Name..... MARKING GUIDE ..... ADM Number:..... F4 P1

School:..... Candidate's Signature.....

121/1
Mathematics Alt.A
FORM FOUR.
OCTOBER 1ST 2024.
2 ½ Hours.

URANGA MATHEMATICS ASSOCIATION-2024.

Kenya Certificate of Secondary Education

MATHEMATICS 121/1
FORM FOUR
TIME: 2 ½ HOURS

INSTRUCTIONS TO CANDIDATES:

- Write your name, school, admission number and sign in the spaces provided above.
- This paper contains **TWO** sections: Section **I** and Section **II**.
- Answer **ALL** the questions in Section **I** and **FIVE** questions from section **II**.
- All answers and working **MUST** be written on the question paper in the spaces provided below each question.
- Marks may be given for correct working even if the answer is wrong.
- Non-programmable silent electronic calculators and KNEC Mathematical tables may be used, except where stated otherwise.

FOR EXAMINERS USE ONLY

SECTION I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total

SECTION II

17	18	19	20	21	22	23	24	Total

Grand Total

This paper consists of 15 printed pages. Candidates should check to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION I (50 MARKS)

Answer ALL the Questions in the spaces provided below each question

1. Without using calculators evaluate: (3 marks)

$$\frac{\frac{1}{2}+2\frac{1}{5}\ of\ 8\div 6(2\times 4\frac{2}{5})}{\frac{1}{2}\ of\ 6(8\div 7\frac{1}{3})}$$

Top

$= \frac{1}{2} + \frac{14}{5}\ of\ 8 \div 6\left(2 \times \frac{22}{5}\right)$

$= \frac{1}{2} + \frac{112}{5} \div \frac{264}{5}$

$= \frac{1}{2} + \frac{\cancel{14}}{\cancel{5}} \times \frac{\cancel{5}}{\cancel{264}_{33}}$

$= \frac{1}{2} + \frac{14}{33}$

$= \frac{61}{66}$ — B1

Bottom

$= \frac{1}{2}\ of\ 6\left(8 \div \frac{22}{3}\right)$

$= \frac{1}{2}\ of\ 6\left(8 \times \frac{3}{22}\right)$

$\frac{1}{2}\ of\ 6\frac{6}{11} = 3\frac{3}{11}$ — B1

$= \frac{61}{66} \times \frac{\overset{1}{\cancel{6}}}{36} = \frac{61}{216}$ — B1

03.

2. A juice vendor had three jugs of juices of different types selling at the same price. Each of the three jugs contain 1080ml, 1350ml and 1170ml of juice. She sold them in mugs (as smallest as possible) such that there is no remainder. If each mug sells at Ksh. 100, calculate the total. amount she received. (3 marks)

