

STRAIGHT

NAME ADM NO.....
SCHOOL..... CANDIDATE'S SIGN.....
DATE.....

121/1
MATHEMATICS
PAPER 1
FORM FOUR
AUGUST, 2022
TIME: 2 ½ HOURS

URANGA MATHEMATICS ASSOCIATION – 2022
Kenya Certificate of Secondary Education (K.C.S.E)

121/1
MATHEMATICS
PAPER 1
FORM FOUR
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TIME: 2 ½ HOURS

INSTRUCTIONS TO CANDIDATES

- a) Write your Name and Admission number in the spaces provided above
- b) Sign and write the date of examination in the spaces provided.
- c) Answer all the questions in section I and only five questions from section II.
- d) All answers and working must be written on the question paper in the spaces provided below each question.
- e) Show all the steps in your calculations giving your answers at each stage in the spaces below each question.
- f) Marks may be given for correct working even if the answer is wrong.
- g) Non-programmable silent electronic calculators and KNEC mathematical tables may be used except where stated otherwise.
- h) This paper consists of 15 printed pages. Candidates should check the question paper to ascertain all the pages are printed as indicated and no questions are missing.

FOR EXAMINERS USE ONLY

SECTION I

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

SECTION II

17	18	19		21	22	23	24	TOTAL

GRAND TOTAL

SECTION I (50 MARKS)

Answer All questions in this section in the spaces provided

1. Evaluate without using calculator giving your answer in simplified form. (3 marks)

$$\frac{\frac{1}{2} \text{ of } 3\frac{1}{2} + 1\frac{1}{2} \left(2\frac{1}{2} - \frac{2}{3} \right)}{\frac{3}{4} \text{ of } 2\frac{1}{2} + \frac{1}{2}}$$

$$= \frac{7}{4} + \frac{11}{4} = \frac{18}{4} \quad M_1 \Rightarrow \frac{18}{4} \times \frac{4}{15}$$

$$M = \frac{1}{2} \times \frac{7}{2} + \frac{3}{2} \left(\frac{5}{2} - \frac{2}{3} \right)$$

$$= \frac{3}{4} \text{ of } 2\frac{1}{2} + \frac{1}{2}$$

$$= 1\frac{1}{5} \quad A_1$$

$$= \frac{7}{4} + \frac{3}{2} \left(\frac{11}{6} \right)$$

$$= \frac{3}{4} \times \frac{5}{2} \times \frac{2}{1}$$

$$= 15/4 \quad M_1$$

2. A dress maker had a cloth which he intended to cut into equal length of either 28 cm, 16cm or 40cm. Determine the number of 16 cm pieces that could be obtained from the cloth. (3 marks)

LCM

	16	28	40
2	8	14	20
2	4	7	10
2	2	7	5
2	1	7	5
5	1	7	1
7	1	1	1

$= 2^4 \times 5 \times 7 = 560 \text{ cm}$

For 16 cm pieces

$$= \frac{560 \text{ cm}}{16 \text{ cm}} = 35 \text{ pieces} \quad A_1$$

3. Use logarithm tables to evaluate to 4 s.f. (4 marks)

M_1	528.4	st.	log.
15.23^2	1.523×10^1		$1.1826 \times 2 = 2.3652$
7.234	7.234×10^0		$0.8593 \times \frac{1}{2} = 0.42965$
528.4	5.284×10^2		2.7229
			2.79485
			2.72290
			0.07195

B_1 for All to
 B_1 correct multiplication

B_1 for Addition and subtract

~~A_1 for correct answer~~

$$\text{Anti log } 0.07195 = \underline{\underline{1.180}} \quad \text{correct antilog. } A_1$$

Four interior angles of a polygon are each 155° , while the rest are each 160° , find the number of sides in this polygon. (3 marks)

n -sides exterior total = 360

155° exterior = 25

160° exterior = 20

$4 \times 25 + (n-4)20 = 360$ M1

$100 + 20n - 80 = 360$ M1

$20n = 340$

$n = 17$ sides A1 $\frac{03}{03}$

5. A metal bar with a cross-sectional area of 44cm^2 has a mass of 5.06kg. The density of the bar is 2.3g/cm^3 . Calculate the length in cm of the bar. (3 marks)

mass = 5060g

$L = \frac{V}{A}$

Volume = $\frac{5060}{2.3}$ M1

= $\frac{2200}{44}$ M1

= 2200cm^3 ✓

= 50cm A1 $\frac{03}{03}$

6. Given that $x=3$, $y=2$ and $z=-1$. Find the value of (3 marks)

$\frac{4xyz - 2xz^2 - 5y}{xy^3z + 3xz^3 + 4y}$

$\frac{4 \times 3 \times 2 \times (-1) - (2 \times 3 \times 1) - (5 \times 2)}{3 \times 8 \times (-1) + 3 \times 3 \times (-1)^3 + 4 \times 2}$ M1

