

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

121/1



MATHEMATICS Alt. A

Paper 1

Nov. 2024 — 2½ hours

Candidate's signature: Date:

Instructions to candidates

- (a) Confirm that this question paper has your name and the correct index number.
- (b) Sign and write the date of examination in the spaces provided above.
- (c) This paper consists of **two** sections: **Section I** and **Section II**.
- (d) Answer **all** the questions in **Section I** and only **five** questions from **Section II**.
- (e) **Show all the steps in your calculation, giving your answers at each stage in the spaces provided 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 18 printed pages.**
- (i) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
- (j) **Candidates should answer the questions in English.**

For Examiner's 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**



2

SECTION I (50 marks)

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

- 1 Without using mathematical tables or a calculator, evaluate $\frac{0.13 \times 0.3 - 0.003}{0.09}$ giving the answer in decimal form. (3 marks)

2 Simplify the expression $\frac{4x^2 - 9}{2x^2 + x - 6}$. (3 marks)



- 3 A straight line L_1 whose equation is $y = 2 - \frac{1}{3}x$ meets the y -axis at Q. Another straight line L_2 is perpendicular to L_1 at Q. Find the equation of L_2 in the form $y = mx + c$ where m and c are constants. (3 marks)
- 4 A circle of radius 3 cm passes through all the vertices of a regular hexagon. Determine the area of the circle that lies outside the hexagon. (3 marks)
- 5 Solve for x in the equation $25^x = 125^{\frac{2}{3}} \div 5^{-1}$. (3 marks)



- 6** A carpenter had two big pieces of wood of equal length. The carpenter cut the first piece into smaller pieces of length 15 cm each without remainder. The carpenter cut the second piece into smaller pieces of length 24 cm each without remainder. Determine the minimum length of each of the big pieces of wood. (2 marks)

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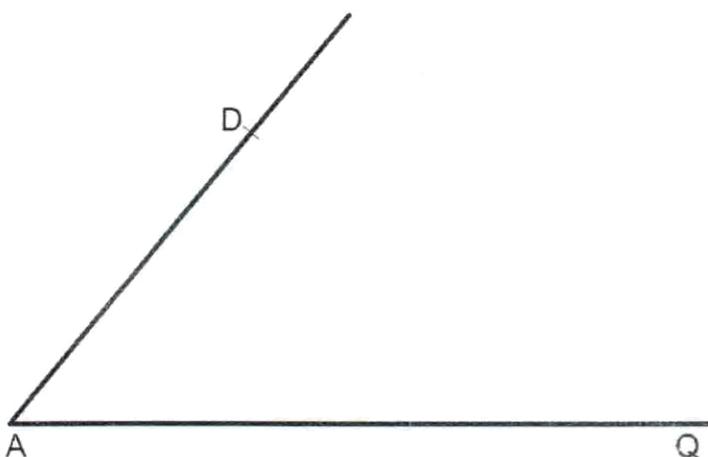
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- 7 A cylindrical container of internal radius 10.5 cm has a hemispherical base. The container has water up to a height of 30.5 cm. Calculate the surface area of the container that is in contact with water. (Take $\pi = \frac{22}{7}$) (4 marks)

2



- 8** In the following figure, points A and D are vertices of a trapezium ABCD. Line DC is parallel to line AQ. Line DC = 4 cm. Point B lies on the line AQ such that angle DCB = 90°.

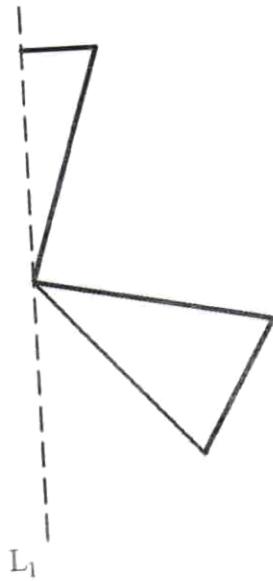


Using a ruler and a pair of compasses only, complete the trapezium. Hence measure the length of line AB. (4 marks)

- 9** The length of a minor arc AB of a circle centre O is 10 cm. The arc AB subtends an angle of 1.25 radians at O. Calculate the area of the minor sector AOB. (3 marks)



- 10** The following figure represents a part of a pattern. A line of symmetry, L_1 , of the pattern is also shown.



Complete the pattern and hence state the order of rotational symmetry of the pattern. (3 marks)

- 11** A Kenyan bank bought and sold foreign currencies on two different dates as shown.

