

SECTION I (50 marks)

Answer all the questions in this section in the spaces provided.

1 An arithmetic progression (AP) is given as:

600, 650, 700, 750,.....

Determine:

(a) the 30th term of the AP; (2 marks)

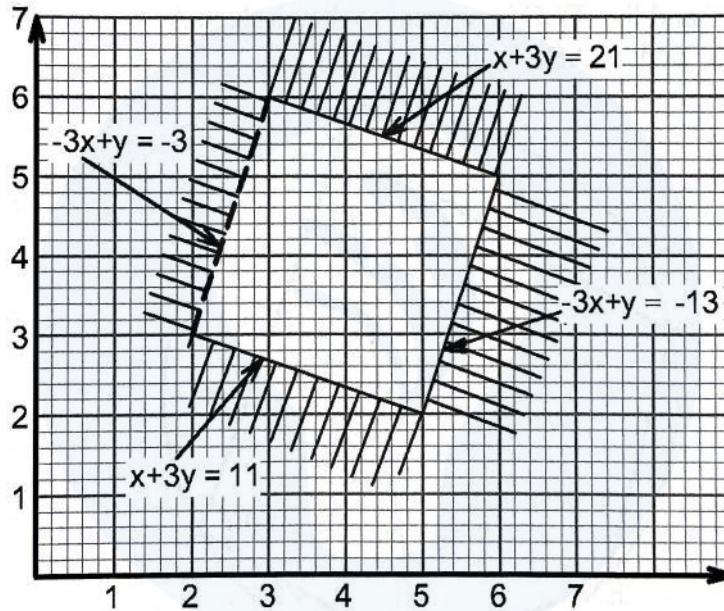
(b) the sum of the first 30 terms of the AP. (2 marks)

2 The quadratic equation $5x^2 + kx + 20 = 0$ has only one root. Determine the possible values of k. (2 marks)

3 Without using mathematical tables or a calculator, evaluate $\frac{\log 125 + \log 64}{\log \sqrt[6]{5} + \log \sqrt[3]{2}}$. (3 marks)

- 4 Make x the subject of the formula $y = \frac{a}{b^x}$. (3 marks)

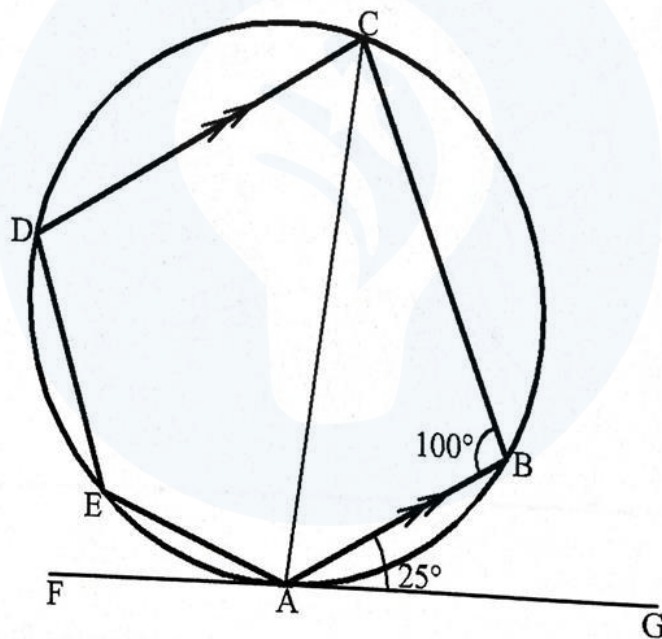
- 5 The unshaded region on the Cartesian plane satisfies the inequalities $x + 3y \leq 21$, $-3x + y < -3$, $-3x + y \geq -13$ and $x + 3y \geq 11$.



- Find the maximum value of $(x + 4y)$ for the integral coordinates $P(x, y)$ lying in the unshaded region. (3 marks)

- 6 An aircraft flew due west from point A (39.64°N , 50°E) to point B (39.64°N , 20°W). Calculate the distance covered by the aircraft correct to the nearest km.
(Take $\pi = \frac{22}{7}$ and $R = 6370$ km) (3 marks)

- 7 In the following figure; A, B, C, D and E are points on the circumference of a circle. Line AB is parallel to line DC and line FAG is tangent to the circle at A. Angle $GAB = 25^\circ$ and $\angle ABC = 100^\circ$.