= $\frac{-24 - 6 - 10}{-24 - 9 + 8}$

= $\frac{-40}{-25}$ M1

= $\frac{8}{5} = 1\frac{3}{5}$ A1

7. Solve for x in the equation $\sin(4x - 20^\circ) - \cos(x + 60^\circ) = 0$ (2 marks)

$\sin(4x - 20) = \cos(x + 60)$

$4x - 20 + x + 60 = 90$ M1

$5x = 50$

$x = 10^\circ$ A1

The cost of buying a certain machine outside Kenya was US \$ 4800. Owino bought such a machine through an agent who deals in Japanese yen. The agent charged 15% commission on the price of the machine and a further 72,220 Japanese yen for shipment.
 How much money in Kenya shillings did he need to send the agent to obtain the machine? (3 marks)
 US \$1 = 117.20 Japanese yen.
 US \$ 1 = Ksh. 103.34

Cost + Commission + shipment

$$\frac{115 \times 4800}{100} + \frac{72220}{117.20}$$

$$= 5520 + 616.2116$$

$$= 6136.2116$$

$$6136.2116 \times 103.34 \text{ M}_1$$

$$= 634,116.11 \text{ Kshs. A}_1$$

9. Given that $a = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$ and $b = \begin{pmatrix} 3 \\ 0 \end{pmatrix}$. Determine the magnitude of the line OM if $OM = a - 3b$ and O is the origin. (3 marks)

$$OM = \begin{pmatrix} -1 \\ 4 \end{pmatrix} - (3)\begin{pmatrix} 3 \\ 0 \end{pmatrix} \text{ M}_1$$

$$= \begin{pmatrix} -1 \\ 4 \end{pmatrix} - \begin{pmatrix} 9 \\ 0 \end{pmatrix}$$

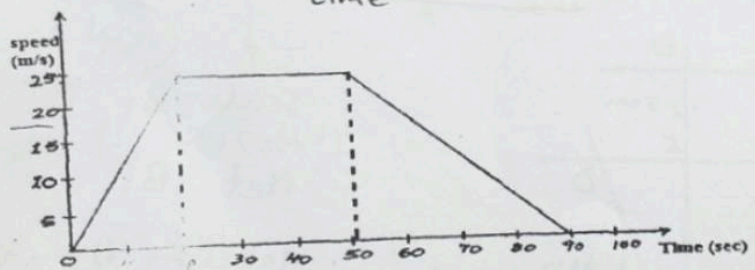
$$= \begin{pmatrix} -10 \\ 4 \end{pmatrix}$$

$$|OM| = \sqrt{(-10)^2 + (4)^2} \text{ M}_1$$

$$= \sqrt{116}$$

$$= 10.7703 \text{ A}_1$$

10. The diagram below is a speed-time graph for a car that travelled between two stations in 90 seconds.



Calculate the average speed of the car. (3 marks)

$$\text{Distance} = \frac{1}{2}h(a+b)$$

$$= \frac{1}{2} \times 25 \times (90+30) \text{ M}_1$$

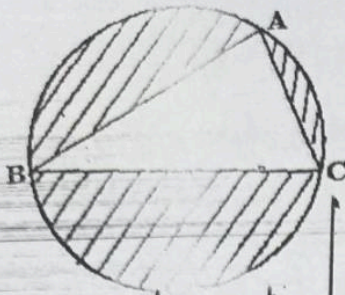
$$= 1500 \text{ m.}$$

$$\text{Av speed} = \frac{T D}{T \text{ Time}}$$

$$= \frac{1500}{90} \text{ M}_1$$

$$= 16.67 \text{ m/s A}_1$$

11. In the figure below a triangle ABC is enclosed in a circle. AB = 6.3cm, AC = 4.2cm and BC = 5.7cm. Angle ABC = 41.03°. Calculate the area of the shaded part. (4 marks)



$$\pi r^2 - \frac{1}{2} AB \sin \theta$$

$$\frac{22}{7} \times 3.199^2 - \frac{1}{2} \times 6.3 \times 5.7 \sin 41.03 \quad M_1, M_2$$

