



Name: M/SUTEMIS ADM Number: .....

School: URANGA MATHEMATICS F4P1 Candidate's index number .....

121/1  
 Mathematics Alt. A  
 FORM FOUR.  
 SEPTEMBER, 2023.  
 2 ½ Hours.

**URANGA MATHEMATICS ASSOCIATION 2023**  
 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 14 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 this section in the spaces provided.

1. Without using mathematical tables or calculators, evaluate;

(3 marks)

$$\sqrt{\frac{0.0625 \times 2.56 \times 0.8}{0.25 \times 0.08 \times 0.5 \times 0.2}}$$

$$\sqrt{\frac{25 \ 81 \ 64}{625 \times 256 \times 8}} \quad - M_1, M_1$$

$$\sqrt{\frac{25 \times 8 \times 8 \times 20}{1 \times 1 \times A_1}}$$

$$= \sqrt{64}$$

$$= \pm 8 \quad - \frac{A_1}{03}$$

Removing decimals and Simplification.

- Accept 8.

2. Two similar solids have surface areas  $48\text{cm}^2$  and  $108\text{cm}^2$  respectively. Find the volume of the smaller solid if the bigger one has a volume of  $162\text{cm}^3$ . (3 marks)

$$ASF = \frac{4}{9}$$

$$VSF = \left(\sqrt{\frac{4}{9}}\right)^3 \quad - M_1$$

$$= \frac{8}{27}$$

$$= \frac{8}{27} \times 162 \quad - M_1$$

$$= 48\text{cm}^3. \quad - \frac{A_1}{03}$$

3. A triangle flower garden has an area of  $28\text{m}^2$ . Two of its edges are 14 metres and 8 metres. Find the angle between the two edges. (2 marks)

$$\sin \theta = \frac{28}{\frac{1}{2} \times 14 \times 8} \quad - M_1$$

$$\theta = \sin^{-1} \frac{1}{2}$$

$$\theta = 30^\circ. \quad - \frac{A_1}{02}$$

4. A watch loses a half a minute every hour. It was set to read the correct time at 0445hr on Monday. Determine in twelve hour system the time the watch will show on Friday at 1845hr the same week. (3 marks)

$$\text{Total time} = 4 \times 24 + 14$$

$$= 110 \text{ hrs.} \quad - B_1$$

$$\text{Lost time} = \frac{1}{2} \times 110$$

$$= 55 \text{ minutes}$$

$$= \frac{1845}{55} \quad - M_1$$

$$5:50 \text{ pm.} \quad - \frac{A_1}{03}$$

5. Find the least whole number by which  $2^5 \times 5^4 \times 7^3$  must be multiplied with to get a perfect cube. What is the cube root of the resulting number? (3 marks)

$$= 2 \times 5^2 = 50 - B_1$$

$$= \sqrt[3]{2^6 \times 5^6 \times 7^3}$$

$$= 2^2 \times 5^2 \times 7 - M_1$$

$$= 700 - \frac{A_1}{03}$$

6. A woman went on a journey by walking, bus and matatu. She went by bus  $\frac{4}{5}$  of the distance, then by matatu for  $\frac{2}{3}$  of the rest of the distance. The distance by bus was 55km more than the distance walked. Find the total distance. (3 marks)

Distance walked

$$= 1 - \left( \frac{4}{5} + \frac{2}{3} \times \frac{1}{5} \right) - M_1$$

$$= \frac{1}{15}$$

$$\frac{4}{5} - \frac{1}{15} = \frac{11}{15}$$

Total distance

$$= \frac{15}{11} \times 55 \text{ km} - M_1$$

$$= 75 \text{ km} - \frac{A_1}{03}$$

7. Simplify the expression:

$$\frac{9t^2 - 25a^2}{6t^2 + 19at + 15a^2}$$

(3 marks)

$$\text{Top} = (3t - 5a)(3t + 5a) - B_1$$

$$= (3t - 5a) \cancel{(3t + 5a)}$$

Bottom

$$= 6t^2 + 19at + 15a^2$$

$$= 6t^2 + 9at + 10at + 15a^2$$

$$= 3t(2t + 3a) + 5a(2t + 3a)$$

$$= (2t + 3a)(3t + 5a) - B_1$$

$$\frac{\cancel{(2t + 3a)} \cancel{(3t + 5a)}}{\cancel{(2t + 3a)} \cancel{(3t + 5a)}}$$