Determine the size of:

(a) $\angle BAC$;

(1 mark)

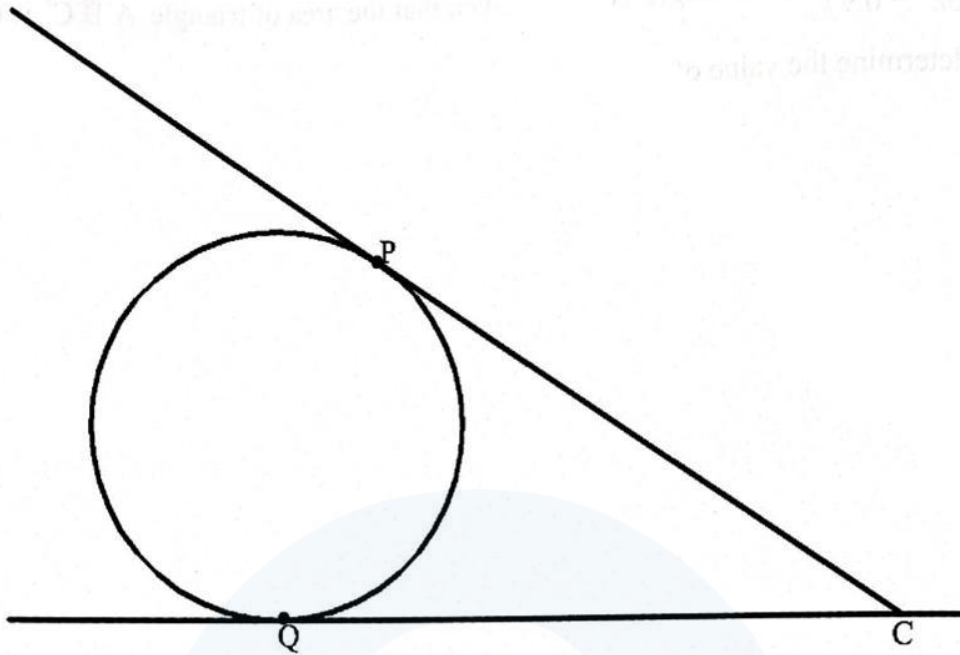
(b) $\angle AED$.

(2 marks)

- 8 Triangle ABC with vertices A(1, 0), B(3, 0) and C(1, 2) is transformed by the matrix $T = \begin{pmatrix} 3k & 1.6 \\ 3k & -0.9 \end{pmatrix}$ onto triangle A'B'C'. Given that the area of triangle A'B'C' is 6 square units, determine the value of k . (3 marks)

- 9 Solve the equation $6\cos^2 x + \sin x = 4$ for $0^\circ \leq x \leq 180^\circ$, giving the answer correct to 2 decimal places. (3 marks)

- 10 The following figure shows a circle. Lines CP and CQ are tangents to the circle at points P and Q respectively.



The circle is to be inscribed in a triangle ABC. Point B lies on CQ produced and $\angle CBA = 90^\circ$.

Use a ruler and a pair of compasses only to:

- (i) locate point O, the centre of the circle; (2 marks)
 - (ii) Complete triangle ABC. (2 marks)
- 11 The deviations of the masses of 10 students from an assumed mean are:
 $-10, -5, -2, 1, 4, 5, 7, 8, 9, 13$
 The mass of the heaviest student was 58 kg. Calculate the mean mass of the students. (3 marks)

- 12 The following table shows part of a monthly income tax rates for a certain year.

Monthly taxable income (Ksh.)	Tax rate (%)
0 to 11 180	10
11 181 to 21 714	15
21 715 to 32 248	20

In a certain month an employee paid a net tax of Ksh 2 200 after getting a tax relief of Ksh 1 280.

Calculate the employee's taxable income that month.

(3 marks)

- 13 The equation of a circle is given by $x^2 + y^2 - 3x + 4y = 0$. Determine:

(a) the coordinates of the centre of the circle;

(2 marks)

(b) the area of the circle in terms of π .

