	6
y	9	4	-3	-6

1	1.5	2	2.5	3
2	4.5	8	12.5	13
7	7.5	8	8.5	9
-5	-3	0	4	9

b.
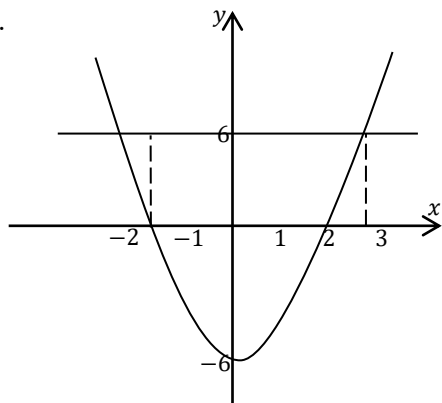
c. i. $x = -1.5, 2$ ii. $x = -2.2, 2.7$

8. a. 4   b. ¢12,000,000.00

  c. i. 15   ii. $-\frac{2}{5}$

9. a.

D   5.8cm   C
5.6cm
A   N   10.2cm   60°   B
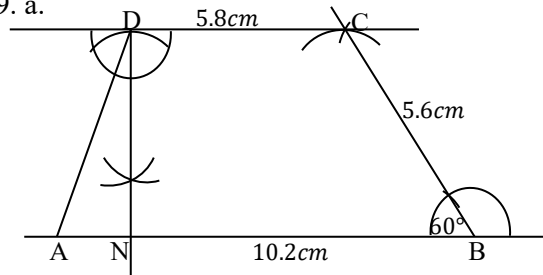
  $|AD| = 5.0cm$

  b. $|DN| = 4.8cm$ c. $38.4cm^2$

10. a.

Marks	Tally	Freq.	Marks less than	Cum. Freq.
1-10	/	1	10.5	1
11-20	////	4	20.5	5
21-30	⧸⧸⧸⧸	5	30.5	10
31-40	⧸⧸⧸⧸ //	7	40.5	17
41-50	⧸⧸⧸⧸ //	7	50.5	24
51-60	⧸⧸⧸⧸ /	6	60.5	30
61-70	////	4	70.5	34
71-80	///	3	80.5	37
81-90	//	2	90.5	39
91-100	/	1	100.5	40
	$\Sigma f = 40$			

  c. i. 45   ii. $\frac{11}{40}$

11. a. i. $\frac{¢48000}{m}$ ii. $m - 40$

   iii. $¢\left(\frac{48000}{m} + 100\right)$

   iv. $¢\left[(m - 40)\left(\frac{48000}{m} + 100\right)\right]$

  b. i. 240   ii. ¢200.00

12. b. ii. $A_1(-8, 4)$ $B_1(-10, 8)$ $C_1(-6, 8)$

   iii. $A_2(-4, -4)$ $B_2(-6, -8)$
     $C_2(-2, -8)$

   iv. $A_3(4, -4)$ $B_3(6, -8)$ $C_3(2, -8)$

  c. Reflection in the line $x = 0$ or y-axis

WASSCE June 2007

1. a. $y = n - m$ b. $1.5km$

2. a. $(x - 1)(x + a)$ b. $x = 30°$ $y = 42°$

3. a. $12.5cm$ b. $407cm^2$

4. a. $391m$ b. $156°$

5. a. $\frac{5}{12}$ b. $\frac{11}{12}$

6. a. $\frac{3}{(x+2)(x-1)}$ b. i. 2 hours   ii. $58km/hr$

7. a. $x = -4, \frac{3}{2}$ b. 0.4771 c. $x = 1$, $y = 2$

8. a. $V = 4.713m^3$

   $V = 4713$ litres $[1m^3 = 1000 \; litres]$
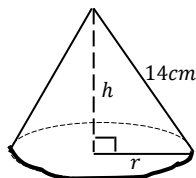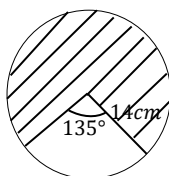
   b. i. $|DE| = 10.8cm$ ii. $|EC| = 2cm$

9.
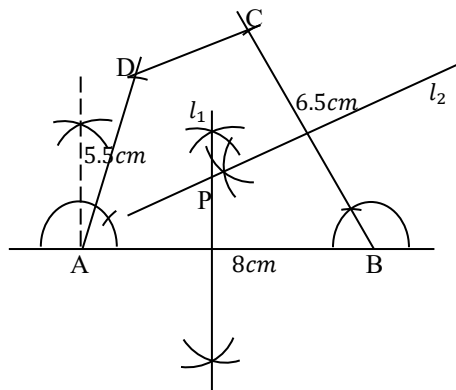
10. a. i. $y = \frac{2.6}{x}$ ii. $y = 0.1$

   b.

   i. $5.25cm$ ii. $12.98cm$

11. a. $x = 6, y = 7$

   b. 1.79

12. c. $A_1(-2,-2)$ $B_1(-8,-2)$ $C_1(-6,-6)$

   d. $A_2(-6,10)$ $B_2(0,10)$ $C_2(-2,14)$

   e. $A_3(6,-2)$ $B_3(12,-2)$ $C_3(10,-6)$

   f. Reflection in the line x-axis followed by

      a translation by the vector $\begin{pmatrix} 4 \\ 0 \end{pmatrix}$

13. a. i. $2x + 1$ ii. $x < -1$

   iii. $-x^2 + 2x - 2$

   b. i. 5 units   ii. $m = -2$

WASSCE November 2007

1. a. $1\frac{1}{5}$ b. 1

2. a. i. $x < -8$
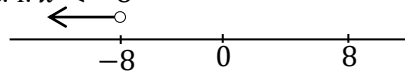
   b. $y = 196$

3. a. $x = 54.0°$ b. $|RP| = 16m$

4. a.

	1	2	3	4	5	6
1	1,1	1,2	1,3	1,4	1,5	1,6
2	2,1	2,2	2,3	2,4	2,5	2,6
3	3,1	3,2	3,3	3,4	3,5	3,6
4	4,1	4,2	4,3	4,4	4,5	4,6
5	5,1	5,2	5,3	5,4	5,5	5,6
6	6,1	6,2	6,3	6,4	6,5	6,6

   i. $\frac{5}{18}$ ii. $\frac{5}{6}$

5. a. $8.56cm$ b. $8.03cm$

6. a. i. $B = \{1, 3, 5, 7, 9, 11, 13, 15\}$

   ii. $B \cap C = \{3, 5, 7, 11, 13\}$

   iii. $(A \cap B)' =$

      {all real numbers except members in A}

   b. $n = 7$ c. -12

7. a. $w = 7cm, l = 10.5cm$

   b. i. $\angle APO = \angle ARB = 90°$

      (angle the radius makes with the tangent)

      $\angle BAR = \angle PAO$ (comon angles)

      $\angle AOP = \angle ABR$ (angles of a triangle)

      $\therefore \triangle APO /// \triangle ARP$

      Thus $\triangle APO$ and $\triangle ARB$ are similar

   ii. $|BR| = 60cm$

8. a.

x	-5	-4	-3	-2	-1.5
y	22	9	0	-5	-6

-1	-0.5	0	1	2	2.5
-6	-5	-3	4	15	22
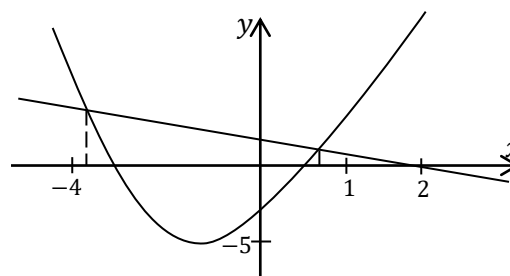
   c. $x = -3.7, 0.7$

9.