$$= \frac{3t - 5a}{2t + 3a} - \frac{B_1}{03}$$

8. Given that the position vectors of P and Q are  $OP = \begin{pmatrix} -2 \\ 10 \end{pmatrix}$  and  $OQ = \begin{pmatrix} x \\ -2 \end{pmatrix}$  and that the magnitude of PQ is 13 units, find the possible values of x. (4 marks)

$$\vec{PQ} = \begin{pmatrix} x \\ -2 \end{pmatrix} - \begin{pmatrix} -2 \\ 10 \end{pmatrix} = \begin{pmatrix} x+2 \\ -12 \end{pmatrix} \quad - M_1$$

$$x^2 + 4x + 4 + 144 - 169 = 0$$

$$x^2 + 4x - 21 = 0$$

$$x = \frac{-4 \pm \sqrt{16 - 4(-21)}}{2} \quad - M_1$$

$$x = 3 \text{ or } -7 \quad - \frac{A_1}{04}$$

$$|\vec{PQ}| = \sqrt{(x+2)^2 + (-12)^2} = 13 \quad - M_1$$

$$(x+2)^2 + 144 = 169$$

9. The size of an interior angle of regular polygon is  $3x^\circ$ . While its exterior angle is  $(x-20)^\circ$ . Find the number of sides of the polygon. (3 marks)

$$3x^\circ + (x-20)^\circ = 180^\circ \quad - M_1$$

$$4x = 200$$

$$x = 50^\circ$$

$$\text{Exterior} = 50^\circ - 20^\circ = 30^\circ$$

$$n = \frac{360^\circ}{30^\circ} \quad - M_1$$

$$n = 12 \text{ sides} \quad - \frac{A_1}{03}$$

10. A Kenya company received US Dollars M. The money was converted into Kenya Shillings in a bank which buys and sells foreign currencies.

	Buying (in Ksh)	Selling (in Ksh)
1 Sterling Pound	125.78	126.64
1 Us Dollar	75.66	75.86

- a) If the company received Ksh.15, 132,000, calculate the amount, M received in US Dollar. (2 marks)

$$= \frac{15,132,000}{75.66} \quad - M_1$$

$$= 200,000 \text{ Dollars} \quad - A_1$$

- b) The company exchanged the above Kenya shillings into Sterling pounds to buy a car in Britain. Calculate the cost of the car to the nearest Sterling pound. (2 marks)

$$= \frac{15,132,000}{126.64} \quad - M_1$$

$$= 119,488 \text{ sp.} \quad - A_1 \text{ (CAO)}$$

11. A plot in a shape of rectangle measures 608m by 264m. Equidistance fencing posts are placed along its length and breadth as far apart as possible. Determine

a) The maximum distance between the posts.

(1 mark)

$$\begin{array}{c|c|c} 2 & 608 & 264 \\ \hline 2 & 304 & 132 \\ 2 & 152 & 66 \\ & 76 & 33 \end{array} \quad \begin{array}{l} = 2^3 \\ = 8 \text{ m.} - B_1 \end{array}$$

b) The number of posts used.

(2 marks)

$$\begin{aligned} &= \frac{2(608 + 264)}{8} - M_1 \\ &= 218 \text{ posts} - \frac{A_1}{03.} \end{aligned}$$

12. Given that  $\sin(x - 30)^\circ = \cos(4x)^\circ$ . Find the  $\tan(2x + 30)^\circ$

(3 marks)

$$\begin{aligned} x - 30 + 4x &= 90^\circ - M_1 \\ x &= 24^\circ \\ \tan(2(24) + 30)^\circ &- M_1 \\ &= 4.705 - \frac{A_1}{03.} \end{aligned}$$

13. A trader sold a dress for Ksh 7,200 allowing a discount of 10% on the marked price. If the discount had not been allowed the trader would have made a profit of 25% on the sale of the suit. Calculate the price at which the trader bought the dress.