10	1080	1350	1170
3	108	135	117
3	36	45	39
	12	15	13

— M1

GCD $= 3^2 \times 10$

$= 90ml$

$= (12 + 15 + 13) \times Sh.100$ — M1

$= Sh.4000.$ — A1

03

3. Simplify the expression below. (3 marks)

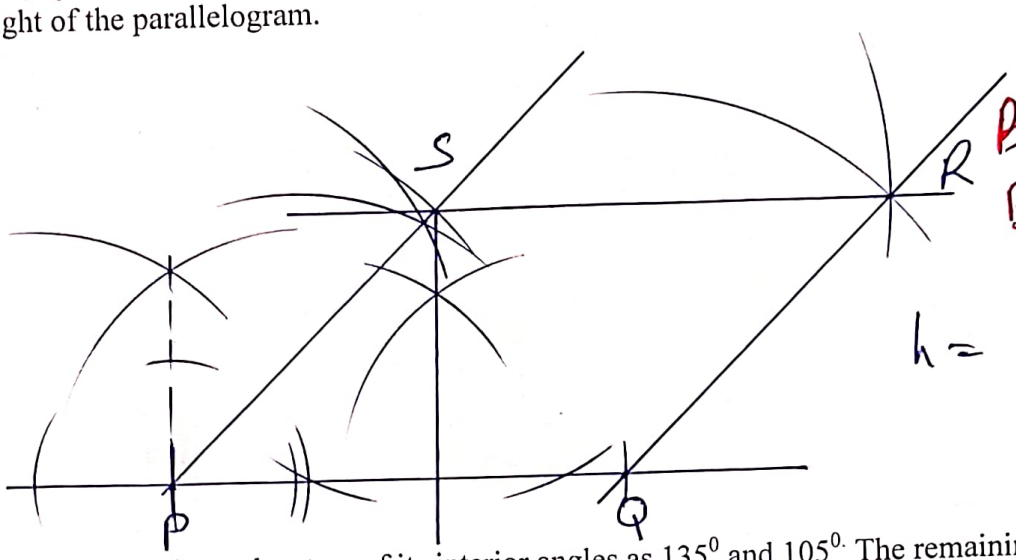
$$\frac{y^4 - x^4}{y^3 - yx^2}$$

$= \frac{(y^2 - x^2)(y^2 + x^2)}{y(y^2 - x^2)}$ — M1 M1

$= \frac{y^2 + x^2}{y}$ — A1

03

4. Using a ruler and a pair of compasses only, construct a parallelogram PQRS in which PQ = 6 cm, QR = 5 cm and angle PSR = 135°. Drop a perpendicular from S to PQ hence state the height of the parallelogram. (3 marks)



B_1 – Constructing 45° or 135°

B_1 – Complete diagram

$h = 3.5 \pm 0.1$ cm. B_1

03

5. An irregular polygon has two of its interior angles as 135^0 and 105^0. The remaining interior angles are all equal to 150^0. Calculate the sum of its interior angles. (3 marks)

$180°(n-3) = 135° + 105° + (n-2)150°$ — M_1

$180n° - 360° = 240° + 150n - 300°$

$30n = 300°$

$n = 10$. — A_1

$= 180°(8)$

$= 1440° - B_1$

03

6. Solve for x in the equation (3 marks)

$$2^{(2x-1)} \times \left(\frac{1}{8}\right)^{(1-x)} = 4^{(3x+1)}$$

$2^{(2x-1)} \times 2^{-3(1-x)} = 2^{2(3x+1)}$ — M_1

$2^{(2x-1)+-3(1-x)} = 2^{2(3x+1)}$

$2x - 1 - 3 + 3x = 6x + 2$ — M_1

$-x = 6$.

$x = -6$. — A_1

03.

7. The following are the exchange rates that were used by a certain forex bureau in Kenya.

Currency	Buying (Ksh)	Selling (Ksh)
South African Rand	8.13	8.19
Norwegian Krone	12.20	12.37

A business lady from Norway converted some Norwegian Krones to Kenya shillings at the FOREX bureau and received Ksh.3,470,290.

(a) Find the amount of Norwegian Krones that the business lady converted to Kenya Shillings. (2 marks)

$= \frac{3,470,290}{12.20}$ — M1

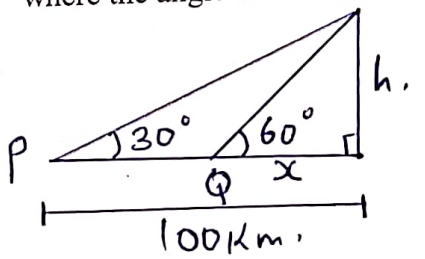
$= 284,450$ NK. — A1

(b) The business lady spent Ksh. 2,355,000 while in Kenya. She then converted the balance to South African Rand. Calculate the amount of money, to the nearest Rand, that she received. (2 marks)

$= \frac{3,470,290 - 2,355,000}{8.19}$ — M1

$= 136,177$ SAR. — A1 (CAO) / 04.

8. A boat is at point P, a distance of 100km from the bottom of a hill. The angle of elevation of the top of the hill is 30° from P. The boat sails straight towards the hill to a point Q from where the angle of elevation to the top of the hill is now 60°. Calculate the distance PQ (3 marks)



$\tan 30° = \frac{h}{100.}$ — M1

$h = 100 \tan 30°$

$= 57.74$ Km.

$\tan 60° = \frac{57.74}{x}$

$x = \frac{57.74}{\tan 60°} = 33.33$ Km

$PQ = 100 - 33.33$ — M1

$= 66.67$ Km. — A1 / 03.

9. A two – digit number is such that the sum of the digit is 12. If the digits are interchanged the value of the new number formed is fifteen more than twice the value of the original number. Find the original number? (4 marks)

Let's number be mn.