$$32.1627 - 11.7866 \quad M_3$$

$$= 20.3761 \text{ cm}^2 \quad A_1$$

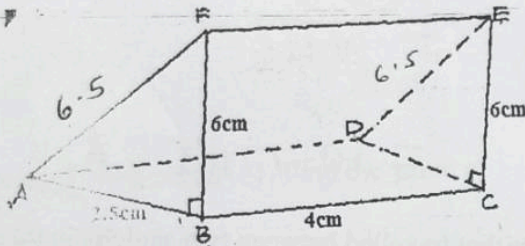
$$20.38 \text{ cm}^2$$

$$2 \text{ Radius} = \frac{b}{\sin B}$$

$$r = \frac{4.2}{2 \sin 41.03}$$

$$= 3.199 \quad B_1$$

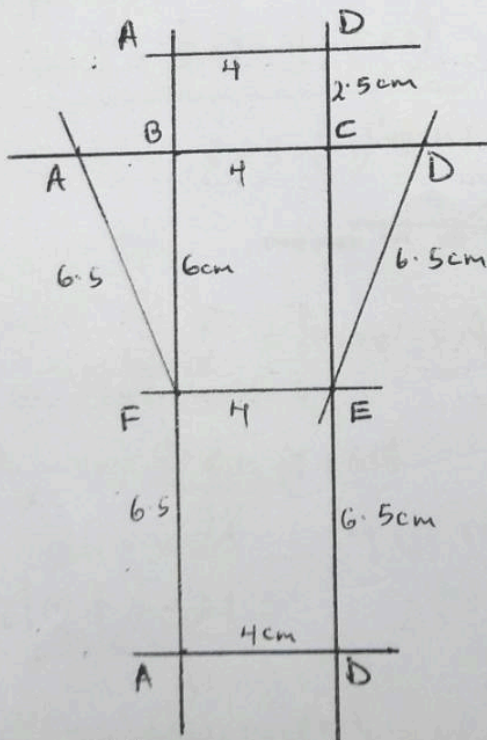
12. The figure below represents a triangular prism AB = 2.5cm, BF = 6cm and BC = 4cm.



Draw the net of the solid.

scale 1:2

(3 marks)



Scale B₁

Net B₁

labelling B₁

3

Solve the following simultaneous inequalities and show your solution on a number line. (3 marks)

$$\frac{x-3}{3} < 1 \text{ and } 3x+1 \geq -17$$

$$\frac{x-3}{3} < 1$$

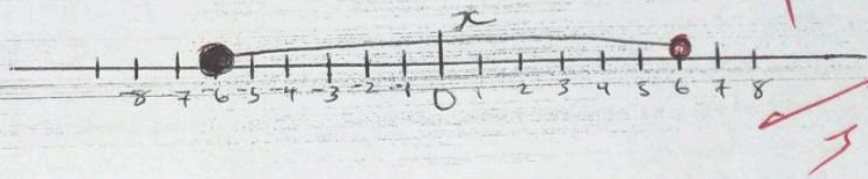
$$x < 6 \quad B_1$$

$$3x+1 \geq -17$$

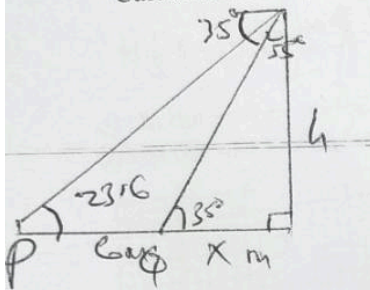
$$3x \geq -18$$

$$x \geq -6 \quad B_2$$

$$-6 \leq x < 6$$



14. The angle of elevation of the top of a storey building from point P is 23.6° . From another point Q 6m from P and nearer to the base of the building the angle of depression from the top of the building is 35° . Calculate to 1 dp the height of the building. (4 marks)



$$\tan 23.6 = \frac{h}{6+x}$$

$$\tan 35 = \frac{h}{x}$$

$$\tan 23.6 = \frac{x \tan 35}{6+x}$$

$$2.621 + 0.437x = 0.7x$$

$$\frac{2.621}{0.263} = \frac{0.263x}{0.263}$$

$$x = 9.96 \text{ m}$$

$$h = 9.96 \tan 35 = 6.97 \text{ m}$$

$$\underline{\underline{7.0 \text{ m} \quad A}}$$

15. Simplify $\left(\frac{1}{3}\right)^{-3} \times 27^{\frac{-2}{3}} \times (4^{-1})^0$

$$3^3 \times \frac{1}{27^{\frac{2}{3}}} \times 1 \quad M_1$$

$$27 \times \frac{1}{(3\sqrt[3]{27})^2} \times 1 \quad M_1$$

$$27 \times \frac{1}{9} \times 1 \quad M_1$$

$$= 3 \quad A_1$$

1. The ratio of Larry's sheep to goats is 5 : 4. On a certain market day she sold $\frac{1}{4}$ of the goats and $\frac{1}{5}$ of the sheep. If she had sold 5 more animals from the herd only $\frac{2}{3}$ of the original number could have been left. How many animals were there before the sale? (3 marks)