(1 mark)

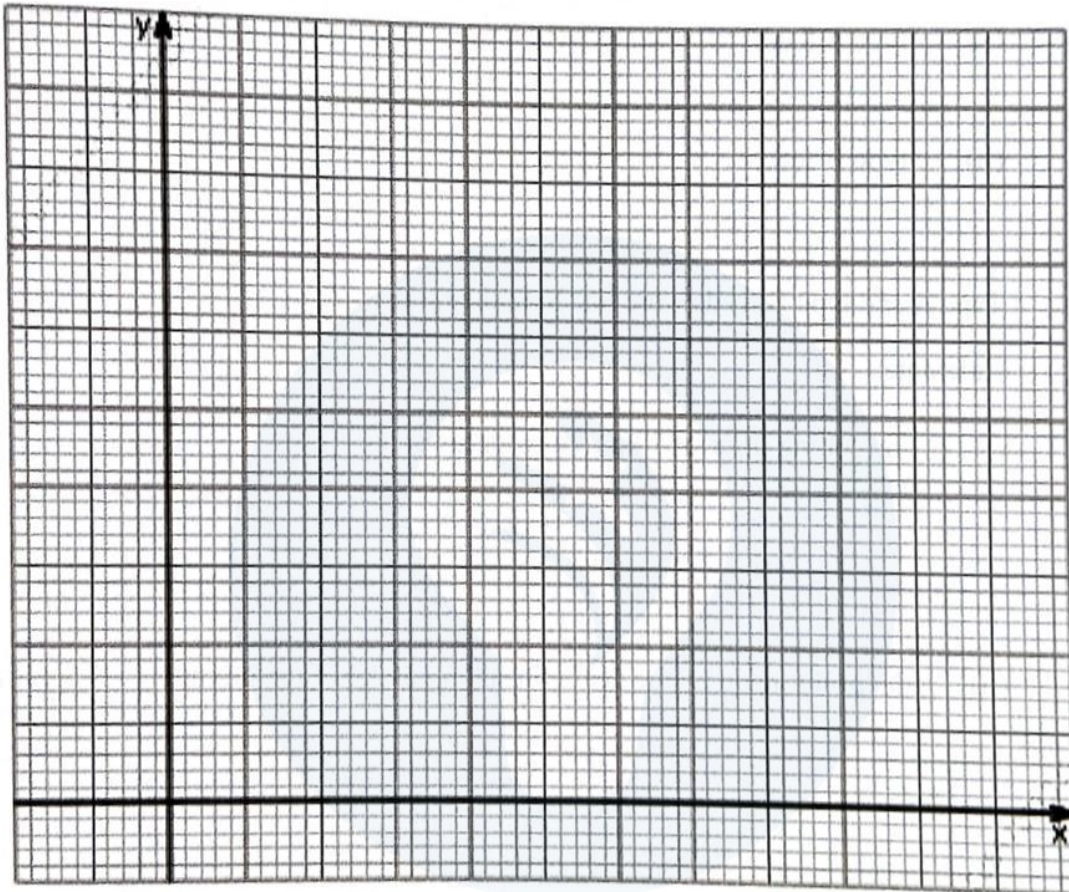
- 14 The position vectors of points A, B and C are such that $\mathbf{OA} = 3\mathbf{i} - 5\mathbf{j} - 4\mathbf{k}$, $\mathbf{OB} = \mathbf{j} + 8\mathbf{k}$, and $\mathbf{OC} = -2\mathbf{i} + 5\mathbf{j} + 16\mathbf{k}$.
Show that the points A, B and C are collinear. (3 marks)

- 15 A particle starts from point O and moves in a straight line so that its velocity $v \text{ ms}^{-1}$ after time t seconds is given by $v = 9t^2 - 18t + 10$.
Calculate the distance travelled by the particle between the time $t = 1$ second and $t = 2$ seconds. (3 marks)

- 6 The following table shows the number of units (U) of water consumed by 6 households in a month. The corresponding amount (A) charged is also given.

No. of units (U)	0.8	1.7	2.2	2.9	3.5	4.2
Amount (A) charged in Ksh	200	340	380	480	600	720

- (a) Using the scale 2 cm to represent 1 unit on the x -axis and 1 cm to represent Ksh 100 on the y -axis, draw the line of best fit for the data on the grid provided. (3 marks)



- (b) Estimate the cost of 1.5 units of water. (1 mark)

SECTION II (50 marks)

Answer only **five** questions from this section in the spaces provided.