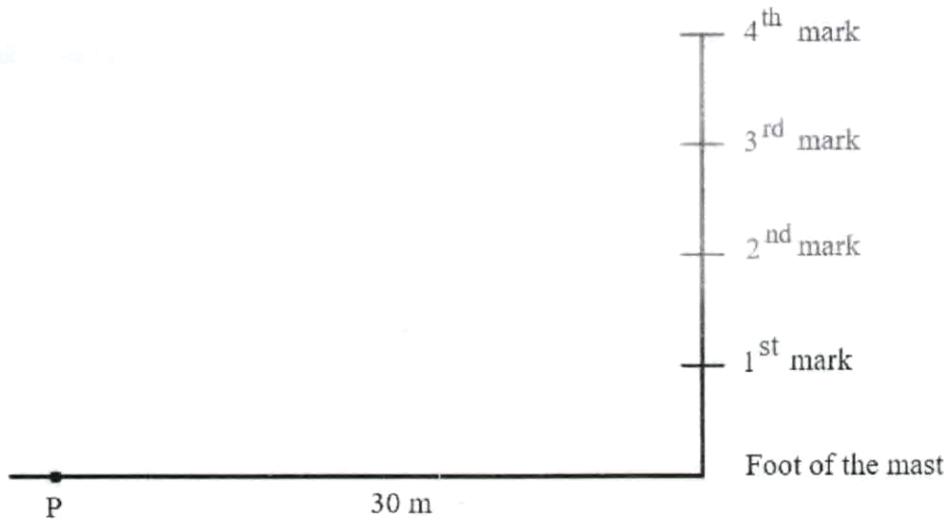
		Buying (In Ksh)	Selling (In Ksh)
12/1/2021	1 South African rand	7.08	7.10
12/2/2021	100 Tanzanian shillings	21.12	21.25

A South African tourist arrived in Kenya on 12/1/2021 with 15 000 South African rands. He changed the whole amount to Kenyan shillings. While in Kenya, he spent a total of Ksh 53 075 and changed the balance to Tanzanian shillings before leaving for Tanzania on 12/2/2021. Determine, in Tanzanian shillings, the amount he received. (3 marks)



- 12** The coordinates of points O, A, B and C are (0, 0), (2, 1), (4, 4) and (-1, 7) respectively. The coordinates of point D is (x, y) . Point M is the midpoint of line CD and it satisfies the vector equation $\mathbf{OM} = \mathbf{OA} + \frac{5}{2}\mathbf{AB}$. Determine the coordinates of point D. (3 marks)

- 13** The following figure (not drawn to scale) represents a communication mast. The mast has been divided into 4 equal parts. A point P is 30 m from the foot of the mast on the same ground level.



The angle of elevation of the 3rd mark from P is 50°.

Calculate the height of the mast.

(4 marks)



- 14** The following frequency distribution table shows the mass, in kilograms, of maize flour sold by 30 traders.

10

Mass (in kg)	10 - 19	20 - 29	30 - 39	40 - 49	50 - 59
No. of traders	3	8	10	7	2

Calculate the median mass of maize flour sold.

(3 mark)

- 15** The table below shows values of x and some values of y for the curve $y = x^2$ for $0 \leq x \leq 3$