Let Total animals be x

$$S = \frac{5}{9}x$$

$$G = \frac{4}{9}x$$

Sold

$$\text{Goats} = \frac{1}{4}\left(\frac{4}{9}x\right) = \frac{1}{9}x$$

$$\text{sheep} = \frac{1}{5}\left(\frac{5}{9}x\right) = \frac{1}{9}x$$

M₁

$$\left[x - \left(\frac{2}{9}x + 5\right)\right] = \frac{2}{3}x \quad \text{M}_1$$

$$\frac{7}{9}x - 5 = \frac{2}{3}x$$

$$\frac{7}{9}x - \frac{2}{3}x = 5$$

$$\frac{7}{9}x - \frac{4}{9}x = 5 \times \frac{9}{1}$$

$$\underline{\underline{x = 45}} \quad \text{A}_1$$

3

SECTION II (50 MARKS)

Answer ONLY FIVE questions in this section

The following are masses of 25 students in form 4 class.

49, 51, 50, 60, 55, 45, 56, 51, 58, 59, 44, 59, 42, 50, 62, 46, 43, 57, 56, 52, 43, 41, 40, 54, 44.

a) Draw a frequency distribution table with lower class as 40—43. (3 marks)

Class	$\frac{x}{2}$	f	cf
40-43	41.5	5	5
44-47	45.5	4	9
48-51	49.5	5	14
52-55	53.5	3	17
56-59	57.5	6	23
60-63	61.5	2	25

B_1 - class
 B_1 - frequency
 B_1 - tally
 B_1 - cf

b) Estimate the median. (3 marks)

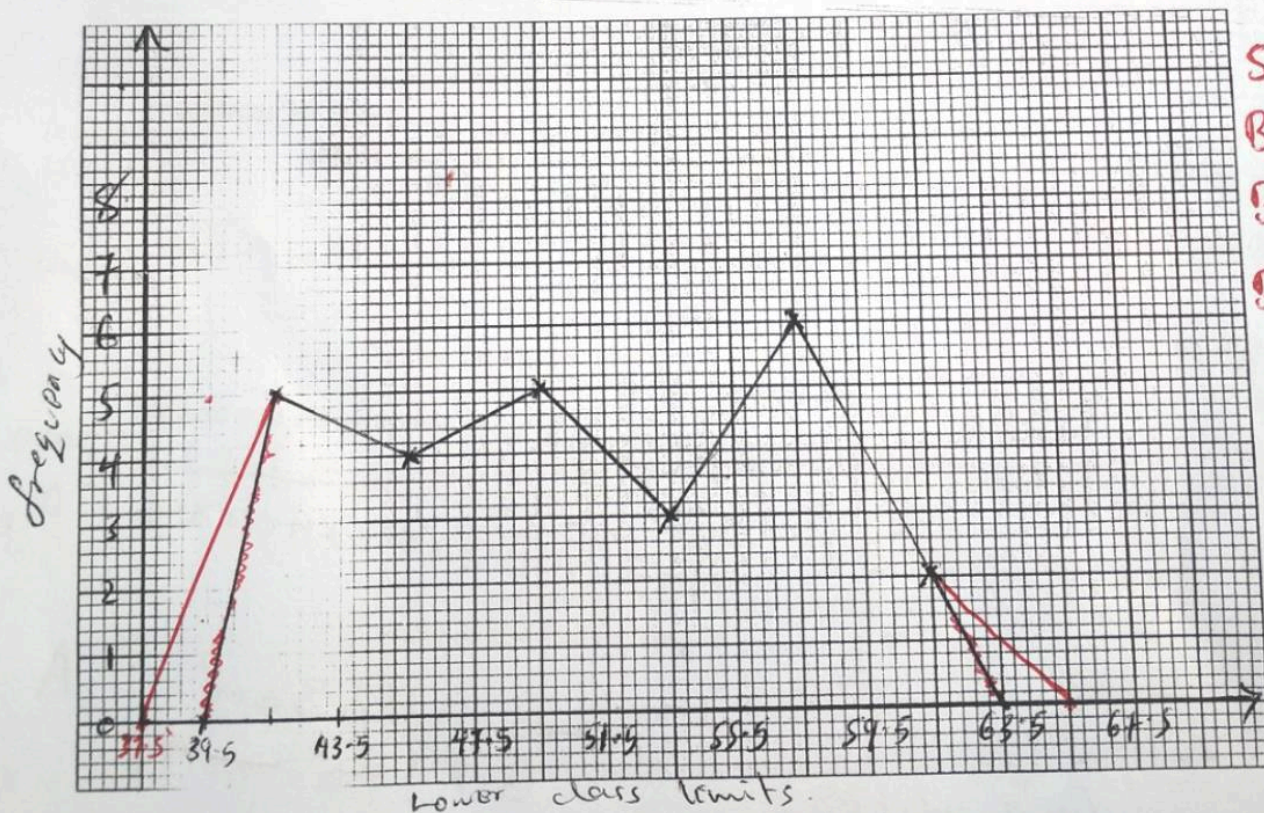
$$L + \left(\frac{\frac{N}{2} - cf}{f} \right) i$$