$m+n = 12$ --- (i) ✓

$nm = 2(mn)+15$

$10n+m = 2(10m+n)+15$ } M_1

$10n+m = 20m+2n+15$ ✓

$8n-19m = 15$ --- (ii)

$(n+m = 12)\ 8$

$8n-19m = 15$

$8n+8m = 96$ — M_1

$8n-19m = 15$ —

$27m = 81$

$m = 3$

$n = 9$ } — A_1

$\Rightarrow 39.$ — B_1

04.

10. Two matrices A and B are such that $A=\begin{pmatrix} k & 4 \\ 3 & 2 \end{pmatrix}$ and $B=\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$, given that the determinant of AB = 4, find the value of K. (3 marks)

$\begin{pmatrix} K & 4 \\ 3 & 2 \end{pmatrix}\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} = \begin{pmatrix} K+12 & 2K+16 \\ 9 & 14 \end{pmatrix}$ — B_1

$14(K+12) - 9(2K+16) = 4.$ — M_1

$14K+168-18K-144 = 4$

$-4K = -20$

$K = 5.$ — A_1

03.

11. Two similar container hold $2000cm^3$ and 6.75 litres respectively. If the smaller container has a diameter of 15.50cm. What is the radius of the larger container correct to 1 decimal place? (3 marks)

$VSF = \frac{2}{6.75} = \frac{8}{27}$

$LSF = \sqrt[3]{\frac{8}{27}} = \frac{2}{3}.$ — M_1

$= \frac{3}{2} \times 15.50 \times \frac{1}{2}$ — M_1

$= 11.6\,cm.$ — A_1 (CAO).

03

12. Solve the inequality below and state the integral values which satisfy the inequality. (3 marks)

$$3 - 2x < x \leq \frac{2x+5}{3}$$

$3 - 2x < x$

$-3x < -3$

$x > 1$ — B_1

$x \leq \frac{2x+5}{3}$

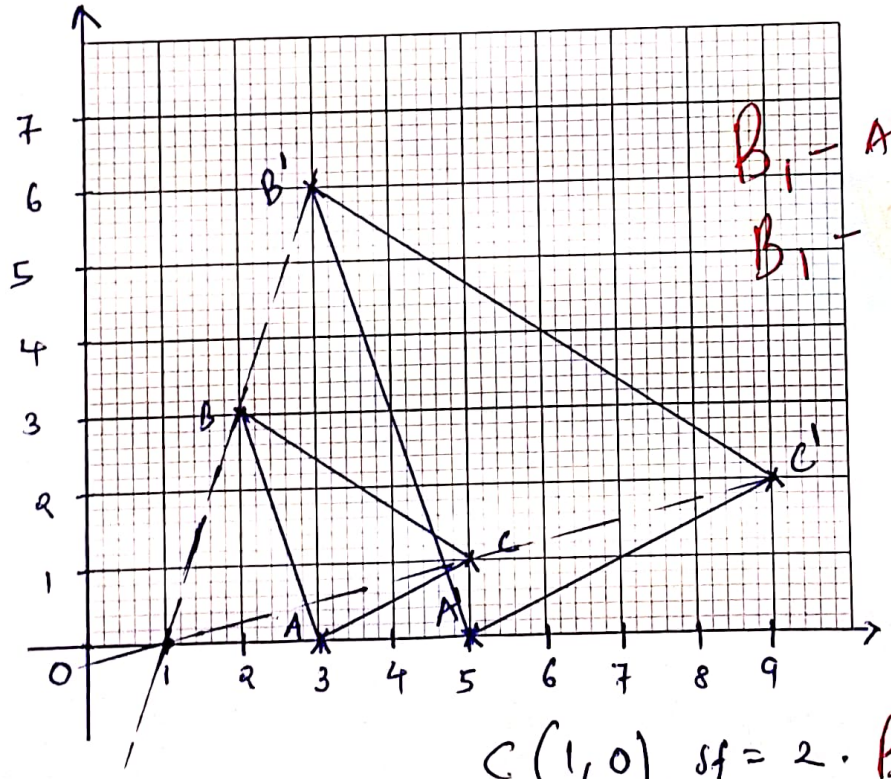
$3x \leq 2x + 5$

$x \leq 5$. — B_1

$\Rightarrow 2, 3, 4$ and 5. — B_1

03

13. Triangle ABC has its vertices at A(3, 0), B(2,3) and C(5,1) if A′(5, 0), B′(3,6) and C′(9,2) is the image of ABC under enlargement. On the same axes and grid provided below, determine the Centre of enlargement and linear scale factor. (3marks)



B_1 — ABC and A'B'C'

B_1 — Locating centre.