Mark(x)	Freq. f	fx	x^2	fx^2
1	14	14	1	14
2	30	60	4	120
3	32	96	9	288
4	40	160	16	40
5	52	260	25	1300
6	80	480	36	2880
7	59	413	49	2891
8	56	448	64	3584
9	21	189	81	1701
10	16	160	100	1600
$Total$	400	2280		15018

a. 5.7   b. 2.2

10. a. i. $\frac{1}{4}$ ii. $x = -9$

b.

$\otimes$	1	2	3	4
1	1	2	3	4
2	2	4	1	3
3	3	1	4	2
4	4	3	2	1

$n = 2$

c. $28.3cm^3$

11.
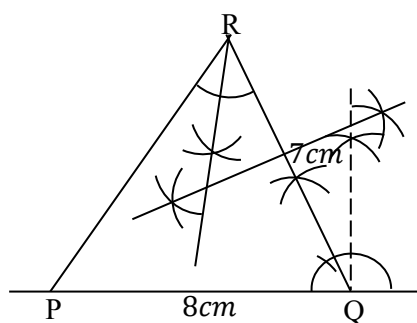
c. i. $|SR| = 4cm$ ii. $\angle PRQ = 57°$

12. a. $m = 3, n = -1$

b. i. 8.54 units   ii. 069°

13. b. ii. $P_1(3, -2)$ $Q_1(9, -8)$ $R_1(2, -7)$

iii. $P_2(-2, -3)$ $Q_2(-8, -9)$

$R_2(-7, -2)$

c. 101°

June 2008

1. a. $p:q = 12:1$ b. $s = 8$ and $t = -6$

2. a. $x = 70°$ b. $15m^3$

3. a. $c = 5$ b. $\frac{1}{2}$ or 2^{-1}

4.
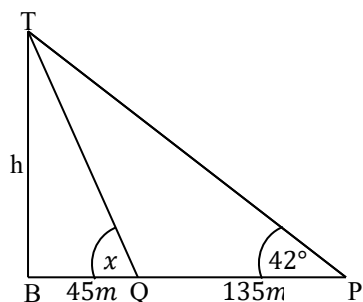
a. $x = 74.5°$ b. $x = 60°$

5. a. Sample space,

  $S = \{7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17,$
      $18, 19, 20, 21, 22, 23, 24, 25, 26\}$

  P(set of prime number or multiples of 3) $= \frac{3}{5}$

  b. $i = 72°$ $j = 24°$

6. a. $x = \frac{1}{4}$ b. $x \geq -3$ c. $x = 12kmh^{-1}$

7. a

x	-2	-1	0	1	2	3	4	5	6
y	16	**8**	2	**-2**	**-4**	-4	-2	**2**	**8**

  b.
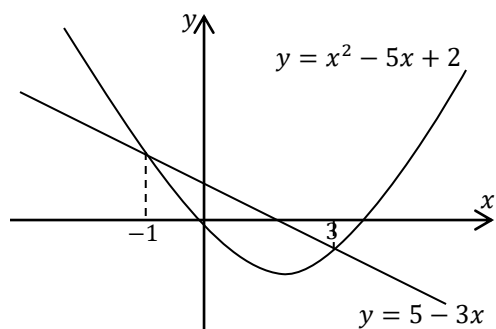
  c. $y = 5 - 3x$

x	-2	-1	0	1	2	3	4	5	6
y	11	8	5	2	-1	-4	-7	-10	-13

  d. $x = -1, 3$

8. b. i. $\angle ACD = 38°$ ii. $\angle DBC = 14°$

9. a. 7.4834   b. D30600   c. $37.00

10. a. Mean$(\bar{x}) = 40.8$ c. $\frac{7}{50}$ or 0.14

11. a. $\frac{11}{14}$ or 0.7857 b. i. $68°$ ii. $11m$

12. a. $p = 3$ $q = -2$

  b. i. $C(5, -4)$ ii. $|\overrightarrow{AC}| = 2.2$

November 2008

1. a. $x = -3$ $y = 4$ b. $16cm, 20cm, 28cm$

2. a. 60   b.

3.
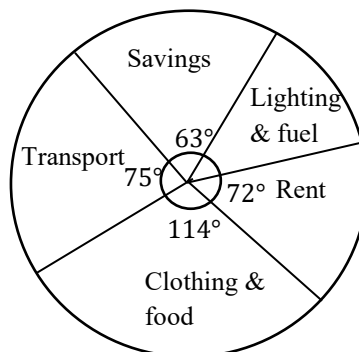
  b. 17.5%

4. b. 252°

5. a. i. $\angle ABC = 117°$ ii. $\angle CED = 27°$

  b. $x = 127°$

6. b. i. $|QR| = 7.6cm$ ii. $|SR| = 12.0cm$

7. b. ii. 32

8. c. i. $x = -0.6$ and 3.3 ii. $y = 4, x = 1$

9. a. $836cm$ b. $36988.89m^2$

10. a. $844.80   b. 7.4%

11. a. $x = 22°$ b. $74.3m$

12. a. i. 42   ii. $x = \frac{4}{3}, \frac{1}{3}$ b. $C(0, 4)$ $D(-5, 3)$

13. b. $y = -1$

June 2009

1. a. $n = \frac{1}{2}$ b. $\frac{x}{x-3}$

2. a. i. Mode $= 3$ ii. 4   iii. $\frac{2}{3} = 0.67$

  b. 75°

3. a. i. 36.87°   ii. 1.5   b. 7.2m

4. a. $x + y - 3$ b. $2.4cm$

5. $600cm^2$

6. a. $x:y = 5:2$

  b. i. $x = 8$kg, $y = 12$kg   ii. 17.9%

7. b. Mean$(\bar{x}) = 78.75$ c. 25%
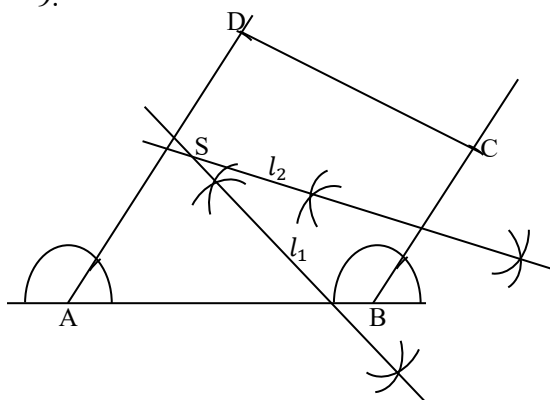
8. a.