$$47.5 + \left(\frac{12.5 - 9}{5} \right) 4 \quad | \quad m_1$$

$$47.5 + 2.8 = 50.3 \quad A_1$$

c) On the grid provided draw a histogram for the data. (3 marks)

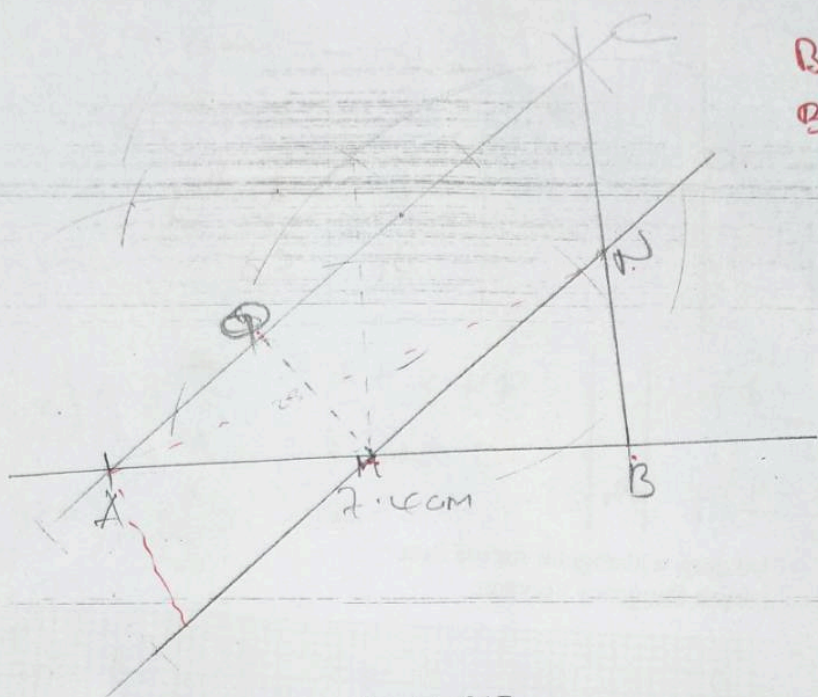
d) On the same grid draw a frequency polygon. (1 mark)



S_1
 B_1 - 3 bars
 B_1 - 3 bars
 B_1 - for polygon

The points?
a) On the...

a) Using a compass only, construct ABC on the spaces provided below with AB=7.4cm, BC=5.9cm and AC=9.3cm (2 marks)



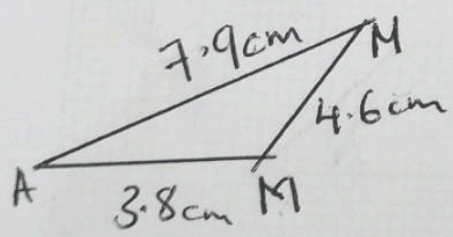
b) Mark a point M on the same diagram, the mid-point of AB. (1 mark)
 c) Using a ruler and compasses, construct a line passing through M and parallel to AC meeting BC at N. (2 marks)

d) Measure NM (1 mark)
 Handwritten notes: 4.6 cm , $B_1 \pm 0.1$, $B_1 \rightarrow MM$

e) What figure is AMNC? (1 mark)

