THE WEST AFRICAN EXAMINATION COUNCIL
WASSCE FOR PRIVATE CANDIDATES, 2023 – SECOND SERIES
FINAL MARKING SCHEME
GENERAL MATHEMATICS / MATHEMATICS (CORE) 2

GENERAL INSTRUCTIONS

1. Marks are subdivided into method **(M)** marks, accuracy **(A)** and independent accuracy marks not preceded by **M** mark **(B)**.

2. The **M** marks should be given for a particular stage if the method is correct; that is, it would, if correctly carried out without numerical error, yield the right answer. **M** marks are not subdivided and unless the **M** Marks for a stage have been awarded, no A marks can be gained for that stage.

3. Deduct **2** for a misreading of the data. Deduct **1** for an answer not given to the degree of accuracy asked for, but this should not be more than once in a question. Deduct **1** for premature approximation which does not considerably simplify the subsequent work.

   Deduction could only be made from **A** or **B** marks and not from M marks.

4. Give **0** for results obtained for work that is indecipherable or wholly suppressed (W.S.O). Deduct **1** mark for omission of an essential working (oew-1).

5 Do not mark beyond the first appearance of a correct answer, i.e. ignore further working after a correct answer.

6. For geometric proofs, except when otherwise stated above, deduct **1** for an essential reason omitted or for a wrong reason given but not more than once in the question.

7. Deduct **1** mark for omission of units or for wrong units but this should not be more than once in one question.

8. If a question is attempted more than once, **mark all** and record the marks for that which has gained the **lowest marks.**

9. If more questions are attempted than the rubric allows, delete the marks for those extra questions which have gained the **lowest marks.**

   This rule implies that for candidates answering more than 5 questions in **Part II,** consider only the best 5 questions and ignore the remaining questions in that part by writing **'MQA'** through. ('MQA' denotes 'More Question Answered' than the rubric allows).

10. Candidates who failed to draw diagrams for questions that required diagrams, must be scored **zero,** whether the solution is correct or not.

11. Candidates who used non mathematical symbols such as *, /, ^ must be scored **zero** in such questions unless required by the question.

12. Unless otherwise stated, equivalent methods not specified in the Marking Scheme should be accepted and given appropriate marks.

13. The **total marks** according to the Marking Scheme are **100.**

14. The final total (and not the question total) should be rounded upwards to the **nearest whole number.**

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GHANA, LIBERIA AND S. LEONE

QUESTION NUMBER	SOLUTION	MARKS
1. (a)	$y = k_1x^2 + \frac{k_2}{x}$	M1 for equation
	$32 = k_1(2)^2 + \frac{k_2}{2}$	M1 for substituting
	$32 = 4k_1 + \frac{k_2}{2}$	
	$64 = 8k_1 + k_2$ ..... (1)	M1 for simplifying
	$86 = k_1(4)^2 + \frac{k_2}{4}$	
	$86 = 16k_1 + \frac{k_2}{4}$	
	$344 = 64k_1 + k_2$ ..... (2)	M1 for either of the equations correct
	$344 = 64k_1 + k_2$	
	$-(64 = 8k_1 + k_2)$	M1 for solving
	$280 = 56k_1$	
	$k_1 = 5$	
	$64 = 8(5) + k_2$	
	$64 - 40 = k_2$	
	$k_2 = 24$	
	$\therefore y = 5x^2 + \frac{24}{x}$	A1 for $y = 5x^2 + \frac{24}{x}$
(b)	$y = 5(3)^2 + \frac{24}{3}$	M1 for substituting
	$= 45 + 8$	
	$= 53$	A1 for 53
		[8 Marks]