C(1, 0), sf = 2. B_1 (Both)

03.

14. Use trapezium method with four strips to estimate the area bounded by the curve $y = \frac{1}{2}x^2 - 2$, the x-axis, $x = -2$ and $x = 2$ (3 marks)

x	-2	-1	0	1	2
y	0	-1.5	-2	-1.5	0

— M_1

$A = \frac{1}{2} \times 1 \{(0+0) + 2(1.5+2+1.5)\}$ — M_1

$= 5.5$ sq units — A_1

03

15. A Jua Kali artisan has 63000g of metal of density 7g/cm^3. He intends to use it to make a rectangular pipe with external dimensions 120mm by 150mm and internal dimensions of 100mm by 120mm. Calculate the length of the pipe in metres. (3 marks)

$V = 63,000g \div 7g/cm^3$ — M_1

$= 9000\ cm^3$.

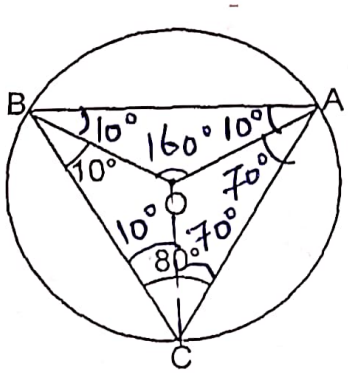
$(12 \times 15 - 10 \times 12)L = 9000$ — M_1

$L = \frac{9000}{60} = 150cm$

$= 1.5$ m. — A_1

03

16. In the figure below, O is the centre of circle. Angle BCA=80^0 and angle CBO = 10^0. Determine the size of angle CAB. (3 marks)



$\angle AOB = 160°$ — B_1

$\angle CAO = 70°$ — B_1

$= 10° + 70°$

$\angle CAB = 80°$ — B_1

03.

SECTION II (50 MARKS)

Answer only FIVE questions in this section in the spaces provided.

17. A rectangular farm measures 20 metres by 16 metres. A path of uniform width x - metres is made all round it. This make the area of the farm to reduce in the ratio 7 : 16.

a) Find an expression in x for the new length and the width (1 mark)

$L = 20 - 2x$

$W = 16 - 2x$ } B_1

b) Find the expression in x for the new area. (1 mark)

$= (20 - 2x)(16 - 2x)$ — B_1

c) Find the possible value of x (4 marks)

New Area $= \frac{7}{16} \times 20 \times 16$ — M_1

$= 140\,m^2$

$(20 - 2x)(16 - 2x) = 140$ — M_1

$320 - 40x - 32x + 4x^2 = 140$

$4x^2 - 72x + 180 = 0$

$x^2 - 18x + 45 = 0$

$x^2 - 3x - 15x + 45 = 0$

$x(x - 3) - 15(x - 3) = 0$ — M_1

$(x - 15)(x - 3) = 0$

$x = 15$ or 3

$\therefore x = 3m$ — A_1

d) The remaining area of the farm is divided among three siblings Abdi, Bor and Celine such that the ratio of Abdi to Bor's is 3 : 4 while that of Bor's to Celine's is 6 : 5. Find the difference between the area of Celine's share and Abdi's share. (4 marks)

$A : B = (3 : 4)\,3$

$B : C \quad (6 : 5)\,2$ — M_1

$A : B : C = 9 : 12 : 10$ — A_1

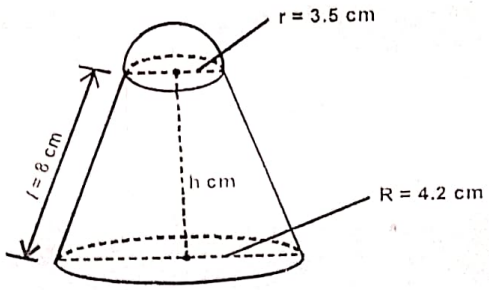
$= 10 - 9 = \underline{1}$

$= \frac{1}{31} \times 140\,M^2$ — M_1

$= 4\frac{16}{31}\,M^2$ — A_1

10

18. The figure below shows a solid made up of a conical frustum and a hemispherical top. The dimensions are as indicated.