x	-4	$-3\frac{1}{2}$	-3	-2	-1
y	-5	0	4	9	10

| 0	1	$1\frac{1}{2}$	2
7	0	-5	-11

b.
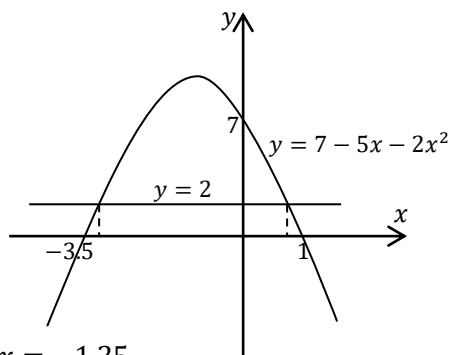
c. i. $x = -1.25$

ii. Maximum value of $y = 10.1$
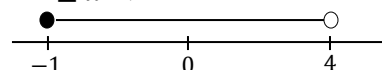
iii. $-3.3, 0.7$ iv. $y > 0 \Rightarrow -3.5 < x < 1$

9.

iv. $|AS| = 5.3cm$

10. a. $s = \dfrac{n\sqrt{p}(n-1)}{2}$

b. i. $\angle ACB = 37°$ ii. $|CD| = 4.3cm$
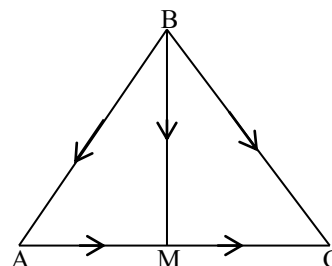
iii. $41cm^2$

11 . b. $L = 9cm, W = 3$cm

12. a.

*	1	2	3	4
1	1	2	3	4
2	2	4	1	3
3	3	1	4	2
4	4	3	2	1

b. i. $n = 1$ ii. $n = 2$

c. i. 1.5 ii. $x = -\dfrac{3}{2}$ or 1

13. a. i. $Q(4, -1)$ ii. $\overrightarrow{PN} = \begin{pmatrix} -3 \\ 1 \\ -\frac{1}{2} \end{pmatrix}$

b. i. Gradient $(m) = -2$

ii. $y + 2x - 6 = 0$

November 2009

1. a. $n = -\dfrac{3}{4}$ b. $\dfrac{8}{31}$

2. a. $y = 2$ b. $2175.25cm^3$

3. a. $\dfrac{3}{14}$ b. $X = 1000$ litres $Y = 400$ litres

4. a. $\angle QSP = 75°$ b. $\angle RQO = 48°$

5. a. $\dfrac{5}{92}$ b. $\dfrac{20}{69}$

6. a. Let U = {women in the group}

Y = {women who sell yam}

M = {women who sell maize}

P = {women who sell plantain}

C = {women who sell maize and plantain}

a = women who sell plantain only

$n(U) = 34, n(Y) = 22, n(M) = 14$
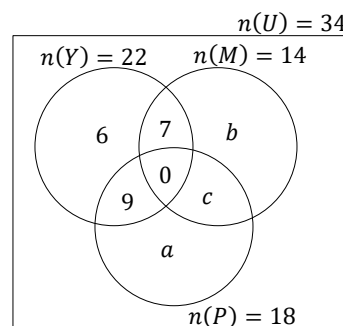
ii. 4 iii. $\dfrac{5}{34}$ b. $a_1 = 1\dfrac{1}{3}$

7. a. $15.1cm^2$ b. $3\sqrt{3}m^2$

8. a. $11\sqrt{10}$ b. i. 35 ii. $\dfrac{555}{810} = 37:54$

9. a.
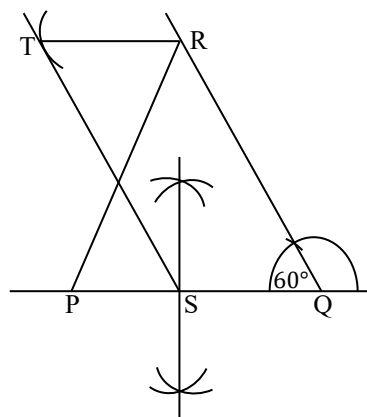
b. i. $|PR| = 7.2cm$ ii. $|TR| = 3.2cm$

iii. $\angle STR = 60°$

10. a. $x = 60°$ b. $68.8m$

11. a. $-1 \le x < 4$

b. 6

12. a.

$\overrightarrow{BM} + \overrightarrow{MC} = \overrightarrow{BC}$

$\overrightarrow{BM} = \overrightarrow{BC} - \overrightarrow{MC}$ ……(1)

Also, $\overrightarrow{BA} + \overrightarrow{AM} = \overrightarrow{BM}$ …… (2)

Adding (1) and (2)

$2\overrightarrow{BM} = \overrightarrow{BC} - \overrightarrow{MC} + \overrightarrow{BA} + \overrightarrow{AM}$

But $|AM|: |MC| = 1:1 \Longrightarrow \overrightarrow{AM} = \overrightarrow{MC}$

Substituting

$2\overrightarrow{BM} = \overrightarrow{BC} - \overrightarrow{MC} + \overrightarrow{BA} + \overrightarrow{MC}$

$2\overrightarrow{BM} = \overrightarrow{BC} + \overrightarrow{BA}$

$2\overrightarrow{BM} = \overrightarrow{BA} + \overrightarrow{BC}$

b. i. $\overrightarrow{WX} = \begin{pmatrix} 1 \\ -4 \end{pmatrix}$ ii. $\overrightarrow{ZY} = \begin{pmatrix} 5 - a \\ 4 - b \end{pmatrix}$

   iii. $Z(4, 8)$

13. a. $\begin{pmatrix} 2 \\ 4 \end{pmatrix}$ b. $A'(2, -3)$

   c. i. $P'(2, 4)$ $Q'(4, 3)$ $R'(3, 2)$

   ii. $P(4, 0)$ $Q(6, -1)$ $R(5, -2)$

   iii. $P''(4, -2)$ $Q''(3, -4)$ $R''(2, -3)$

November 2010

1. a. $7\frac{1}{6}$ b. $U_4 = \frac{47}{9}$ $U_5 = \frac{137}{27}$

$U_4 + U_5 = \frac{278}{27}$

2. a. $(x + 3)(x + 1 + m)$ b. GH¢100.00

3. a. $2700m$ b. $390,000m^2$

4. a. $\frac{5\sqrt{6}}{6}m$ b. $2.5cm$

5. a. $\frac{12}{25}$ or 0.48 b. $\angle TKC = 30°$

6. a. i. 23 ii. 8 b. 14.4%

7. a.