Trapezium B_1

f) Drop a perpendicular line from M to intersect line AC at Q, hence determine the area of AMN (3 marks)



$$S = \frac{1}{2}(7.9 + 4.6 + 3.8) = 8.2 \quad B_1$$

$$A = \sqrt{8.2 \times 0.3 \times 4.4 \times 3.6} \quad M_1$$

$$= 6.2423 \text{ cm}^2 \quad A_1$$

Handwritten note: $6.24 \text{ cm}^2 \rightarrow A_1$

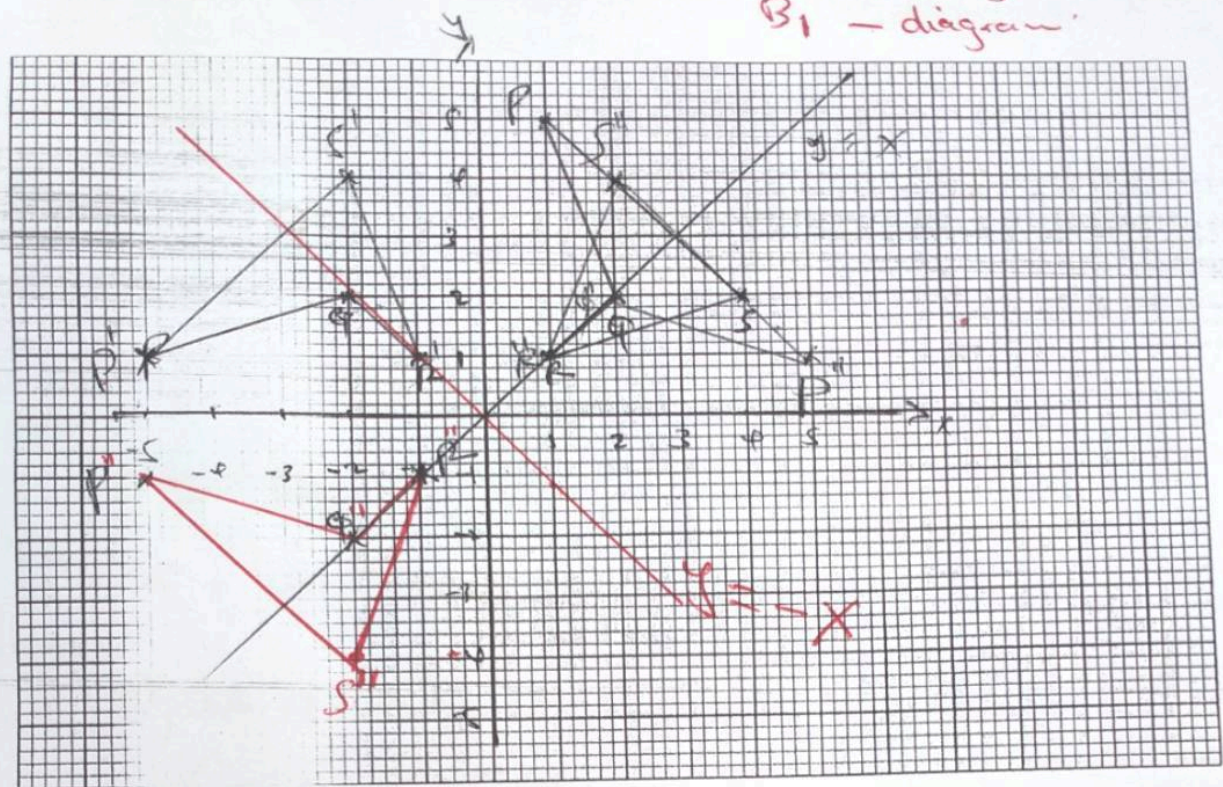
Handwritten note: $\frac{1}{2}bh \Rightarrow$

$$\sqrt{s(s-a)(s-b)(s-c)}$$

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The points $P(1,5)$, $Q(2,2)$, $R(1,1)$ and $S(4,2)$ are vertices of a quadrilateral PQRS.
a) On the same grid provide, draw the quadrilateral PQRS. (2 marks)

B_1 plotting
 B_1 - diagram



b) On the grid provided above draw $P^1Q^1R^1S^1$ image of PQRS under a rotation of positive quarter turn. State the co-ordinates of $P^1Q^1R^1S^1$. (3 marks)

$P^1(-5,1)$, $Q^1(-2)$, $R^1(-1,1)$, $S^1(-3,4)$. B_1 - plotting
 B_1 - image
 B_1 - coordinates