The top radius r = 3.5cm, bottom radius R = 4.2cm, slant height l = 8cm and the height of the frustum part is h cm.

(a) Find the surface area of the solid (Take $\pi = {}^{22}/_{7}$) (5 marks)

$\frac{4.2}{3.5} = \frac{L+8}{L}$ — M1

$L = 40$ cm.

$L = 48$ cm.

CSA of frustum

$= \left(\frac{22}{7} \times 4.2 \times 48\right) - \left(\frac{22}{7} \times 3.5 \times 40\right)$ — M1

$= 193.6$ cm^2

CSA of Hemisphere

$= 2 \times \frac{22}{7} \times 3.5^2$ — M1

$= 77$ cm^2

TSA $= 193.6 + 77$ — M1

$= 270.6$ cm^2 — A1

(b) If a similar solid has a total surface area of 81.51cm^2, determine the radius of its base, to the nearest whole number (1 mark)

$SF = \sqrt{\frac{81.51}{270.6}}$

$= 0.548834685 \times 4.2$

$= 2$ cm. — B1

(c) (i) Find the height h of the frustum. (1 mark)

$h = \sqrt{8^2 - 0.7^2}$ — B1

$= 7.969$ cm.

(ii) Hence determine the volume of the solid (3 marks)

$\frac{4.2}{3.5} = \frac{7.969+h}{h}$

$h = 39.845$ cm.

Volume of frustum

$= \left(\frac{1}{3} \times \frac{22}{7} \times 4.2^2 \times 47.814\right) - \left(\frac{1}{3} \times \frac{22}{7} \times 3.5^2 \times 39.845\right)$ — M1

$= 372.26$ cm^3.