- 17 A poultry feeds dealer has two types of chicken feeds: type A and type B. He sells 1 kg of type A at Ksh 45 and 1 kg of type B at Ksh 30. He makes a profit of 20% per kg of type A feed sold and 25% per kg of type B feed sold. He also sells mixtures of type A and type B feeds.
- (a) Determine the amount of profit made by the dealer for selling 1 kg of:
- (i) type A feed; (1 mark)
- (ii) type B feed. (1 mark)
- (b) Type A and type B feeds were mixed in the ratio 3 : 7.
Calculate:
- (i) the selling price of 1 kg of the mixture; (2 marks)
- (ii) the profit made by the dealer in selling 50 kg of the mixture. (2 marks)
- (c) The dealer made a profit of Ksh 1 387.50 for the sale of 200 kg of a different mixture of type A and type B feeds.
Determine the ratio of type A feed to that of type B feed in the mixture. (4 marks)

- 18 (a) A quantity P is partly constant and partly varies as the square root of a quantity Q .
Given that $P = 20$ when $Q = 4$ and that $P = 60$ when $Q = 100$, find Q when $P = 22$.
(4 marks)

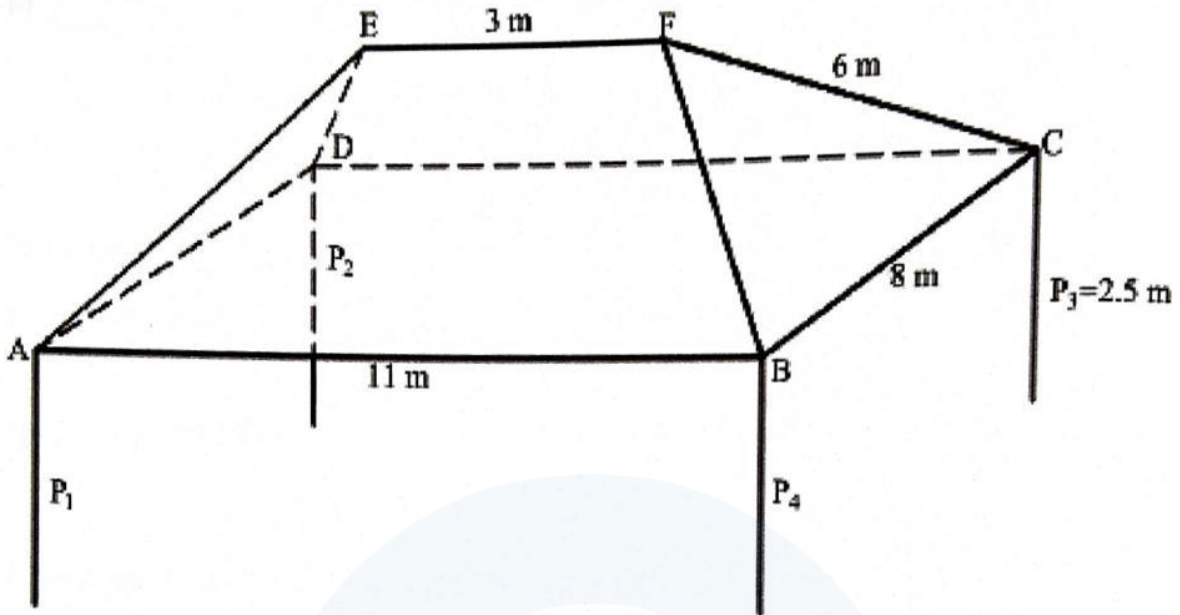
- (b) Three quantities, T , U and V are such that T varies directly as the square of $(10 - U)$ and inversely as the cube root of V .

When $T = 12$, $U = 4$ and $V = 8$.

- (i) Determine the equation connecting T , U and V . (3 marks)

- (ii) Find U when $T = 5\frac{2}{5}$ and $V = 15\frac{5}{8}$. (3 marks)

- 19 The following figure shows a tent erected on a level ground. The roof $ABCDEF$ of the tent is supported by four vertical posts P_1 , P_2 , P_3 and P_4 each of height 2.5 m. The ridge $EF = 3$ m is centrally placed. Further, $AB = 11$ m, $BC = 8$ m and $FB = FC = ED = EA = 6$ m.