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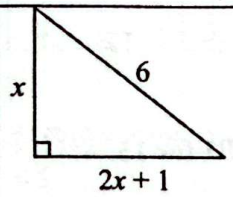
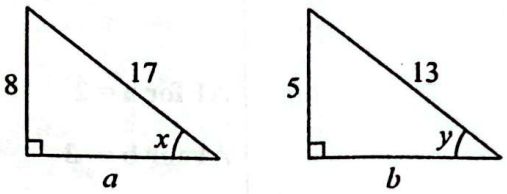
QUESTION NUMBER	SOLUTION	MARKS
2. (a)	$x^2-9=0$ $(x+3)(x-3)=0$ $x=3,\ x=-3$	M1 for equating factors to 0 A1 for 3, -3
(b)	$2(1)a-(1)^2b=7$ $2a-b=7$ ..... (1) $2(-2)a-(-2)^2b=4$ $-4a-4b=4$ $a+b=-1$ ..... (2) $2a-b=7$ $+(a+b=-1)$ $3a = 6$ $a=2$ $2+b=-1$ $b=-3$	M1 for substituting A1 for equation 1 A1 for equation 2 M1 for solving A1 for a = 2 A1 for b = -3 [8 Marks]
3.	 $6^2=(2x+1)^2+x^2$ $36=4x^2+4x+1+x^2$ $5x^2+4x-35=0$ $x=\frac{-4\pm\sqrt{4^2-4(5)(-35)}}{2(5)}$ $=\frac{-4\pm\sqrt{179}}{10}$ $x=2.2758 \quad x=-3.076$ $\therefore x=2.28\,\text{cm}$	M1 for use of Pythagoras Theorem M1 for simplifying A1 for quadratic equation M1 for solving A1 for all correct A1, A1 for factors A1 for 2.28cm [8 Marks]

QUESTION NUMBER	SOLUTION	MARKS
4. (a)	$\frac{1}{4} * \frac{1}{2} = \frac{1}{4} + \frac{1}{2} + \left(\frac{1}{4}\right)^2 \left(\frac{1}{2}\right)$	**M1 for substituting**
	$= \frac{1}{4} + \frac{1}{2} + \frac{1}{16} \times \frac{1}{2}$	
	$= \frac{1}{4} + \frac{1}{2} + \frac{1}{32}$	**M1 for simplifying**
	$= \frac{8+16+1}{32}$	
	$= \frac{25}{32}$	**A1 for $\frac{25}{32}$**
(b)		
	$a = \sqrt{17^2 - 8^2}$	
	$= \sqrt{225}$	
	$= 15$	**B1 for 15**
	$b = \sqrt{13^2 - 5^2}$	
	$= \sqrt{144}$	
	$= 12$	**B1 for 12**
	$\frac{\sin x - \cos y}{\cos x + \sin y} = \frac{\frac{8}{17} - \frac{12}{13}}{\frac{15}{17} + \frac{5}{13}}$	**M1 for substituting**
	$= \frac{104 - 204}{195 + 85}$	**M1 for simplifying**
	$= \frac{-100}{280}$	
	$= \frac{-5}{14}$	**A1 for $\frac{-5}{14}$**
		[8 Marks]

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QUESTION NUMBER	SOLUTION	MARKS
5. (a)	$20 = \frac{a+3+52-2a}{2}$ $40 = 55 - a$ $a = 55 - 40$ $= 15$	M1 for finding median M1 for clearing fraction M1 for solving A1 for 15
(b)	$\text{Mean} = \frac{12+13\times2+15+18+22\times2+23\times2+24}{10}$ $= \frac{185}{10}$ $= 18.5$ $= 19$	M1 for finding mean M1 for substituting M1 for simplifying A1 for 19 [8 Marks]
6. (a)	$\oplus$ table: 2 4 6 8 / 2 4 6 8 1 / 4 6 8 1 3 / 6 8 1 3 5 / 8 1 3 5 7 $\otimes$ table: 2 4 6 8 / 2 4 8 3 7 / 4 8 7 6 5 / 6 3 6 0 3 / 8 7 5 3 1	B3 $\left(-\frac{1}{2}ee\right)$ for adding in mod 9 B3 $\left(-\frac{1}{2}ee\right)$ for multiplying in mod 9
(b) (i)	$(4\otimes6)\oplus(2\otimes4) = 6\oplus8$ $= 5$	M1 for reading A1 for 5
(ii)	$3(2)\otimes8 = 3$ $\therefore n = 2$	M1 for reading A1 for 2
(iii)	$4\otimes4 = 7$ $8\otimes8 = 1$ $\therefore \{n : n = 4,\ 8\}$	M1 for reading A1 for $\{n: n = 4, 8\}$ (-1 oms { }) [12 Marks]