Hemisphere

$= \frac{2}{3} \times \frac{22}{7} \times 3.5^3$ — M1

$= 89.83$ cm^3

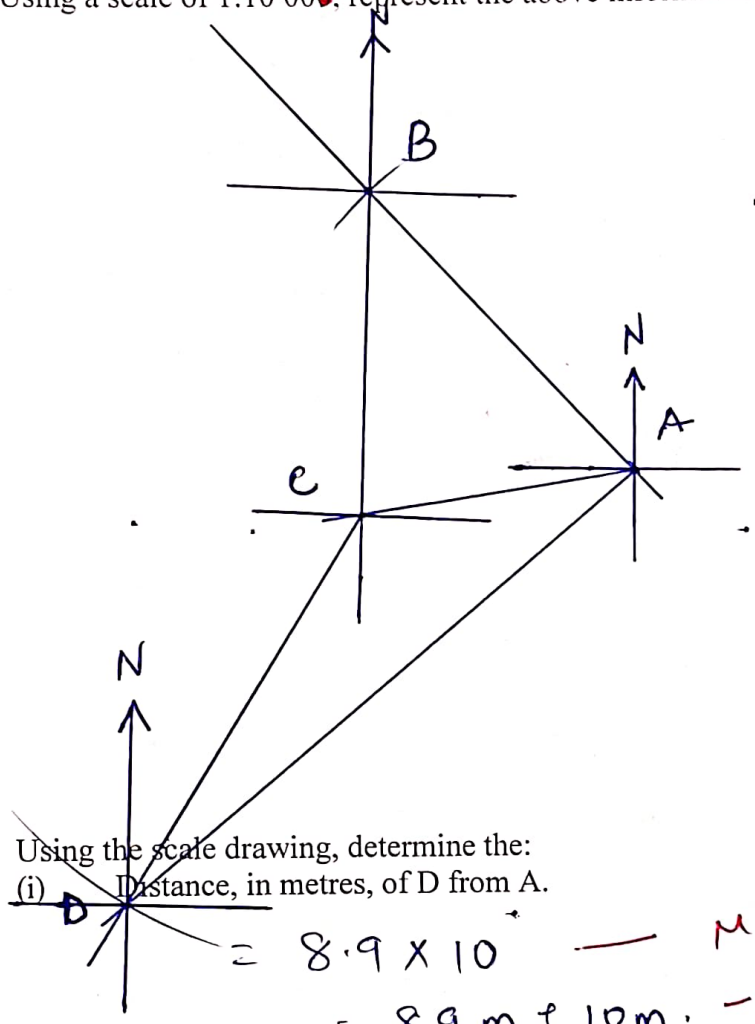
Total $= 462.09$ cm^3. — A1

9

10

19. A school garden is enclosed by four straight boundaries AB, BC, CD and DA. Point B is 50 metres on a bearing of 315° from A, C is directly south of B on a bearing of 260° from A and D is 60 metres on a bearing of 210° from C.

(a) Using a scale of 1:10 000, represent the above information on a scale drawing. (3 marks)



B_1 – B Located
B_1 – C Located
B_1 – D Located

(b) Using the scale drawing, determine the:

(i) Distance, in metres, of D from A. (2 marks)

$= 8.9 \times 10$ — M1

$= 89\text{m} \pm 10\text{m}.$ — A1

(ii) Bearing of A from D. (1 mark)

$= 049° \pm 1°$ — B1

(c) Calculate the area of the garden in hectares. (4 marks)

$ABC = \frac{1}{2} \times 50 \times 42 \sin 45°$ — M1

$= 742.46\ m^2$

$ACD = \frac{1}{2} \times 60 \times 89 \sin 19°$ — M1

$= 869.27\ m^2$

$= \frac{742.46 + 869.27}{10,000}$ — M1

$= 0.161173\ Ha.$ — A1

10

20. A point A is (-1, 8) and B is (8, 2).

a) Find

i. The position vector $\underset{\sim}{AB}$ (2 marks)

$\underset{\sim}{AB} = \underset{\sim}{b} - \underset{\sim}{a}$ — M1

$= \begin{pmatrix} 8 \\ 2 \end{pmatrix} - \begin{pmatrix} -1 \\ 8 \end{pmatrix} = \begin{pmatrix} 9 \\ -6 \end{pmatrix}$ — A1

ii. $|\underset{\sim}{AB}|$ (2 marks)

$= \sqrt{9^2 + (-6)^2}$ — M1

$= 10.82$ units. — A1

b) Given that a point P divides $\underset{\sim}{AB}$ in the ratio 1:2, find the co-ordinates of P. (3 marks)

$\underset{\sim}{P} = \frac{2}{3}\begin{pmatrix} -1 \\ 8 \end{pmatrix} + \frac{1}{3}\begin{pmatrix} 8 \\ 2 \end{pmatrix}$ — M1

$= \begin{pmatrix} -\frac{2}{3} \\ 16/3 \end{pmatrix} + \begin{pmatrix} 8/3 \\ 2/3 \end{pmatrix} = \begin{pmatrix} 2 \\ 6 \end{pmatrix}$ — A1

$P(2, 3)$. — B1

c) Another point R has co-ordinates (11, 0). Show that points A, B and R are collinear. (3 marks)

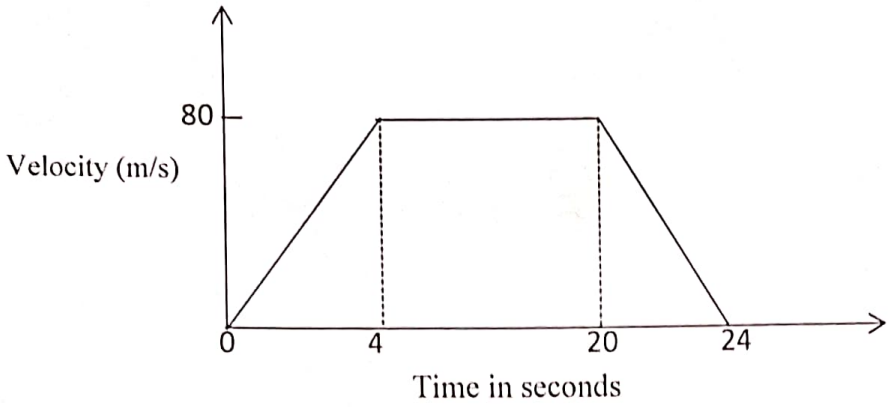
$\underset{\sim}{AB} = \begin{pmatrix} 9 \\ -6 \end{pmatrix}$