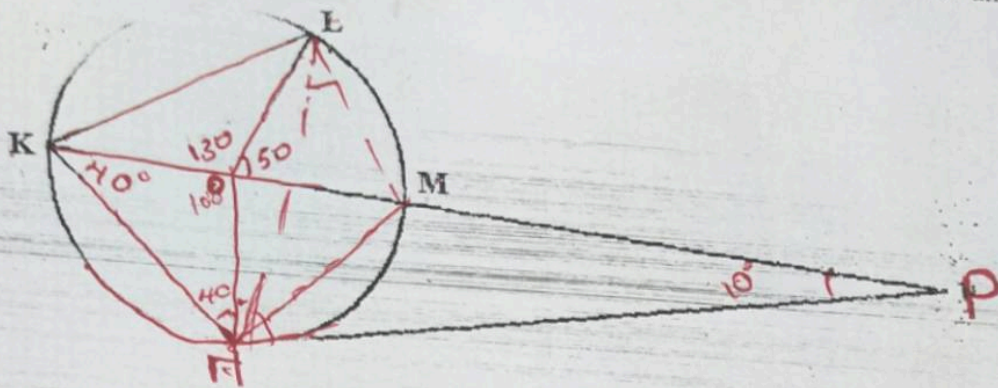
c) The points P^1, Q^1, R^1, S^1 are the images of P, Q, R, S under reflection in the line $y = 0$. On the same grid draw the quadrilateral $P^{11}Q^{11}R^{11}S^{11}$ and state its co-ordinates. (3 marks)

~~$P^{11}(5,1)$, $Q^{11}(2,2)$, $R^{11}(1,1)$, $S^{11}(2,4)$~~
 $P^{11}(-5,-1)$, $Q^{11}(-2,-2)$, $R^{11}(-1,-1)$, $S^{11}(-2,-4)$. B_1 - plotting
 B_1 - image
 B_1 - coordinates

d) Quadrilateral $P^{11}Q^{11}R^{11}S^{11}$ is the image of PQRS under a certain reflection. On your graph, draw the mirror line of reflection and find its equation. (2 marks)

draw R_y
 $y = x$ R_y
 $y = x \rightarrow y = -x$
 B_1 line

In the figure, K, L and N are points on the circumference of the circle centre O. The point K, O, M and P are collinear. PN is a tangent to the circle at N. $\angle KOL = 130^\circ$ and $\angle KN = 40^\circ$



Find the value of the following angles, stating the reasons in each case.

a) angle **MLN**

(2 marks)

40° ; angle sum of a triangle add up to 180° also angle subtended

b) angle **OLM**

(2 marks)

25° ; base angles of isosceles triangle are equal

c) angle **LHP**

(2 marks)

65° ; angle between tangent and radius is 90°

d) angle **LMM**

(2 marks)

115° ; angle subtended by an arc at the circumference is half that at centre

e) angle **MPN**

(2 marks)

10° ; triangle PON - angle sum of a triangle add up to 180°

A group of teachers decided to raise ksh. 144,000 to buy a plot of land. Each teacher was to contribute the same amount. Before the contributions were made five of the teachers retired. The remaining teachers had each to contribute 2400 more by ksh. 2400 to meet their target. If there were x teachers originally.

(i) Write down an expression for the amount that teachers were to contribute originally. (1 mark)

$$\frac{144,000}{x} \quad B_1$$

(ii) Write down an expression for the amount that each teacher was to contribute after five teachers retired. (1 mark)

$$\frac{144000}{x-5}$$

$$\text{or } \frac{144000}{x} + 2400 \quad B_1$$

(iii) Write down an equation in x and solve for x . (5 marks)

$$1440x = 144(x-5) + 2400(x-5)$$

$$\frac{144000}{x-5} = \frac{144000}{x} + 2400$$

$$1440x = 144x - 720 + 2400x - 12000$$

~~B1~~ M1

$$2400x - 1200x - 720 = 0$$

$$x^2 - 5x - 300 = 0$$

B1

$$x = \frac{5 \pm \sqrt{25 + 1200}}{2}$$

M1

$$20 \text{ or } -15 \Rightarrow A_1$$

$$x = 20 - B_1$$

$$x = \frac{5 + 35}{2} = 20$$

~~B1~~ - *

A1

(iv) Calculate the percentage increase of the contribution per teacher. (3 marks)

$$\frac{2400}{7200} \times 100$$

M1

M1

$$33.3\%$$

A1

a) A straight line passes through the point (8, -2) and (4, -4) has its equation in the form $ax + by + c = 0$ where a, b and c are integers. Determine the numerical values of a, b and c. (3 marks)