x	-3	-2	-1	0	1
y	7	0	-5	-8	-9

2	3	4	5
-8	-5	0	7
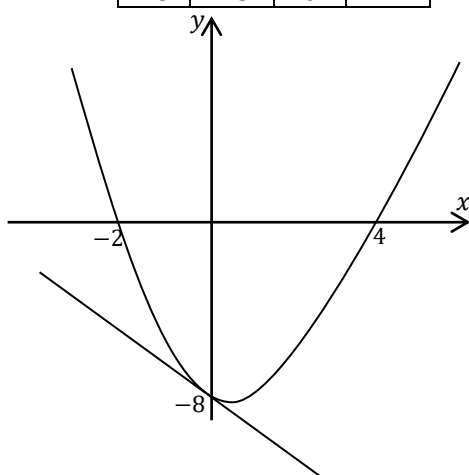
c. i. $-3 \le x \le 1$ ii. Gradient $(m) = -2$

8. a.
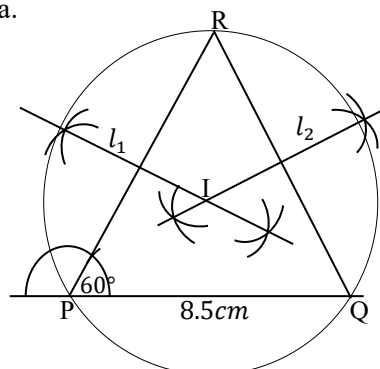
b. ii. radius $= 4.6cm$ iii. $|QR| = 8.3cm$

9. a. $xy^{-1} = \frac{x}{y}$
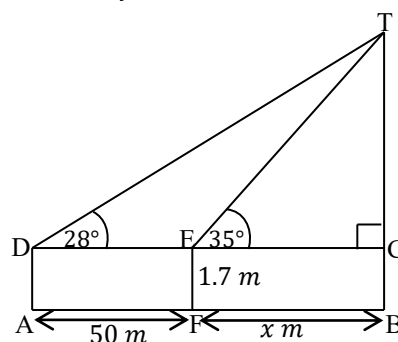
b. $112m$

10. a.

Marks	Freq. f	Cum. Freq.	Marks less than
$1 - 10$	1	1	10.5
$11 - 20$	3	4	20.5
$21 - 30$	5	9	30.5
$31 - 40$	8	17	40.5
$41 - 55$	12	29	50.5
$51 - 60$	10	39	60.5
$61 - 70$	5	44	70.5
$71 - 80$	4	48	80.5
$81 - 90$	2	50	90.5

c. i. 23 ii. 16%

11.
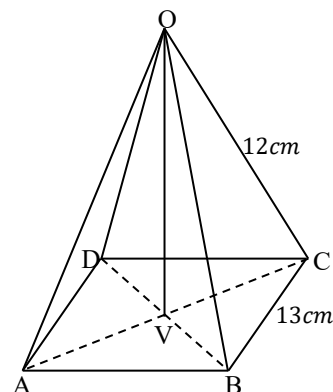
a. $7.7cm$ b. $430cm^3$

12. a. i.

$\odot$	2	4	6
2	4	8	2
4	8	6	4
6	2	4	6

  ii. α. $x = 2$ β. $e = 6$ γ. $f = 4$

b. i. $-\frac{4}{5}$ ii. -4

13. a. i. $A'(2,0)$ $B'(3,3)$ $C'(6,7)$

  ii. $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$

b. $\begin{pmatrix} 9 \\ 6 \end{pmatrix}$ c. $2y + x - 12 = 0$

WASSCE JUNE 2011
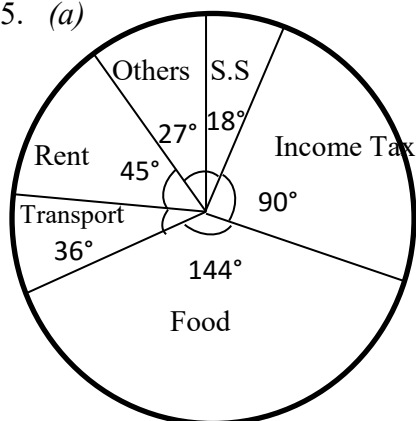
1. (a) $1\frac{17}{28}$ (b) $9-2\sqrt{2}$

2. (a) $\dfrac{x+1}{x(x-1)}$

  (b) Akin is 16 and Dop is 19

3. (a) $\angle SQT = 30°$ $\angle BKC = 50°$
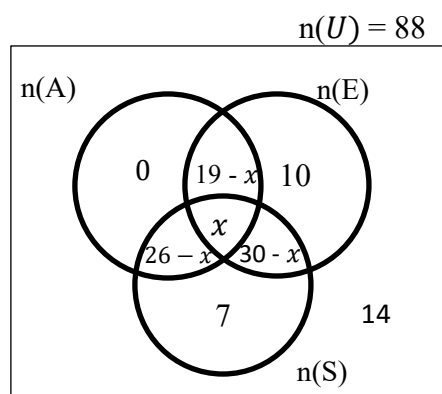
4. (a) 7 cm   (b) 5 cm

5. (a)

  (b) 18%

6. (a)

  (b) $19 - x + x + 26 - x + 7 + 30 + 14 = 88$

  (c)(i) 64   (ii) 0   (iii) 36

7. (a) $t = \dfrac{3v+w-uw}{v-uv}$

  (b)(i) 15.2   (ii) -4, 1.5

    (iii) a = 2, b = 5 and c = -12

8. (a)(i) 20 m   (ii)(α) 40.3 m

    (β) 29.74°

  (b) 6

9. (b) (i) $|PQ| = 8.5\ km$

    (ii) $|RQ| = 4.8\ km$

  (c) $\angle PQR = 90°$ (d) 4.2 km

10. (a) 40   (b) 5   (c)
  1.26

11. (a) $\frac{1}{4}$ (b)(i) 12 cm

  (ii) 71 cm

12. (a) (8, 10)   (b)(i) $-6\frac{1}{2}$ (ii) x
  = -2, 18

13. (c) Reflection in the line y = 0 or x-
  axis

WASSCE NOVEMBER 2011

1. a. $\frac{3}{5}$ b. 0.6314

2. a. $x = 2$ and $y = -\frac{1}{2}$ b. $\dfrac{4}{m-1}$

3. a. $15092cm^3$ b. $|RU| = 2cm$

4. a. $\frac{15}{8}$ b. 63°

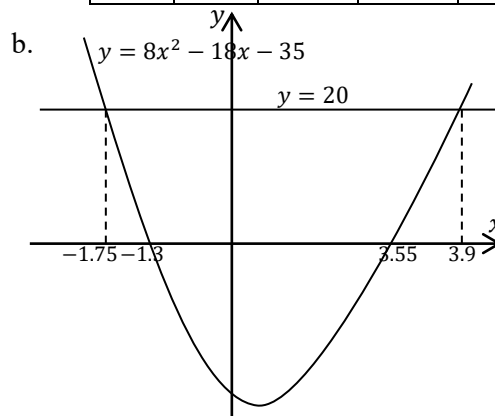5. a. $\frac{2}{45}$
  b. $x = 34\%, y = 68\%$ and $z = 58\%$