(3 marks)

$$\begin{aligned} MP &= \frac{100}{90} \times 7,200 - M_1 \\ &= \text{Sh. } 8,000 \\ BP &= \frac{100}{125} \times \text{Sh. } 8,000 - M_1 \\ &= \text{Sh. } 6,400. - \frac{A_1}{03.} \end{aligned}$$

14. In August, Joyce donated  $\frac{1}{6}$ th of her salary to a children's home while Chui donated  $\frac{1}{5}$ th of his salary to the same children's home. Their total donation for August was Ksh 14,820. In September, Joyce donated  $\frac{1}{8}$ th of her salary to the children's home while Chui donated  $\frac{1}{12}$ th of his salary to the children's home. The total donation for September was Ksh 8,675. Calculate chui's monthly salary. (4 marks)

Let James salary =  $x$  and Chui =  $y$

$$\frac{1}{6}x + \frac{1}{5}y = 14,820 \text{ --- (i)}$$

$$\frac{1}{8}x + \frac{1}{12}y = 8,675 \text{ --- (ii)}$$


---


$$5x + 6y = 444,600$$

$$3x + 2y = 208,200$$

Solving the Equations -  $M_1$

$$x = \text{sh. } 45,000 \text{ --- } A_1$$

$$3(45,000) + 2y = 208,200$$

$$2y = 73,200$$

$$y = \text{sh. } 36,600. \text{ --- } B_1$$

(3 marks)

04

15. Simplify completely

$$\frac{3^{n+3} - 3^{n+1}}{4 \times 3^{n+2}}$$

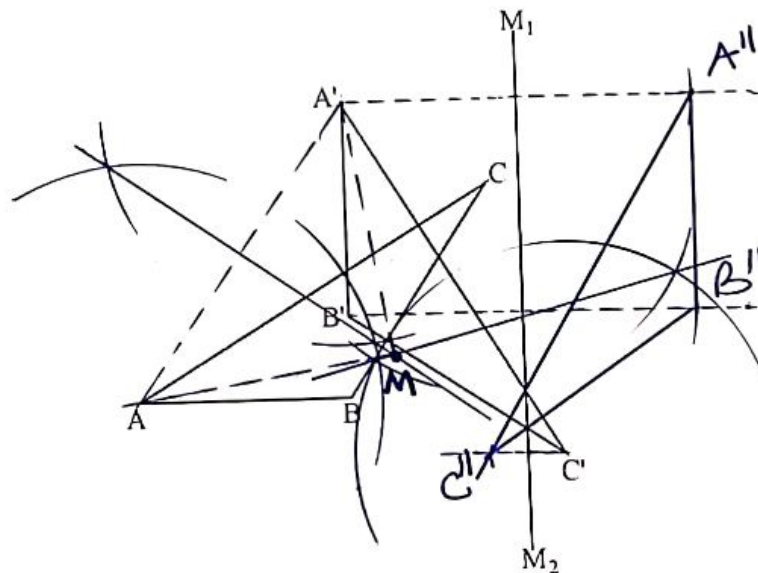
$$= \frac{3^n \times 3^3 - 3^n \times 3^1}{4 \times 3^n \times 3^2} \text{ --- } M_1$$

Let  $3^n = y$ .

$$= \frac{27y - 3y}{36y} \text{ --- } M_1$$

$$= \frac{2}{3} \frac{A_1}{03}$$

16. In the figure below, triangle  $A'B'C'$  is the image of triangle  $ABC$  after a rotation.  $M_1M_2$  is a mirror Line.



$B_1$  - Centre located  
 $B_1$  - Angle of rotation ( $-90^\circ$ )  
 $B_1$  -  $A''B''C''$   
 drawn  
03

a) Find the centre and angle of rotation that maps  $ABC$  onto  $A'B'C'$ .

(2 marks)

Centre  $M$ , Angle  $-90^\circ$

b) Draw  $A''B''C''$  the image of  $A'B'C'$  under a reflection on the line  $M_1M_2$

(1 mark)

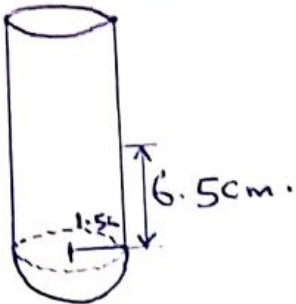
SECTION II (50 MARKS)

Answer ANY FIVE questions from this section in the spaces provided

17. Atembo poured spirit into a test tube which has hemispherical bottom of inner radius 1.5cm. He noted that the spirit is 8cm high.