Calculate:

- (a) The length of the projection of FC on the ground correct to 4 significant figures. (3 marks)
- (b) The height of ridge EF above the ground. (3 marks)
- (c) The angle between edge FB and edge FC . (2 marks)
- (d) The angle between the plane FBC and the ground. (2 marks)

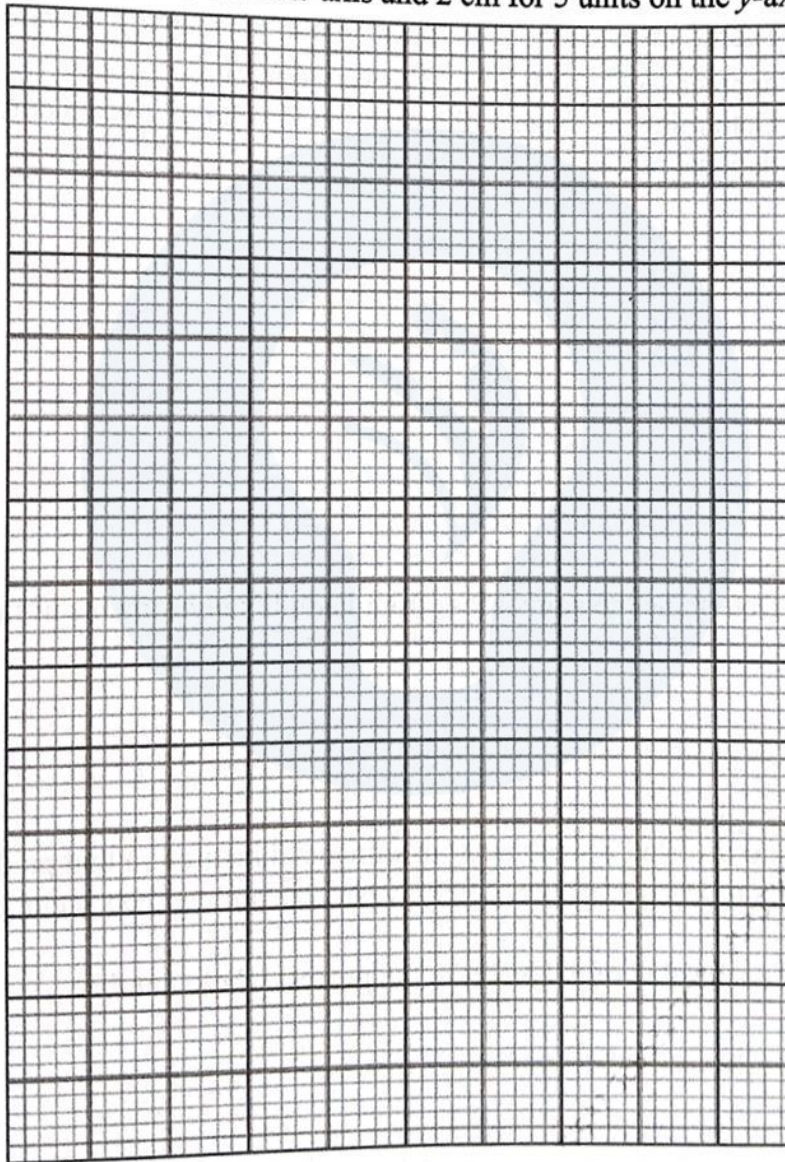
- 20 The table below shows values of x and some values of y for the curve $y = 3x^3 + x^2 - 7x$ in the range $-2 \leq x \leq 2$.

(a) Complete the table by filling in the missing values of y correct to 1 decimal place.

x	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
y		2.6	5			-2.9			14

(2 marks)

- (b) On the grid provided, draw the graph of $y = 3x^3 + x^2 - 7x$ for $-2 \leq x \leq 2$. Use the scale: 2 cm for 1 unit on the x -axis and 2 cm for 5 units on the y -axis. (3 marks)



(c) Use the graph to solve the equation:

(i) $3x^3 + x^2 - 7x - 4 = 0$

(2 marks)

(ii) $3x^3 + x^2 - 10x = 0$

(3 marks)

- 21 (a) Fadhili deposited Ksh 400 000 in an account that paid compound interest on deposits at a rate of 7% p.a. At the end of 3 years, he withdrew all the money from the account. (2 marks)
- (i) Calculate the amount that Fadhili withdrew.
- (ii) Fadhili invested the withdrawn amount in shares. The value of the shares depreciated at a rate of 1.5% every 6 months. Determine the value of the shares at the end of 2 years correct to 2 decimal places. (3 marks)
- (iii) Determine the gain or loss from Fadhili's investments in the 5 years. (1 mark)
- (b) Nyambuto invested Ksh 400 000 in a financial institution that paid compound interest at the rate of 6% per annum. After n years, the amount had accumulated to Ksh 500 000. Calculate the value of n , correct to the nearest whole number. (4 marks)

- 22 The probabilities of obtaining scores 1, 2, 3, 4 and 5 using a biased pentagonal spinner were recorded as shown in the following table.