6. GH¢10,500.00   b. GH¢105.00

7. a. $\frac{3}{20}$
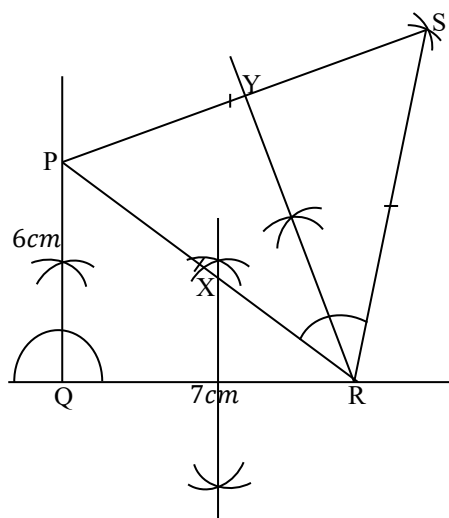 b. i. $94.0m$ ii. $163m$ iii. $129m$

8. a.

x	-2	-1.5	-1.0	0	0.5
y	33	10	-9.0	-35	-42
	1.0	1.5	2.0	3.0	4.0
	-45	-44	-39	-17	21

b.

c. i. $\{x : x = -1.3, 3.55\}$

  ii. $\{x : x = -1.75, 3.9\}$

9.

$|XY| = 4.6cm$

10. a.

$\oplus$	0	1	2	3	4
0	0	1	2	3	4
1	1	2	3	4	5
2	2	3	4	5	6
3	3	4	5	6	0
4	4	5	6	0	1

$\otimes$	0	1	2	3	4
0	0	0	0	0	0
1	0	1	2	3	4
2	0	2	4	6	1
3	0	3	6	2	5
4	0	4	1	5	2

  b. i. 3, 4   ii. 1   iii. 4

11. a. $4.2cm$ b. $12.0cm^2$ c. $17cm^3$

  d. 65°

12. a. 34   b. 5.7

13. b. i. Rotation through 180° about the

    origin is given by $(x, y) \rightarrow (-x, y)$

    $A(4, 8) \rightarrow A'(-4, -8)$,

    $B(2, 2) \rightarrow A'(-2, -2)$

    $C(6, 2) \rightarrow A'(-6, -2)$

    $D(8, 8) \rightarrow A'(-8, -8)$

   ii. Reflection in the line $y = 2$ is given

    by $(x, y) \rightarrow (x, 2k - y)$ where $k = 2$

  c. $A(4, 8)$ $C''(6, 2)$

   Gradient $= -2$

1. *(a)* $\frac{84}{125}$ *(b) 12*

2. *(a) 45 years*   *(b) 44°*

3. *(a) 4.17*   *(b) 40°*
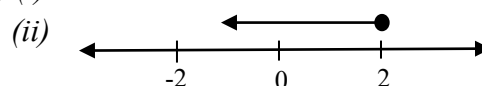
4. *(a)* $\sqrt{2} + \frac{2}{3}\sqrt{3}$ *(b) 36.44 cm*

5. *(a) 17.8 cm*   *(b) y + 7 = 25*

6. *(a)* 5.657×10^{-2} *(b) (i) x = 7*

(ii) 56_7

  (c) GH¢100,000.00

7. *(a) (i)* $x \leq 2$

   (ii)

 (b)

x	-4	-3	-2	-1	0	1	2	3	4
y	**4**	**0**	**-2**	-2	0	**4**	10	18	**28**

    (ii) (α) -2.25   *(β) 6.75*

8. *(b) Two locations* m_1 *and* m_2

(c) m_1 *from* $N = |Nm_1| = 6.3$ *cm or*

  12.6 km

 m_2 *from* $N = |Nm_1| = 14$ *cm or 28 km*

   (d) m_1 *is closer to all the three towns*

  than m_2, *hence* m_1 *would be convenient*

  for all the three towns.

9. *(a) 10.368 litres*

   (b)(i) 16.060 cm   *(ii) 27.688 cm²*
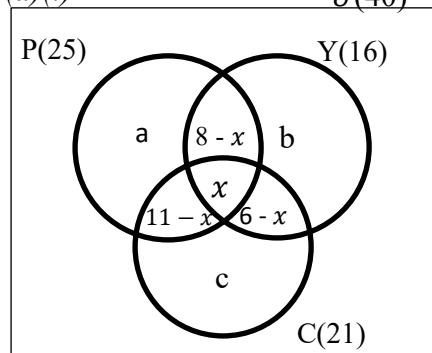
10. *(a)(i) 2*   *(ii) 1, 3 or 5*

   (b)(i) 7   *(ii) 4*

11. *(a)* $\frac{8}{17}$

   (b)(i) 8 m   *(ii) 26.9 m*   *(iii) 15°*

12. *(b) Translation by the vector* $\binom{1}{3}$

   (c) Find coordinates and draw

13. *(a)(i)*

(ii) 3

(b)(i) $\frac{2}{5}$ *(ii)* $\frac{19}{40}$

WASSCE NOVEMBER 2012
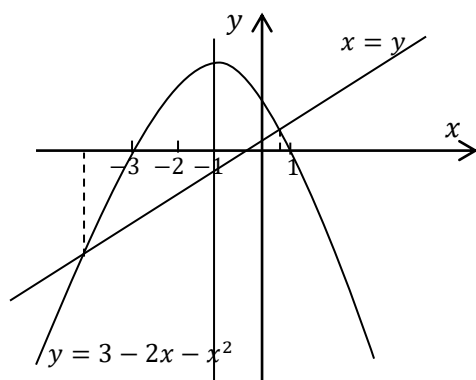
1. a. $\{10, 12, 14\}$ b. 1

c. $\{10, 12, 14, 15, 16, 17\}$

2. a. $(5a - 2b)(a + 2b)$ b. $n = 7$

3. a. $82°$ b. $13°$

4. a. $10cm$ b. $61.1cm^2$

5. a. i.

Scores	Tally	Frequency
10	///	3
11	////	4
12	//// ////	9
13	//// //// //	12
14	//// ///	8
15	////	4
		$\Sigma f = 40$

ii. 13

b. $\frac{9}{64}$

6. a. i. $P = \frac{m^2 n}{m^2 t - 2Sn}$ ii. $\frac{2}{3}$

b. GH¢5,440.00

7. a. $46°$

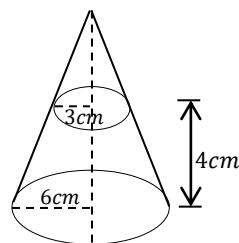b. i. $8.93m$ ii. $36.65°$ iii. $9.46°$

8. a.

x	-5	-4	-3	-2
y	-12	-5	0	3

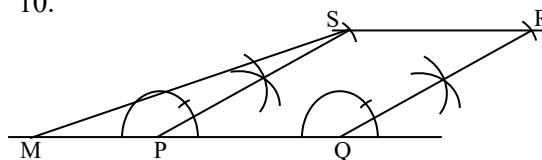| -1	0	1	2	3
4	3	0	-5	-12

b.

c. i. $x = -1$

ii. $-1 < x \leq 3$ iii. $x: x = -3.8, 0.8$

9. a. 4.0 kg

b.

i. $302cm^2$ ii. $264cm^3$

10.

i. $|SM| = 10.6cm$ ii. $\angle QMS = 19°$

11. a. $x = 8$

b. i. $7, 9, 11, 13, 15$ ii. 2.4

12. a. i.