(a) What is the area of surface in contact with spirit?

( $\pi = 3.142$ ) (4 marks)



$$\begin{aligned} \text{Hemisphere} &= 2 \times 3.142 \times 1.5^2 - M_1 \\ &= 14.139 \text{ cm}^2 \end{aligned}$$

Cylindrical part

$$\begin{aligned} &= 2 \times 3.142 \times 1.5 \times 6.5 - M_1 \\ &= 61.269 \text{ cm}^2 \end{aligned}$$

Total

$$\begin{aligned} &= 14.139 + 61.269 - M_1 \\ &= 75.408 \text{ cm}^2 - A_1 \end{aligned}$$

(b) Calculate volume of spirit in the test tube.

(4 marks)

$$\begin{aligned} \text{Hemisphere} &= \frac{2}{3} \times 3.142 \times 1.5^3 - M_1 \\ &= 7.0695 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \text{Cylinder} &= 3.142 \times 1.5^2 \times 6.5 - M_1 \\ &= 45.95175 \end{aligned}$$

$$\begin{aligned} \text{Total} &= 7.0695 + 45.95175 - M_1 \\ &= 53.02125 \text{ cm}^3 - A_1 \end{aligned}$$

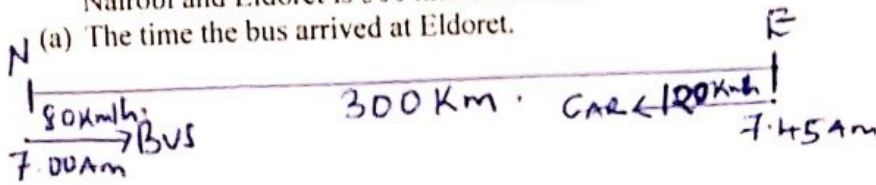
(c) If Atembo obtained the mass of the spirit as 10g. Calculate the density of the spirit. (2 marks).

$$\rho = \frac{10 \text{ g}}{53.02125 \text{ cm}^3} - M_1$$

$$= 0.1886 \text{ g/cm}^3 - A_1$$

18. A bus left Nairobi at 7.00 am and traveled towards Eldoret at an average speed of 80km/hr. At 7.45am a car left Eldoret towards Nairobi at an average speed of 120km/hr. The distance between Nairobi and Eldoret is 300 km. Calculate:

(a) The time the bus arrived at Eldoret.



(2 marks)

$$\begin{aligned} \text{Time} &= \frac{300}{80} = 3 \frac{3}{4} \text{ hrs} \\ &= 7:00 \text{ am} + 3 \text{ hrs } 45 \text{ min} \\ &= 10:45 \text{ am} \quad \text{--- } A_1 \end{aligned}$$

(4 marks)

(b) The time of the day the two met.

Relative Distance

$$\begin{aligned} &= 300 \text{ km} - 80 \text{ km/h} \times \frac{3}{4} \text{ hrs} - M_1 \\ &= 240 \text{ km.} \end{aligned}$$

Relative speed

$$\begin{aligned} &= 80 \text{ km/h} + 120 \text{ km/h} \\ &= 200 \text{ km/h.} \end{aligned}$$

Time taken to meet

$$= \frac{240}{200} = 1 \text{ hr } 12 \text{ mins}$$

Time of the day

$$\begin{array}{r} 7:45 \text{ am} \\ + 1:12 \\ \hline 8:57 \text{ am} \quad \text{--- } A_1 \end{array}$$

Note: follow through

(c) The distance of the bus from Eldoret when the car arrived in Nairobi.

(2 marks)

Time taken by car

$$= \frac{300}{120} = 2 \frac{1}{2} \text{ hrs.}$$

$$\text{Time} = \frac{7:45}{10:15 \text{ am.}} \quad \text{--- } B_1$$

$$\begin{array}{r} = 10:45 \text{ am} \\ - 10:15 \text{ am} \\ \hline 30 \text{ min} \end{array}$$

$$= \frac{1}{2} \text{ hr} \times 80 \text{ km} = 40 \text{ km} \quad \text{--- } B_1$$

Note: follow through

(d) The distance from Nairobi when the two met.