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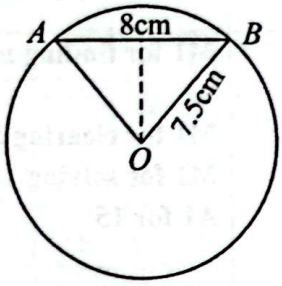
QUESTION NUMBER	SOLUTION	MARKS
7. (a)		
	Let $\theta = \angle AOB$	
	$\sin(\frac{1}{2}\theta) = \frac{4}{7.5}$	
	$\frac{1}{2}\theta = \sin^{-1}\left(\frac{4}{7.5}\right)$	M1 for trigonometry ratio
	$= 32.23$	M1 for simplifying
	$\theta = 64.46°$	
	$= 64.5°$	A1 for 64.5°
(b)	Length of arc $= \frac{64.46}{360} \times 2 \times \frac{22}{7} \times 7.5$	M1 for substituting
	$= 8.441$	
	$= 8.4$ cm	A1 for 8.4 cm
(c) (i)	Area of major sector $= \frac{295.54}{360} \times \frac{22}{7} \times 7.5^2$	M1 for substituting
	$= \frac{365730.75}{2,520}$	M1 for simplifying
	$= 145.1325$	
	$= 145.1$ cm^2	A1 for 145.1 cm^2
(ii)	Area o $\Delta AOB = \frac{1}{2} \times 8 \times \sqrt{7.5^2 - 4^2}$	M1 for simplifying
	$= 4 \times 6.3443$	
	$= 25.3772$	
	$= 25.4$ cm^2	A1 for 25.4 cm^2
(iii)	Area of major segment $= 145.13125 + 25.3772$	M1 for simplifying
	$= 170.59845$	
	$= 170.6$ cm^2	A1 for 170.5 cm^2 (-1 ou/wu once only)
		[12 Marks]

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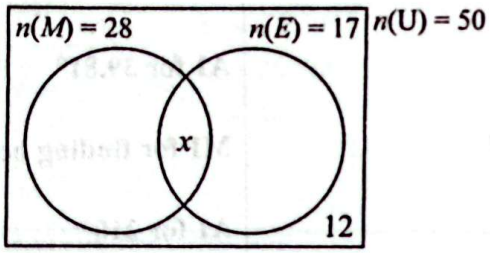
QUESTION NUMBER	SOLUTION	MARKS
8. (a) (i)	$y = x\sqrt{t^2+u}$	
	$\frac{y}{x} = \sqrt{t^2+u}$	
	$\frac{y^2}{x^2} = t^2+u$	M1 for squaring
	$y^2 = x^2t^2 + x^2u$	M1 for clearing fraction
	$x^2t^2 = y^2 - x^2u$	
	$t^2 = \frac{y^2-x^2u}{x^2}$	M1 for solving
	$t = \sqrt{\frac{y^2-x^2u}{x^2}}$	A1 for $t = \sqrt{\frac{y^2-x^2u}{x^2}}$
(ii)	$t = \sqrt{\frac{12.2^2 - (0.02)^2(1.1)}{(0.02)^2}}$	M1 for substituting
	$= 609.9990$	M1 for simplifying
	≈ 610	A1 for 610
(b)		B2 $\left(-\frac{1}{2}ee\right)$
	$50 - 12 = 28 - x + x + 17 - x$	M1 for equation
	$38 = 45 - x$	M1 for solving
	$x = 7$	
	Only Piano $= 28 - 7$	
	$= 21$	A1 for 21
		[12 Marks]