$\otimes$	1	2	3	4
1	1	2	3	4
2	2	4	10	12
3	3	10	13	20
4	4	12	20	24

ii. α. $\{x: x = 1\}$ β. $\{m: m = 2\}$

b. i. 47 ii. $x = 1, 3\frac{1}{2}$

13. c. $P(1, 1) \rightarrow P_1(-1, -1)$

$Q(1, 5) \rightarrow P_1(-1, -5)$

$R(5, 4) \rightarrow P_1(-5, -4)$

d. $P(-1, -1) \rightarrow P_2(3, -4)$

$Q(-1, -5) \rightarrow Q_2(3, -8)$

$R(-5, -4) \rightarrow R_2(-1, -7)$

e. $P(1, 1) \rightarrow P_3(-1, 1)$

$Q(1, 5) \rightarrow Q_3(-1, 5)$

$R(5, 4) \rightarrow R_3(-5, 4)$

WASSCE JUNE 2013

1. *(a)* $1\frac{1}{3}$ *(b) -0.6199*

2. *Younger brother is 9 and elder brother is 29*

3. $668.5 \ cm^2$

4. *(a)* $\frac{12}{65}$ *(b) 6 cm*

5. *(a) 5*   *(b) GH¢ 25,000.00*

6. *(a)(i) GH¢ 40,000.00   (ii) 33.33%*

(b)(i) GH¢ 32 ,160.00

(ii) GH¢ 30,160≤ x ≤ GH¢ 35,160

7. *(c)(i) -9*   *(ii) -3.0*

8. *(a)(i) -2*   *(ii) 1*

x	-2	-1	0	1	2	3	4	5
y	19	**6**	-3	**-8**	-9	**-6**	1	**12**

  (b)(i) 13.9 units   *(ii) 330°*

9. *(b)(i) 7.3 cm*   *(ii) 5.6 cm*   *(iii) 96°*

10. *(a)* $\sqrt{2}$ *(b) 131 cm²*

11. *(a) 4.9 m*   *(b) 62°*

12. *(d)(i) 2.8*   *(ii) 8.1*

13. *(a) (7, 5)*

   (i) m = 3 (ii) n = 2 or 5

  (c)(i) Invalid   *(ii) Invalid*

    (iii) Valid

WASSCE NOVEMBER 2013

1. a. $x = -\frac{1}{2}$ b. $x = 30°$ c. $x = 119°$

2. a. $720m^3$ b. $384m^2$

3. a. $x \leq \frac{2}{7}$

  b. X= GH¢12,000   Y= GH¢4,000

    Z= GH¢8,000

4. b. 22.2%
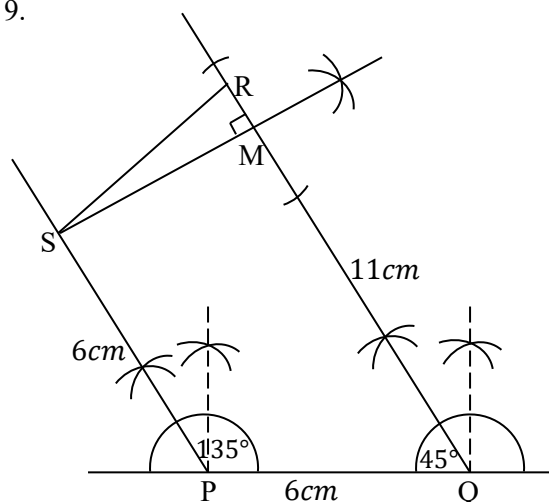
5. a. 20.52 km   b. 63°

6. a. i. 24%   ii. GH¢600.00

  b. i. 64   ii. $\frac{4}{3}$ or $1\frac{1}{3}$

7. a. $x:y = 2:5$

  b. i. GH¢1.20   ii. 160

8. a. $9.5cm$ b. i. $5cm$ ii. $5.88cm$

9.

  b. i. $|RS| = 4.2cm$ ii. $\angle MSP = 90°$

10. a.

Class Boundary	Height (cm)	Frequency
149.5 – 154.5	150 – 154	4
154.5 – 159.5	155 – 159	7
159.5 – 164.5	160 – 164	9
164.5 – 169.5	165 – 169	13
169.5 – 174.5	170 – 174	5
174.5 – 179.5	175 - 179	2

  b. 22.5%   c. $163.75cm$

11. a. $y + 3 = 0$

  b. i.

⊗	0	1	2	3	4	5	6
0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6
2	0	2	4	6	1	3	5
3	0	3	6	2	5	1	4
4	0	4	1	5	2	6	3
5	0	5	3	1	6	4	2
6	0	6	5	4	3	2	1

  ii. From the table;

    $1 \otimes 2 = 2 \otimes 1 = 2$;

    $4 \otimes 5 = 5 \otimes 4 = 6$

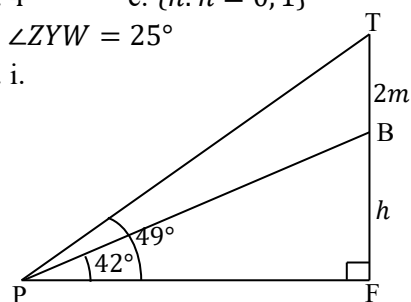 $6 \otimes 4 = 4 \otimes 6 = 3$ etc.

  Hence the operation $\otimes$ is commutative

    b. 4   c. $\{n : n = 0, 1\}$

12. a. $\angle ZYW = 25°$

  b. i.

  ii. $7.2m$ iii. $10.8m$

WASSCE JUNE 2014

1. *(a)* 5.0×10^1 *(b) 75°*

2. *(a)* $19\sqrt{3}$ *(b) 7*

3. *(a)* $x = \frac{1}{2}$, $y = \frac{1}{3}$ *(b) 36 km*

4. *(a) 42 cm*   *(b) 101.5°*

5. *(a) 0.35*   *(b) 0.5*   *(c) 0.25*

6. *(a) -38*   *(b) 14.0%*

7. *(a)*

x	0°	30°	60°	90°	120°
y	1.0	2.0	2.7	3.0	2.0

150°	180°	210°	240°	270°
2.0	1.0	0.0	−0.7	−1.0

(c) 15° and 165°

8. *(a)*

⊗	1	5	9	10
1	1	5	9	10
5	5	3	1	6
9	9	1	4	2
10	10	6	2	1

    (i) 1   *(ii)(α) 9*   *(β) 9*

(b) $\frac{51}{68}$

9. *(a)(i) 4*   *(ii) 38*

   (b)(i) 40°   *(ii) 60°*

10. *(a) {x : x = -1, 6}*   *(b) 9.0 cm²*

11. *(a) 1.16*   *(b)* $\frac{3}{5}$

12. *(a) 70°*

   (b)(i)
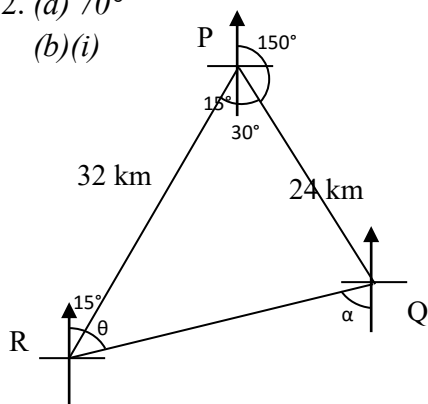
    (ii) 22.67 km   *(iii) 243°*

13. *(a)(i) -1 and 3*   *(ii) -* $\frac{11}{28}$

   (b) The operation is not commutative.