Score	1	2	3	4	5
Probability	k	0.1	0.25	$2k$	0.2

(a) Determine:

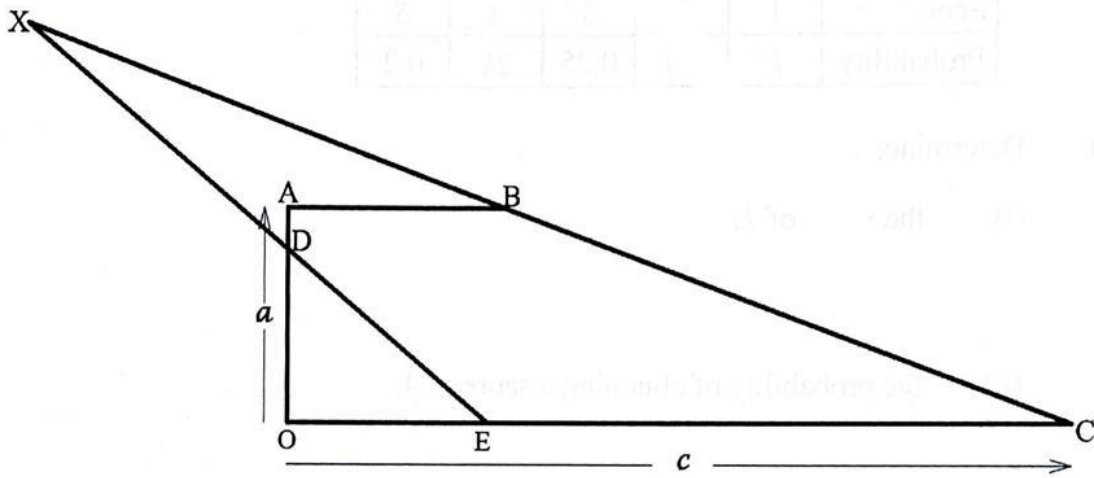
- (i) the value of k ; (2 marks)
- (ii) the probability of obtaining a score of 4. (1 mark)

(b) The spinner was spun twice.

- (i) Work out the probability of obtaining an even number in the first spin and an odd number in the second spin. (4 marks)

- (ii) The total score, S , for the two spins was obtained. Determine the probability that $S \geq 9$. (3 marks)

- 23 In the following figure, OABC is a trapezium. **AB** is parallel to **OC** and $\mathbf{OC} = 4\mathbf{AB}$. D is a point on **OA** such that $\mathbf{OD} : \mathbf{DA} = 3 : 1$ and E is a point on **OC** such that $\mathbf{OE} : \mathbf{EC} = 1 : 3$.



- (a) Given that $\mathbf{OC} = \mathbf{c}$ and $\mathbf{OA} = \mathbf{a}$, express in terms of \mathbf{a} and \mathbf{c} .
- (i) \mathbf{ED} . (1 mark)
- (ii) \mathbf{CB} . (1 mark)
- (b) Line ED and CB produced intersect at X such that $\mathbf{EX} = h\mathbf{ED}$ and $\mathbf{CX} = k\mathbf{CB}$, where h and k are scalars.
- (i) Express \mathbf{EX} in terms of \mathbf{a} , \mathbf{c} and h . (1 mark)
- (ii) Express \mathbf{CX} in terms of \mathbf{a} , \mathbf{c} and k . (1 mark)

- (c) Determine the values of h and k . (5 marks)