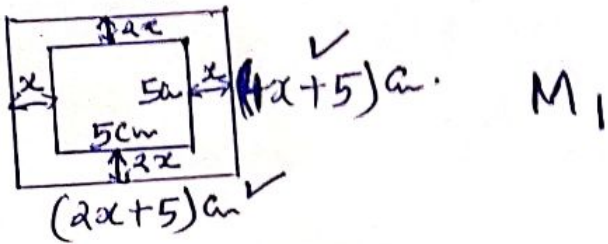
(2 marks)

$$= 300 - (120 \times \frac{6}{5}) \quad \text{--- } M_1$$

$$= 156 \text{ km.} \quad \text{--- } A_1$$



19. A square photograph is mounted on a frame such that it leaves a uniform border of width  $2x$  cm at the bottom and at the top. At each side, a uniform border which is half the border at the bottom is left. If the side of the square photograph is  $5$  cm and area of frame is  $75$  cm<sup>2</sup>.  
 (a) Write down a simplified equation in  $x$  for the area of the frame. (3 marks)



$$(2x+5)(4x+5) = 75$$

$$8x^2 + 10x + 20x + 25 = 75 \quad M_1$$

$$8x^2 + 30x - 50 = 0$$

$$4x^2 + 15x - 25 = 0 \quad A_1$$

- (b) What are the dimensions of the frame?

(4 marks)

$$x = \frac{-15 \pm \sqrt{15^2 - 4(4x-25)}}{8} \quad M_1$$

$$x = \frac{-15 \pm 25}{8}$$

$$x = 1.25 \text{ or } -5.$$

$$x = 1.25 \text{ cm.} \quad A_1$$

$$2x + 5 = 2(1.25) + 5 = 7.5 \text{ cm} = B_1$$

$$4x + 5 = 4(1.25) + 5 = 10 \text{ cm.} = B_1$$

- (c) What is the percentage area of the frame that is not covered by the photograph?

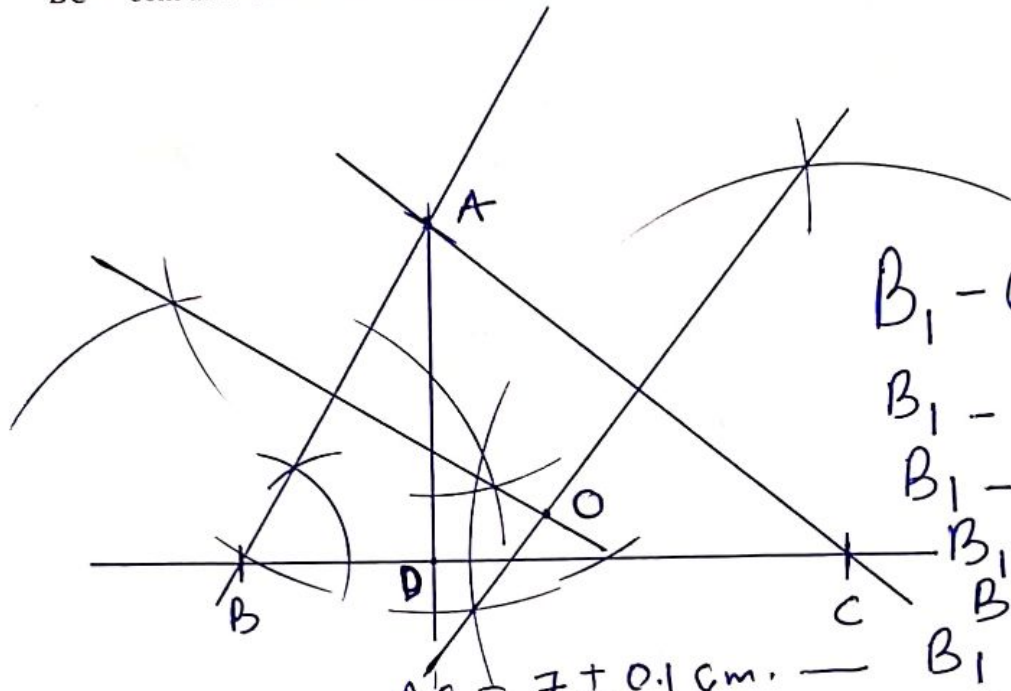
(3 marks)