WASSCE NOVEMBER 2014

1. a. $(m - n + 3r)(m - n - 3r)$
   b. $x = 2$ and $y = 1$
2. a. GH¢290   b. GH¢6.83
3. a. $|TR| = 3cm$ b. $\frac{12}{65}$
4. a. 1   b. i. $\{10, 12, 14\}$ ii. 1
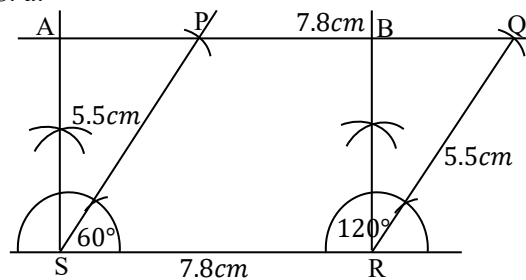5. a. $12cm$ b. $\angle OXZ = 67°$
   c. $192cm^3$
6. a. 36 boys
   b. i. common ratio $(r) = \pm 2$ ii. 128
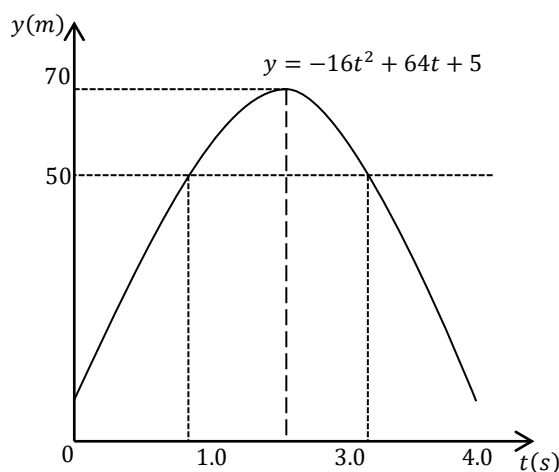7. a. 4.17 minutes   b. $p = -6$ and $k = 36$

8. a.

  b. i. $2.8cm$ ii. $4.8cm$

9. a.

t	0.0	0.5	1.0	1.5
y	5	33	53	65

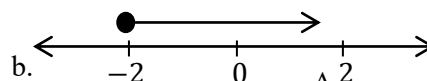| 2.0	2.5	3.0	3.5	4.0
66	65	53	33	5

b.

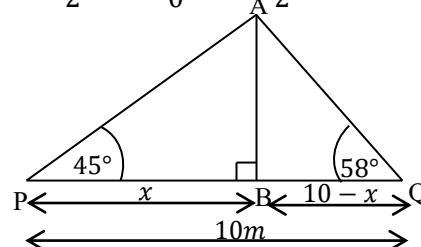 c. i. $68m$ ii. $t = 0.9$s or 3.1s   iii. $69m$

10. a. $x \geq -2$

b.

   i. $6.2m$ ii. $6.2m$

11. a. $\frac{5}{16}$

b. i.

Score	Tally	Frequency
1	////	4
2	//	2
3	///	3
4	//	2
5	///// /	6
6	///	3
		$\Sigma f = 20$

ii. Upper quartile $= 5$
   Lower quartile $= 2$

   iii. Interquartile range $= 5 - 2 = 3$

12. a. i. $\angle SPR = 79°$ ii. $\angle QSR = 11°$

b. i. $g = \dfrac{fT^2}{Uf - T^2}$ ii. $g = 3\frac{3}{11}$

13. a. 7.1 units

b. i. $M(2, 1)$ $S(5, 1)$

ii. $\overrightarrow{QR} = \begin{pmatrix} 6 \\ -4 \end{pmatrix}$ $\overrightarrow{MS} = \begin{pmatrix} 3 \\ -2 \end{pmatrix}$

iii. $\begin{pmatrix} 6 \\ -4 \end{pmatrix} = 2\begin{pmatrix} 3 \\ -2 \end{pmatrix}$

$\overrightarrow{QR} = 2\overrightarrow{MS}$

Since $\overrightarrow{QR}$ is a scalar multiple of $\overrightarrow{MS}$,
$\overrightarrow{QR}$ is parallel to $\overrightarrow{MS}$.

iv. $3y + 2x - 7 = 0$

WASSCE JUNE 2015

1. (a) $7\frac{7}{30}$ (b) $\frac{4}{9}$
2. (a) $x \leq -12$ (b) $x = 6$ and 4
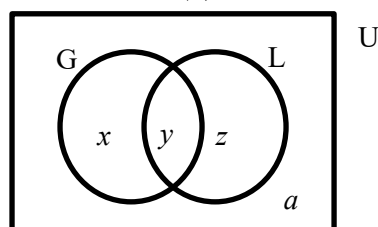3. (a) 7 sides   (b) $\angle PRS = 46°$
4. (a) $1\frac{2}{15}$ (b)(i) 8 m   (ii)
2.8
5. (a) $1600 cm^2$ (b) $\angle QRS = 76°$
6. (a)(i)

(ii)(α) Not valid   (β) Not valid
    (γ) Valid
(b)(i) $c = 830 + \frac{1}{5}n$ (ii)GH¢ 930.00

7. (a)

x	-3	-2	-1	0
y	21	6	-5	-12

1	2	3	4	5
-15	-14	-9	0	13

(c)(i) $y = -14.5$ (ii) $x = -0.6$ or 3.1

8. (b)(i) $|QX| = 2.8 cm$ (ii) $\angle XWZ = 75°$
9. (a) 3 (b)(i) ₦ 40.00 (ii) ₦ 1,625.00
10. (a) 5   (b)(i) 150 m   (ii) 1,391 m

11. (a) $m = \dfrac{hdp}{t - hd}$ (b) $\angle WYZ = 42°$

(c)(i) $\{n : n = 5\}$ (ii)$\{n : n = \emptyset\}$

12. (b)(i) $262 m^3$ (ii) $635 m^2$

13. (b)(i) 87%   (ii) $\frac{7}{20}$

WASSCE NOVEMBER 2015

1. (a) 1   (b) GH¢ 334,875.00
2. (a) $x = -2$ or 3   (b) 9 bags
3. (b) $42 m^2$
4. (a) $2\frac{7}{12}$ (b) $x = 308°$