$$C_1 = \frac{-4 + 2}{4 - 8}$$

$$= \frac{1}{2}$$

$$\frac{y + 4}{x - 4} = \frac{1}{2} \quad m_1$$

$$2y + 8 = x - 4$$

$$x - 2y - 12 = 0 \quad A$$

$$a = 1, b = -2, c = -12 \quad B_1$$

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

$$y = \frac{1}{2}x - 6 \quad m_1$$

$$y = 0, x = 12$$

$$P (12, 0) \quad A_1$$

c) Another straight line is perpendicular to the line (a) above passes through point P and cuts the y-axis at Q. Determine the co-ordinates of point Q. (3 marks)

$$C_1 = -2 \quad B_1$$

$$\frac{y}{x - 12} = -2 \quad m_1$$

$$y = -2x + 24$$

$$x = 0, y = 24$$

$$\Rightarrow Q (0, 24) \quad A_1$$

d) Find the distance between P and Q. (Leave your answer in surd form) (2 marks)

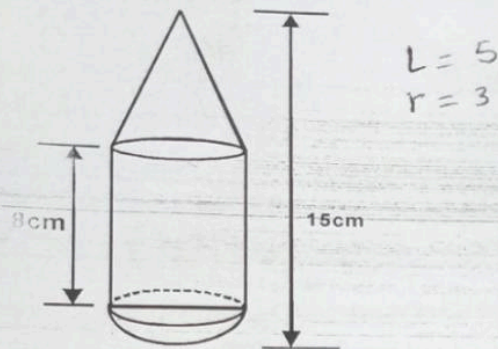
$$\begin{pmatrix} 12 \\ 0 \end{pmatrix} - \begin{pmatrix} 0 \\ 24 \end{pmatrix} = \begin{pmatrix} 12 \\ -24 \end{pmatrix} \quad m_1$$

$$\sqrt{12^2 + (-24)^2}$$

$$= \sqrt{144 \times 5}$$

$$= 12\sqrt{5} \quad A_1$$

23. The figure shows a model representing a rocket capsule. The model whose total height is 15cm is made up of a conical top, a hemispherical bottom and the middle part is cylindrical. The radius of the base of the cone and the radius of the hemisphere are each 3cm. The height of the cylindrical part is 8cm.



- a) Calculate the external surface area of the model. (4 marks)

$$\pi rL + \pi dh + 2\pi r^2$$

$$\frac{22}{7} \times 3 \times 5 + \frac{22}{7} \times 6 \times 8 + 2 \times \frac{22}{7} \times 3^2 \quad M, M_1$$

$$= 47.14 + 150.86 + 56.57 \quad M_1$$

$$= \underline{254.55 \text{ cm}^2} \quad A_1$$

- b) The actual rocket has a total height of 6 metres. The outside of the actual rocket capsule is to be painted. Calculate the amount of paint required if an area of 20m^2 requires 0.75 litres of the paint. (6 marks)

$$Lsf = \frac{1}{40} \quad A sf = \frac{1}{1600} \quad B, B_1$$

$$1600 \times 254.55 = 407,282.30 \quad M_1$$

$$\frac{407,282.30 \times 0.75}{20 \times 10,000} \quad M, M_1$$

$$= \underline{15,275.08 \text{ Litres}} \quad A_1$$

$$1.5275 \text{ Lit.} \quad A_1$$

24. A trader sold an item for 7,500 after allowing his customer 15% discount on the marked price. In so doing he made a profit of 35%.

a) Calculate the marked price of the item.

(3 marks)

$$85\% = 7500$$

$$\Rightarrow \frac{7500 \times 100}{85} \text{ M.M.}$$

$$= 8,823.50 \text{ A}_1$$

ii) Calculate the cost price of the item which the trader had bought the item.

(2 marks)

$$\frac{100}{135} \times 7500 \text{ M.M.}$$

$$= 5,555.50 \text{ A}_1$$

b) If the trader had sold the item without giving a discount, calculate the percentage profit he would have made.

(3 marks)

$$\frac{8823.50 - 5555.50}{5555.50} \times 100 \text{ M.M.}$$

$$= 58.82\% \text{ A}_1$$

c) To clear his stock the trader decided to sell the remaining items at a loss of 10%. Calculate the price he sold each item.

(2 marks)

$$\frac{90}{100} \times 5555.50 \text{ M.M.}$$

$$= 4999.95 \text{ A}_1 \text{ or } 5,000 \text{ A}_1$$