$$\begin{aligned} \text{Area of frame not covered by photo} &= 75 \text{ cm}^2 - 5^2 \text{ cm}^2 \\ &= 50 \text{ cm}^2 \quad B_1 \\ &= \frac{50}{75} \times 100\% \quad M_1 \end{aligned}$$

$$= 66 \frac{2}{3}\% \quad A_1$$

$$\frac{10}{10}$$

20. (a) Using a ruler and a pair of compasses only, draw a triangle ABC such that  $AB = 5\text{cm}$ ,  $BC = 8\text{cm}$  and  $\angle ABC = 60^\circ$ . Measure AC and  $\angle CAB$ . (4 marks)



$AC = 7 \pm 0.1\text{cm.}$  — B1  
 $\angle CAB = 82^\circ \pm 1^\circ$  — B1  
 $AD = 4.3 \pm 0.1\text{cm.}$  — B1

- (b) Find a point O in  $\triangle ABC$  such that  $OA = OB = OC$ . (2 marks)

- (c) Construct a perpendicular from A to BC to meet BC at D. Measure AD. Hence calculate the area of the  $\triangle ABC$  (4 marks)

$$\begin{aligned}
 A &= \frac{1}{2} \times 8 \times 4.3 - M1 \\
 &= 17.2\text{ cm}^2, - A1 \\
 &\underline{\underline{10}}.
 \end{aligned}$$

21. The table below shows the amount in shillings of pocket money given to students in a particular school.

Pocket Money (Ksh)	210-219	220-229	230-239	240-249	250-259	260-269	270-279	280-289	290-299
No. of Students	5	13	23	32	26	20	15	12	4

(a) State the modal class.

240-249. B<sub>1</sub>

(1 mark)

(b) Calculate the mean amount of pocket money given to these students to the nearest shilling.

(4 marks)

Class	F	X	FX
210-219	5	214.5	1072.5
220-229	13	224.5	2918.5
230-239	23	234.5	5393.5
240-249	32	244.5	7824.0
250-259	26	254.5	6617.0
260-269	20	264.5	5290.0
270-279	15	274.5	4117.5
280-289	12	284.5	3414.0
290-299	4	294.5	1178.0
	150		37,825