5. (b)(i) $\frac{5}{36}$ (ii) $\frac{17}{36}$ (iii) $\frac{11}{36}$

6. (a) $x = 9$ (b)(i) 15 girls

(ii) 25 students   (iii) $\frac{2}{5}$ or 0.4

7. (a)(i) $2x^2 - 10x + 25$
   (ii) $x = 3.62 m$ and $1.38 m$
   (b) $s = \frac{1}{2}nd(n - 1)$

8. (a) $r = 68 m$
   (b)(i) $y = 17 cm$ (ii) $x = 73°$
9. (a) $x = 26°$ (b)(i) $|MO| = 8 cm$
   (ii) $|NQ| = 19 cm$
10. (a) $w = 12 cm$
   (b)(i) $|PR| = 25 km$ (ii) N82°W or 278°
11. (c)(i) 69 ± 0.3 (ii) 0.7 ± 0.02
12. (a) $\angle PQT = 62.7°$
    (b) $h = 17.8 cm$ (c) 66.7%

WASSCE JUNE 2016

1. (a) $2\frac{7}{12}$ (b) $\frac{16}{25}$
2. (a) $1\frac{3}{17}$ (b) $\angle RST = 49°$
3.(a) $x = -4, 2$

(b) $x = 7$ years and $y = 17$ years

4. (a)

n(U) = 40

n(P) = 20   n(Q) = 16

8   4   7

3

5   2

11

n(R) = 21
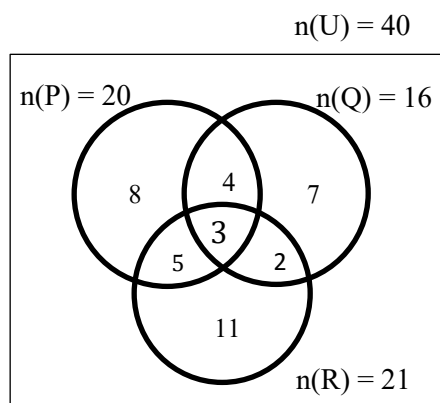
(b)(i) 40   (ii) $\frac{11}{40}$

5. Area = 32 cm^2

6. (a) t = 10   (b)(i) $\frac{1}{2}$ (ii) 4000 m^2

7. (a) i = 72°   j = 24°   (b) θ = 129°

8. (b) $|TQ| = 5.2\ cm$

9. (a)

x	-1	0	1	2	3	4	5	6
y	11	5	1	-1	-1	1	5	11

(c)(i) y = -1.3 (ii) y = 1.4, 3.5

(iii) x = 0.7, 4.3

10. (a) x = 7, y = 9   (c) 17.5%

11. (a) h = 5.20 m   (b) 109°

12. (b)(i) $\angle XYZ = 30°$ (ii) $|XZ| = 14\ km$

13. (a) x = 8

(b)(i) Q(5,-1) R(6,-2) $|\overrightarrow{QR}| = \sqrt{2}$

(ii) $\overrightarrow{MQ} = \begin{pmatrix} 1 \\ 1\frac{1}{2} \end{pmatrix}$

WASSCE NOVEMBER 2016

1. (a) $x \geq -3$ (b)(i) $y = \frac{2xz}{x-z}$ (ii) $y = 6\frac{2}{3}$

2. 17.25%

3. (a) $m = 60°$ (b) $x = 30°$

4. (a) $\frac{17}{50}$ or 0.34   (b) $\frac{3}{25}$ or 0.12

5. (a) $|QS| = 15.85\ m$ (b) 20.00°

6. (a) $x = 5$ (b) GH¢4,000.00

7. (a) $x = 11\frac{1}{4}$ or 11.25   (b)(i)

$r = 23\ m$ (ii) $vol = 13,139 m^3$

8. (a) Long of Q = 40.0°E

(b) Lat of R = 80.28°S

9. (b) 31.43 cm

10.

(a)

x	−3	−2	−1	0
y	10	3	−2	−5

1	2	3	4	5
-6	-5	-2	3	10

(d) (-0.4 ± 0.1, -3.8 ± 0.2)

(4.5 ± 0.1, 6.0 ± 0.2)

11. (a) $\frac{3}{10}$ or 0.3

(b) (i) $|QX| = 73.1\ km$

(ii)106.6°

12. (c) $3y + 8x + 52 = 0$

13. (b)(i) Mean = 4   (ii) S.D = 1.414

WASSCE JUNE 2017

1. (a) $\overline{2}.8495$ (b) 36

2. (a) $\frac{\sqrt{3}}{6} + \frac{\sqrt{6}}{6}$ (b) 8

3. (a) 12 cm   (b)$\angle QRS = 37°$

(c)$|PQ| = 15\ cm$

4. (a) ₦3,300.00   (b)8

5. (a) $\frac{19}{24}$ (b)$\frac{7}{15}$

6. (a)(i) GH¢ 6,866,10 (ii)GH¢ 1,706.70

(b) 20.5%

7. (a)

t(s)	0	1	3	5
h(m)	1000	995	955	875

7	9	11	13	15
755	595	395	155	-125

(c)(i) t = (14.2±0.2) secs

(ii) t = (11.40±0.2) secs

(iii) h = (720±0.2) m

8. (a) y=60°

(b)(ii)(α))$\angle MLX = 115°$

(β))$\angle LNM = 31°$

9. (a) $M = \frac{T+WPS^2}{2WPS}$

(b)(ii) $|QW| = 30\ m$

10. (a) x = -1   (b) 28.3 cm

11. (a) 3   (b)(i) 2   (ii)$\frac{6}{11}$

12. *(a)(i)* $1\frac{7}{10}$ *(ii)* $8\frac{1}{2}$

    (b) $\overrightarrow{CP} = \begin{pmatrix} -5 \\ 11 \end{pmatrix}$

13. *(a) x = 1.00 or 0.67*

    (b) $N = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

WASSCE NOVEMBER 2017

1.a. $\frac{2}{3}\sqrt{3} + \sqrt{2}$ b. $x = $ GH¢20,000.00

2.a.i. $|PR| = 2\sqrt{2}$ *cm* or $2.8284cm$

   ii. $|RS| = \left(2\sqrt{3} - 2\right)cm$

   b. $x = 5°$

3.a. 18.15 years   b. 2 years

4. $17.8cm^2$

5.a. $x < \frac{102}{175}$

   b.i. $\angle TPS = 47°$ ii. $\angle PQR = 47°$

6.a.i. $y = $GH¢720.00   ii. GH¢72.00

   b. $Z = 4$

7.a. $5140km$ b. $350°$ or $(N10°W)$

   c. 46 hours

8.a.i. $q = \pm\sqrt{\left(r - \frac{f}{2}\right)^2 - \frac{f^2}{4}}$ ii. $q = 2.24$

   b. ₦40.00

9. b.i. $|PR| = 7.5cm$ or $750m$

    ii. $|SR| = 4.5cm$ or $450m$

10.a. $\frac{8}{35}$ b.i. $\frac{72}{245}$ ii. $\frac{96}{1225}$

11.a. $2640cm^3$ b. $\theta = 8°$

12.c. $\left|\overrightarrow{A_1C_1}\right| = 3\sqrt{2}$ units

13.a. $x = 2$ or 7