$\underset{\sim}{AR} = \begin{pmatrix} 11 \\ 0 \end{pmatrix} - \begin{pmatrix} -1 \\ 8 \end{pmatrix} = \begin{pmatrix} 12 \\ -8 \end{pmatrix}$ } B1

$\underset{\sim}{AR} = 1\frac{1}{3}\underset{\sim}{AB}$ hence B1 they are parallel. Having Common point A, A, B and R are collinear. B1

10

21. (a) The figure below is a velocity time - graph for car



(i) Find total distance traveled by the car (2 marks)

$= \frac{1}{2} \times 80 (24 + 16)$ — M1

$= 1600\ m$ — A1

(ii) Calculate the deceleration of the car. (2 marks)

$a = \frac{0 - 80}{4}$ — M1

$= -20\ m/s^2$ — A1

deceleration $= 20\ m/s^2$ — B1

(b). A Bus left Busia at 8.00am and travelled towards the Nairobi at an average speed of 72km/h. At 8.30am a Car left Busia and followed the lorry at an average speed of 96km/h. Determine the time of the day when the Car caught up with the Bus. (5 marks)

Relative distance $= 72\ Km/h \times \frac{1}{2}\ hr$ — M1

$= 36\ Km.$

Relative speed $= (96 - 72)\ Km/h$ — M1

$= 24\ Km/h.$

Time taken to catch up

$= \frac{36}{24}$ — M1

$= 1\ hr\ 30\ min.$

8.30 Am

1.30 + — M1

10.00 Am. — A1

10

22. A straight line **L1** passes through the points (8, -2) and (4,-4).

(a) Write its equation in the form ax + by +c = 0, where a, b and c are integers. (3 marks)

$m = \frac{-4+2}{4-8} = \frac{1}{2}$. — M1

$\frac{y+4}{x-4} = \frac{1}{2}$ — M1

$x - 4 = 2y + 8$

$x - 2y - 12 = 0$. — A1

(b) If the line **L1** above cuts the x-axis at point P, determine the coordinates of P. (2 marks)

$x - 2(0) - 12 = 0$. — M1

$x = 12$

$P(12, 0)$ — A1

(c) Another line **L2**, which is a perpendicular bisector to the line in (a) above cuts the y axis at the point Q. Determine the coordinates of point Q. (3 marks)

$\frac{y+3}{x-6} = -2$. — M1

$y + 3 = -2x + 12$

$y = -2x + 9$. — A1

$Q(0, 9)$. — B1

(d) Find the equation of another line **L3** parallel to **L1** and passing through point R(-2,4) (2 marks)

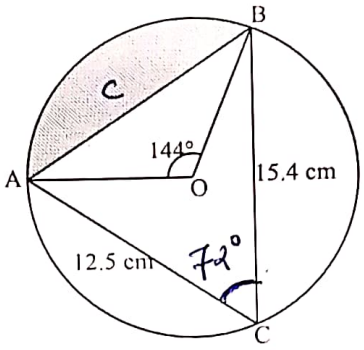
$\frac{y-4}{x+2} = \frac{1}{2}$ — M1

$y - 4 = \frac{1}{2}x + 1$

$y = \frac{1}{2}x + 5$. — A1

10

23. In the figure below, A, B and C are points on the circumference of a circle centre O
AC =12.5 cm , BC =15.4 cm and angle AOB = 144°



(a) Calculate correct to 1 decimal place:

(i) The length of the chord AB. (3 marks)

$c^2 = 12.5^2 + 15.4^2 - 2(12.5 \times 15.4)\cos 72^\circ$ — M1

$c^2 = 274.4384572$ — M1

$c = 16.6$ cm. — A1 (CAO)

(ii) The size of angle CAO. (3 marks)

$\frac{16.57}{\sin 72^\circ} = \frac{15.4}{\sin A}$ — M1

$A = 62.12^\circ$

$= 62.12^\circ - 18^\circ$ M1

$= 44.1^\circ$ — A1 (CAO)

(b) Taking π to be 3.142, calculate the area of the shaded segment. (4 marks)

$\frac{16.57}{\sin 72^\circ} = 2R$ — M1

$R = 8.711$ cm.