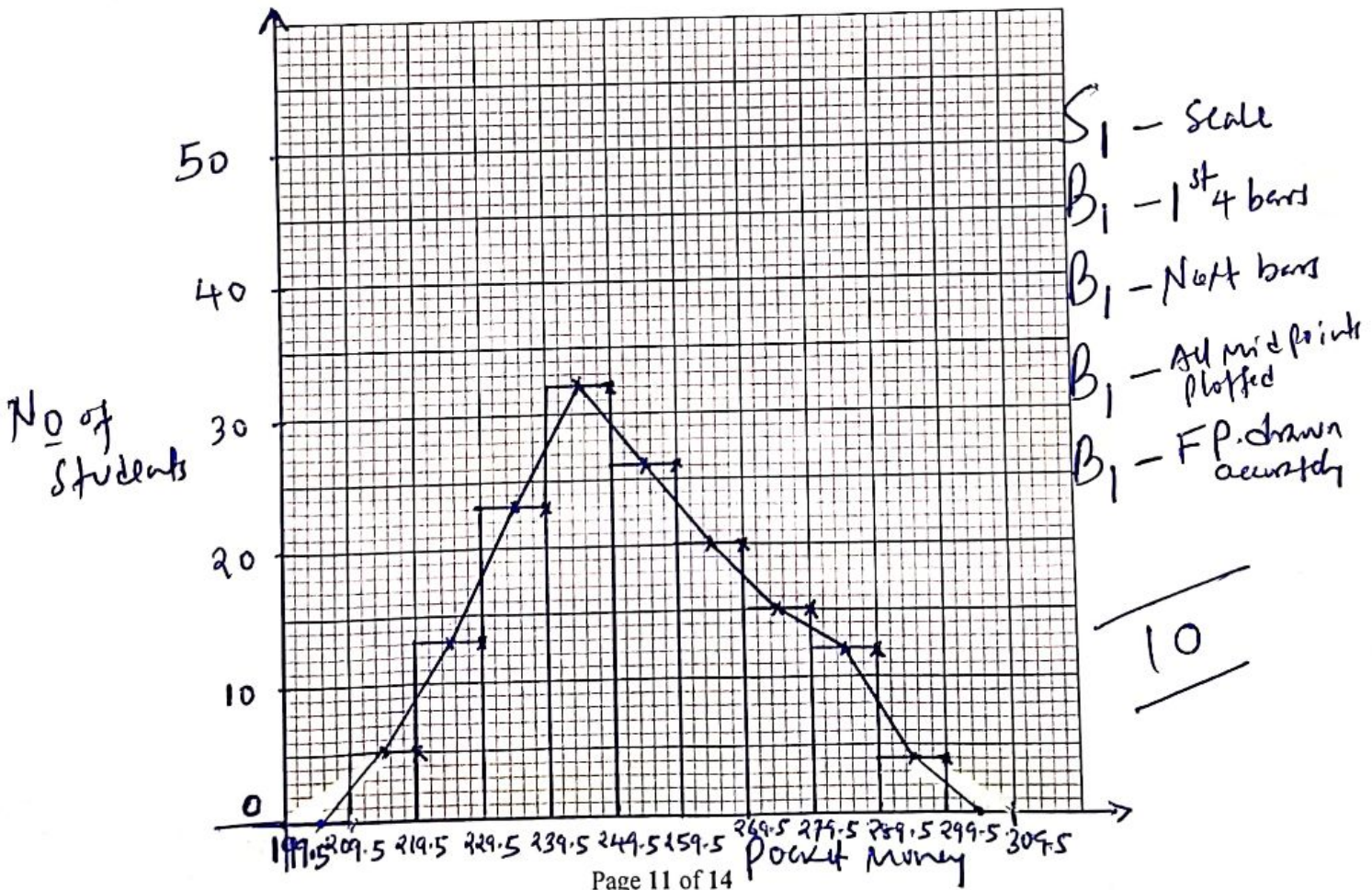
B<sub>1</sub> - AUX

B<sub>1</sub> - AUX

$$\bar{x} = \frac{37,825}{150} - M_1$$

$$= \text{Ksh. } 252. - A_1$$

(c) Use the same axes to draw a histogram and a frequency polygon on the grid provided. (5 marks)



22. The speed of a projectile  $v$  m/s at a given time  $t$  is given by  $v = 10(10t - t^2)$  calculate. (3 marks)
- a. The time when the velocity is maximum.

$$v = 100t - 10t^2 \quad \text{--- M}_1$$

$$\frac{dv}{dt} = 100 - 20t = 0 \quad \text{--- M}_1$$

$$t = 5 \text{ sec} \quad \text{--- A}_1$$

- b. The maximum velocity attained (2 marks)

$$V = 100(5) - 10(5)^2 \quad \text{--- M}_1$$

$$= 250 \text{ m/s} \quad \text{--- A}_1$$

- c. The distance travelled by the body in the first 6 seconds. (3 marks)