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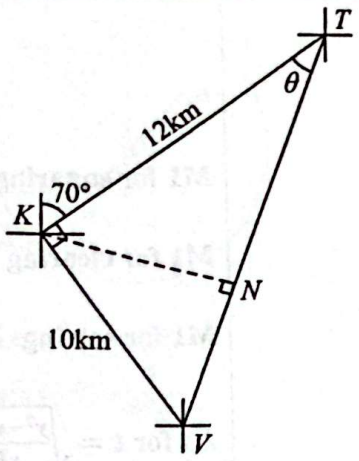
QUESTION NUMBER	SOLUTION	MARKS
9. (a)		B3 $\left(-\frac{1}{2}ee\right)$ (10km, 12km, 70°or 90° relative position of K, T and V)
(b) (i)	$\lvert VT\rvert^2 = 12^2 + 10^2$ $= 144 + 100$ $\lvert VT\rvert = \sqrt{244}$ $= 2\sqrt{61}\,\text{km} = 15.62\,\text{km}$	M1 for use of Pythagoras M1 for simplifying A1 for 15.62 km
(ii)	$\tan\theta = \frac{10}{12}$ $\theta = \tan^{-1}(\frac{5}{6})$ $= 39.81°$	M1 for trigonometry ratio A1 for 39.81°
	Bearing $= 270° - (20° + 39.81°)$ $= 210.19°$ $= 210°$	M1 for finding bearing A1 for 210°
(c)	$\cos(39.81) = \frac{\lvert NT\rvert}{12}$ $\lvert NT\rvert = 12 \times 0.7682$ $= 9.2184$ $= 9.22\,\text{km}$	M1 for ratio A1 for 9.22 km [12 Marks]

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QUESTION NUMBER	SOLUTION	MARKS
10. (a) (i)	$\angle MSR = 180° - 52°$ $= 128°$ $\angle RNM + \angle MSR = 180°$ $\angle RNM + 128° = 180°$ $\angle RNM = 180° - 128°$ $\angle RNM = 52°$	M1 for $\angle MSR$ A1 for 128° M1 for $\angle RNM$ A1 for 52°
(ii)	$\angle MOR = 2 \times 52°$ $= 104°$ $\angle OMS + 104° = 180°$ $\angle OMS = 180° - 104°$ $\angle OMS = 76°$	M1 for $\angle MOR$ A1 for 104° M1 for $\angle OMS$ A1 for 76°
(b)	$24 - 2\tan(3x - 10) = 14$ $2\tan(3x - 10) = 10$ $\tan(3x - 10) = 5$ $3x - 10 = \tan^{-1}(5)$ $3x - 10 = 78.69°$ $3x = 88.69°$ $x = 29.56°$ $= 30°$	M1 for equation M1 for simplifying M1 for solving A1 for 30° [12 Marks]

QUESTION NUMBER	SOLUTION	MARKS
11. (a) (i)	$x-4y+1=0$ ..... (1) $2x-3y-3=0$ ..... (2) From equ (1) $x=4y-1$ Substitute into equ (2) $2(4y-1)-3y-3=0$ $8y-2-3y-3=0$ $5y=5$ $y=1$ $x=4(1)-1$ $=3$ $\therefore Q(3,1)$	M1 for solving A1 for $y=1$ Al for $x=3$ A1 for Q (3, 1)
(ii)	$P(2,-1)$, $Q(3,1)$ $\frac{1+1}{3-2}=\frac{y+1}{x-2}$ $2=\frac{y+1}{x-2}$ $2x-4=y+1$ $y=2x-5$	M1 for finding equation of the lines A1 for $y=2x-5$
(iii)	$\lvert PQ\rvert=\sqrt{(3-2)^2+(1+1)^2}$ $=\sqrt{1+4}$ $=\sqrt{5}=2.2361$	M1 for finding length A1 for 2.2361 (At least one decimal place)
(b)	$\log_b(x-2)=\log_b y-3$ $\log_b(x-2)=\log_b y-3\log_b b$ $\log_b(x-2)=\log_b y-\log_b b^3$ $\log_b(x-2)=\log_b\left(\frac{y}{b^3}\right)$ $x-2=\frac{y}{b^3}$ $y=b^3(x-2)$	M1 for use of law of logarithm M1 for application of law of logarithm M1 for solving A1 for $y=b^3(x-2)$
		[12 Marks]