$A = \left(\frac{144}{360} \times 3.142 \times 8.711^2\right)$ — M1

$\left(\frac{1}{2} \times 8.711^2 \sin 144^\circ\right)$ — M1

$= 73.07\ cm^2$ — A1

10

24. (a) Find the coordinates of the stationary points of the curve $y = x^3 - 6x^2 + 9x + 5$ (4 marks)

$3x^2 - 12x + 9 = 0$ — M1

$3x^2 - 3x - 9x + 9 = 0$

$3x(x-1) - 9(x-1) = 0$

$(3x-9)(x-1) = 0$

$x = 3$ or 1 — A1

when $x = 3$

$y = 3^3 - 6(3)^2 + 9(3) + 5 = 5$

$(3, 5)$ — B1

when $x = 1$

$y = (1)^3 - 6(1)^2 + 9(1) + 5 = 9$

$(1, 9)$ — B1

(b) Determine the nature of the stationery points in (a) above. (2 marks)

$(3, 5)$

when $x = 2$, $= 3(2)^2 - 12(2) + 9 = -3$

when $x = 4$, $= 3(4)^2 - 12(4) + 9 = 9$

$(3, 5)$ is Minimum point — B1

$(1, 9)$

when $x = 0$, $= 3(0)^2 - 12(0) + 9 = 9$

when $x = 2$, $= 3(2)^2 - 12(2) + 9 = -3$

$(1, 9)$ is Maximum point — B1

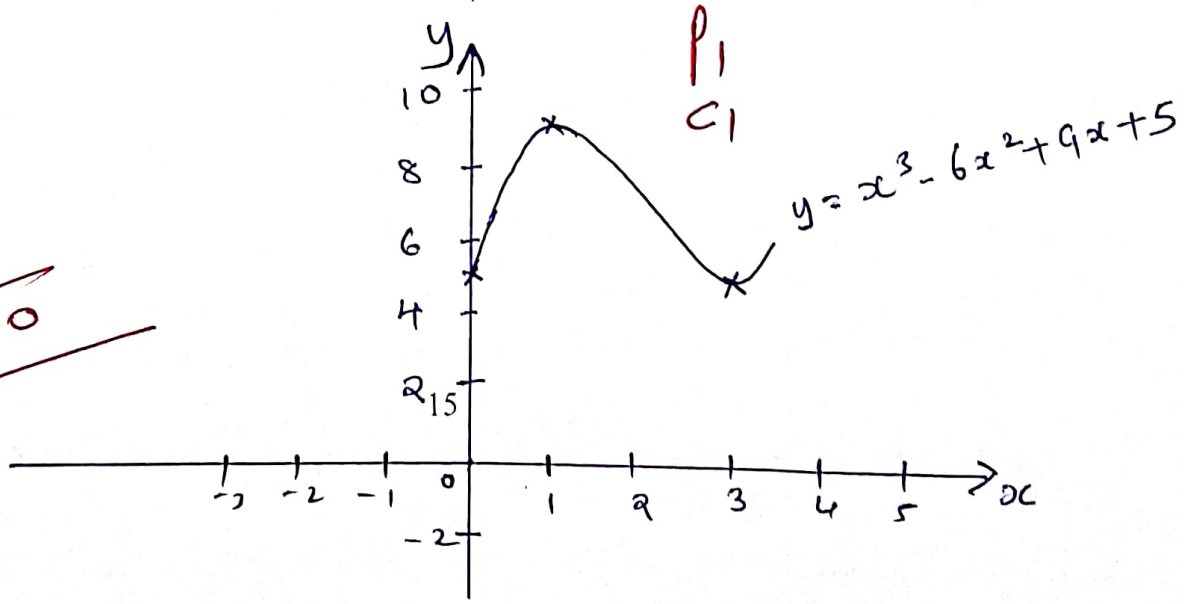
(c) Determine the co-ordinates of the y –intercept of the curve. (2 marks)

$y = (0)^3 - 6(0)^2 + (9 \times 0) + 5$ — M1

$y = 5$.

$(0, 5)$ — A1

(d) Hence sketch the curve $y = x^3 - 6x^2 + 9x + 5$ (2 marks)



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