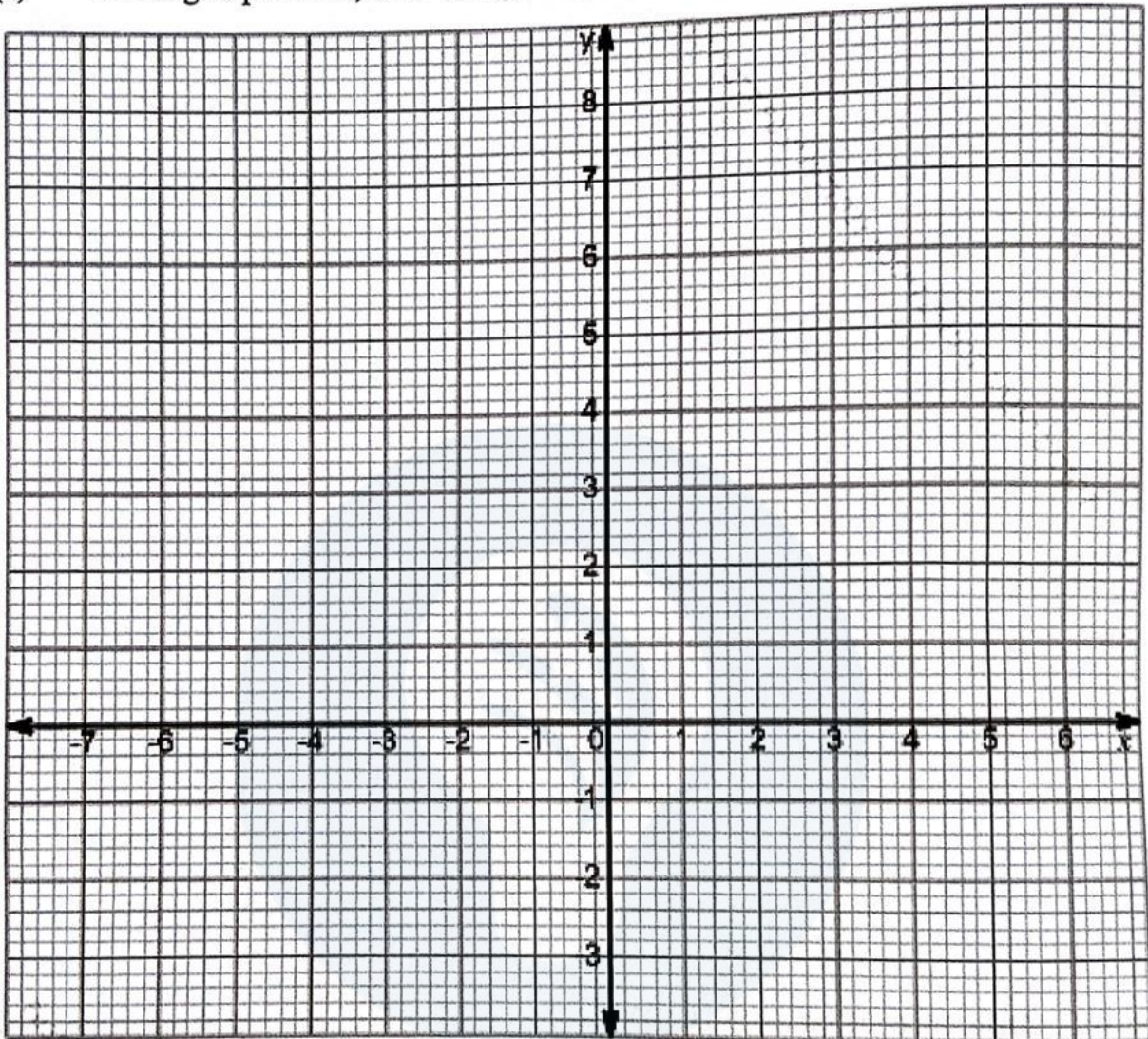


- (d) Determine the ratio of ED : DX. (1 mark)

- 24 PQR is a triangle with vertices $P(5, -1)$, $Q(3, -1)$ and $R(3, -3)$.

(a) On the grid provided, draw triangle PQR.

(1 mark)



(b) On the same grid, draw $\triangle P'Q'R'$ the image of $\triangle PQR$ under a reflection in line $y = x$.

(3 marks)

(c) $\triangle P''Q''R''$ is the image of $\triangle P'Q'R'$ under a transformation matrix

$$T = \begin{pmatrix} 1.5 & -0.5 \\ -0.5 & 1.5 \end{pmatrix}$$

(i) Find the coordinates on the vertices of $P''Q''R''$.

(2 marks)

- (ii) On the same grid, draw triangle $P''Q''R''$. (1 mark)
- (d) Determine a single transformation matrix that maps $\triangle PQR$ directly to $\triangle P''Q''R''$. (3 marks)



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