$$S = \int (100t - 10t^2) dt$$

$$S = 50t^2 - \frac{10}{3}t^3 + c \quad \text{--- M}_1$$

$$S = 50(6)^2 - \frac{10}{3}(6)^3 \quad \text{--- M}_1$$

$$= 1080 \text{ m} \quad \text{--- A}_1$$

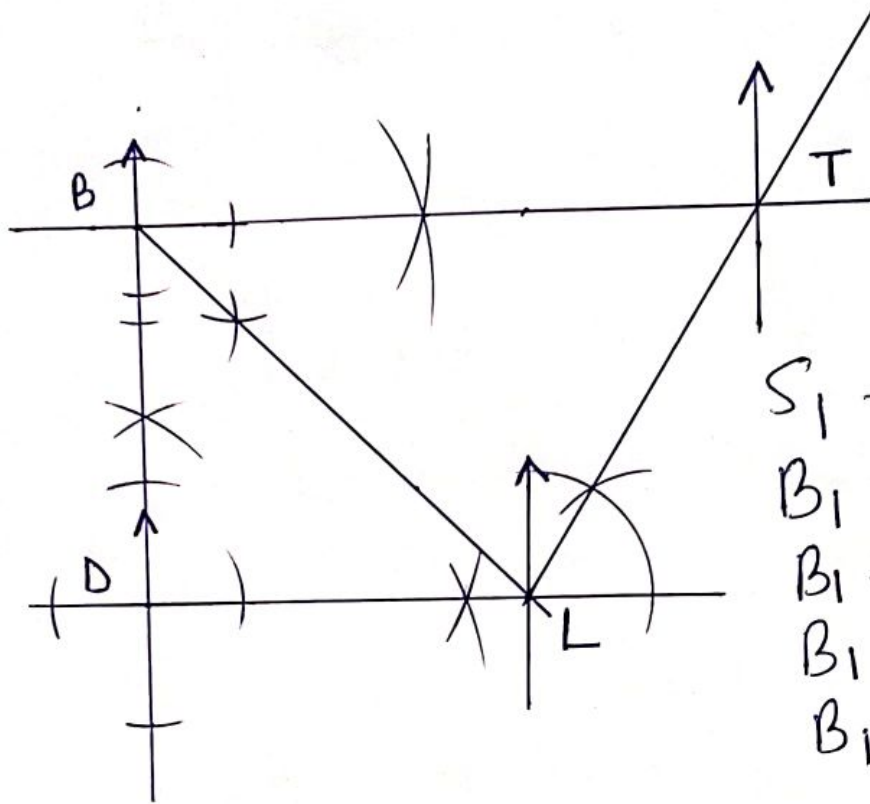
- d. The acceleration of the projectile at  $t = 6.5$  sec. (2 marks)

$$a = 100 - 20(6.5) \quad \text{M}_1$$

$$a = -30 \text{ m/s}^2 \quad \text{A}_1$$

$$\frac{\text{A}_1}{10}$$

23. A boy started walking due East from a dormitory 100m South of a bore-hole. He walked to the school library from which the bearing of the bore-hole is  $315^\circ$ . He then walked on a bearing of  $030^\circ$  to the water tank. From the water tank he went west to the bore-hole.  
 a) Using a scale of 1cm to represent 20m, construct a diagram to show the positions of the tank, borehole, dormitory and library. (5 marks)



- b) Find the distance and bearing of the bore-hole from the water tank. (3 marks)

$$\begin{aligned} \text{Distance} &= 8.0 \times 20 \quad \text{--- } M_1 \\ &= 160 \text{ m} \pm 2 \text{ m} \quad \text{--- } A_1 \\ \text{Bearing} &= 270^\circ \pm 1^\circ \quad \text{--- } B_1 \end{aligned}$$

- c) Calculate the total distance covered by the boy. (2 marks)

$$\begin{aligned} &= (5 + 6 + 8) \times 20 \quad \text{--- } M_1 \\ &= 380 \text{ m} \pm 6 \text{ m} \quad \text{--- } A_1 \end{aligned}$$

10

24. A straight line L1 has a gradient  $-\frac{1}{2}$  and passes through point P (-1, 3). Another line L2 passes through the points Q (1, -3) and R (4, 5). Find.

a) The equation of L1. (2 marks)

$$\frac{y-3}{x+1} = -\frac{1}{2} - M_1$$

$$y = -\frac{1}{2}x + 2\frac{1}{2} - A_1$$

b) The gradient of L2. (1 mark)

$$m = \frac{5+3}{4-1} = 2\frac{2}{3} B_1$$

c) The equation of L2. (2 marks)

$$\frac{y-5}{x-4} = \frac{8}{3} - M_1$$

$$y = -2\frac{2}{3}x - 5\frac{2}{3} - A_1$$

d) The equation of a line passing through a point S (0, 5) and is perpendicular to L2. (3 marks)

$$m = -\frac{3}{8} \text{ --- } B_1$$

$$\frac{y-5}{x} = -\frac{3}{8} - M_1$$

$$y = -\frac{3}{8}x + 5 - A_1$$

e) The equation of a line through R parallel to L1. (2 marks)

$$\frac{y-5}{x-4} = -\frac{1}{2} - M_1$$

$$y = -\frac{1}{2}x + 7 - A_1$$


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10