QUESTION NUMBER	SOLUTION	MARKS
12. (a) (i)	$p = \frac{1}{2}, \quad p^1 = 1 - \frac{1}{2} = \frac{1}{2}$	
	$q = \frac{3}{4}, \quad q^1 = 1 - \frac{3}{4} = \frac{1}{4}$	B1 for either of the compliments
	$r = x, \quad r^1 = 1 - x$	
	$\frac{1}{12} = \left(\frac{1}{2}\right)\left(\frac{1}{4}\right)(1-x)$	M1 for equation
	$\frac{1}{12} = \frac{1-x}{8}$	M1 for simplifying
	$\frac{8}{12} = 1 - x$	M1 for solving
	$\frac{2}{3} = 1 - x$	
	$x = 1 - \frac{2}{3}$	
	$= \frac{1}{3}$	A1 for $x = \frac{1}{3}$
(ii)		
	P(only one passing)	
	$= \left[\frac{1}{2} \times \frac{1}{4} \times \frac{2}{3}\right] + \left[\frac{1}{2} \times \frac{3}{4} \times \frac{2}{3}\right] + \left[\frac{1}{2} \times \frac{1}{4} \times \frac{1}{3}\right]$	M1 for probability
	$= \frac{2}{24} + \frac{6}{24} + \frac{1}{24}$	M1 for any brackets correct
	$= \frac{9}{24}$	A1 for all correct
	$= \frac{3}{8}$	A1 for $\frac{3}{8}$
(b)		
	$x^2 - 9 - y^2 = 72$	M1 for applying diff. of 2 squares
	$(x + 3y)(x - 3y) = 72$	
	$(x + 3y)(9) = 72$	M1 for substituting
	$x + 3y = 8$	A1 for 8
		[12 Marks]

$x = \frac{-1}{6} \quad y = \frac{17}{2}$

QUESTION NUMBER	SOLUTION	MARKS
13. (a)	Let x = the number	
	$\frac{1}{4}x+4\frac{1}{3}=20\frac{2}{3}-\frac{1}{3}x$	M1 for equation
	$\frac{1}{4}x+\frac{13}{3}=\frac{62}{3}-\frac{1}{3}x$	
	$12\left(\frac{1}{3}x\right)+12\left(\frac{13}{3}\right)=12\left(\frac{62}{3}\right)-12\left(\frac{1}{4}x\right)$	M1 for clearing fraction
	$3x+4(13)=4(62)-4x$	
	$3x+52=248-4x$	
	$3x+4x=248-52$	M1 for solving
	$7x=196$	
	$x=28$	A1 for 28
(b)	Interest after 1st half $=\frac{8}{100}\times 300,000$	M1 for finding interest
	$=\$24,000$	A1 for \$24, 000
	Total amount $=300,000+24,000$	
	$=\$324,000$	A1 for \$324, 000
	Interest after 2nd half $=\frac{8}{100}\times 324,000$	
	$=\$25,920$	A1 for \$25,920
	Amount at the end of the year $=25,920+324,000$	
	$=\$349,920.00$	A1 for \$349,920
	Interest at the end of 3rd half $=\frac{8}{100}\times 349,920$	
	$=\$27,933.60$	
	Amount at the end of 3rd half year	
	$=27,993.6+349,920$	
	$=\$377,913.60$	A1 for \$377,916.60
	Interest at the end of 4th half $=\frac{8}{100}\times 377,913.60$	
	$=\$30,233.09$	
	Amount at the end of 4th half	
	$=30,233.09+377,913.60$	
	$=\$408,146.69$	A1 for \$408,146.69
	Compound Interest $=408,146.69-300,000$	
	$=\$108,146.69$	B1 for \$108,146.69
		[Accept use of formula]
		[12 Marks]

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GHANA, LIBERIA AND S. LEONE

GHANA		**11/01/2024**
NIGERIA		**11/01/2024**
GAMBIA		**11/01/2024**
SIERRA LEONE		**11/01/2024**
LIBERIA		**11/01/2024**