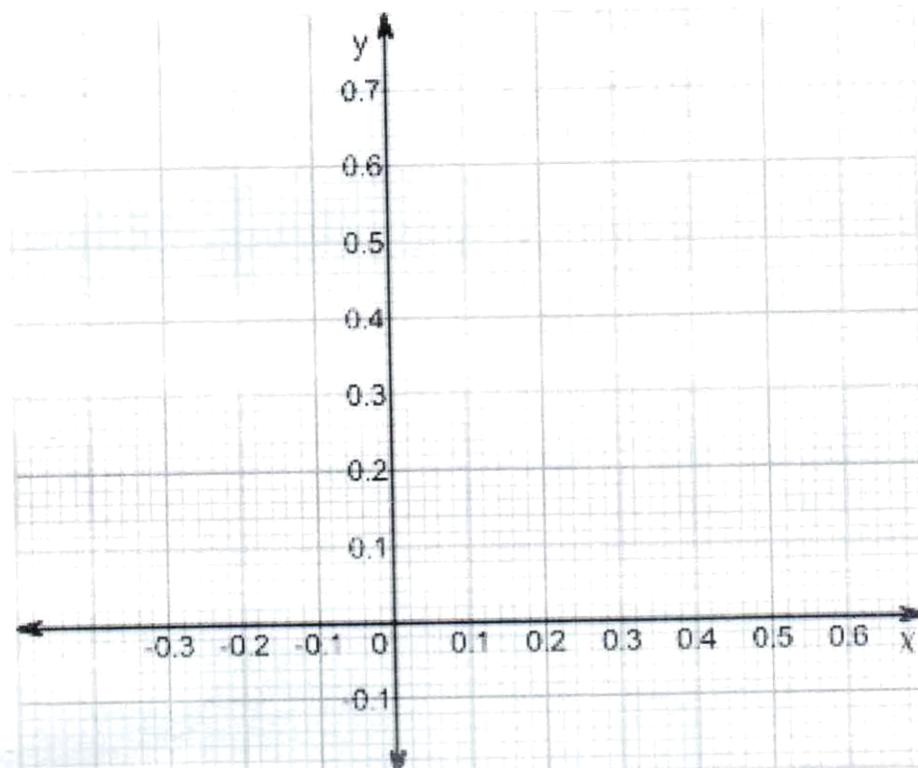
x	0	0.5	1	1.5	2	2.5	3
y	0	0.25	1		4		9

- (a) Complete the table by filling in the missing values of y . (1 mark)
- (b) Use the mid ordinate rule with 3 strips to estimate the area bounded by the curve $y = x^2$, the x -axis and the line $x = 3$. (2 marks)



9

Use the cartesian plane provided to solve graphically the simultaneous equations $2x + 3y = 1.2$ and $5x + 4y = 1$.



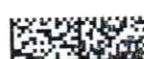
(3 marks)

k)

k)

s)

s)



SECTION II (50 marks)

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

- 17 On a market day, Abdul had 32 goats while Chebet had 56 goats. Chebet sold twice as many goats as Abdul. After the sale, the number of the goats that Abdul and Chebet remained with was in the ratio 3 : 5 respectively.

(a) Determine the total number of goats sold by Abdul and Chebet at the market. (4 marks)

(b) Abdul and Chebet raised a total of Ksh 97 600 from the sale of goats at the market. Abdul's selling price per goat was 5% higher than that of Chebet. Determine the ratio of the earnings of Abdul to Chebet from the sale of goats. (4 marks)

(c) Abdul decreased the selling price per goat in the ratio 19:21 for the goats that remained. Determine the new selling price per goat. (2 marks)



- 18** The price of pens in a bookshop changed in the months of February, March and April. The price of a pen was sh 2 less in the month of February than the price of a pen in the month of March. In the month of April the price of a pen was sh 2 more than the price of a pen in the month of March. The bookshop sold pens worth Ksh 4 200 in February. In April, pens worth Ksh 4 500 were sold.

Take Ksh x to be the price of a pen in March

- (a) Write an expression in x for the number of pens sold by the bookshop in:

 - (i) February; (1 mark)
 - (ii) April. (1 mark)

(b) The bookshop sold 50 more pens in February than in April. Determine the number of pens sold in February. (6 marks)

c) Determine the percentage change in the number of pens sold by the bookshop in April compared to the number sold in February. (2 marks)



12

- 19** Airport S is 1700 km on a bearing of 300° from airport R. Airport Q is 800 km on a bearing of 215° from R.
In the following figure, airport R is represented by point R.

17



- (a) Using a scale of 1 cm to represent 200 km, show on the figure the relative positions of airports S and Q. (3 marks)

(b) Use the scale drawing to determine:

 - (i) the distance from airport S to airport Q in kilometres; (1 mark)
 - (ii) the bearing of S from Q. (2 marks)

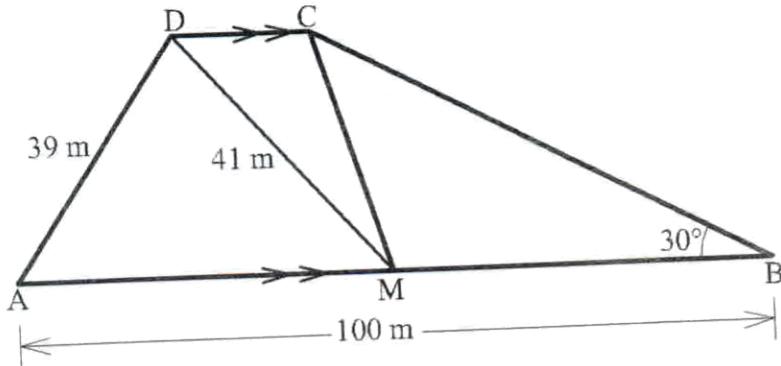
(c) An aircraft flying at a speed of 400 km/h left S for Q at 8.00 am. Determine the time when the aircraft was exactly 1000 km from airport R on its way to Q. (4 marks)



13

20

The following figure represents a piece of land in the shape of a trapezium ABCD. Lines AB and DC are parallel. Point M is the midpoint of AB. The land is divided into three triangular plots. Line AB = 100 m, AD = 39 m, MD = 41 m and angle ABC = 30° .



- (a) Calculate the area of the triangular plot AMD and hence the perpendicular distance between the two parallel sides. (4 marks)

- (b) Calculate the length of:
(i) BC; (2 marks)

- (ii) MC. (2 marks)

- (c) Calculate the size of the obtuse angle BMC. (2 marks)



Turn over



- 21** Two matrices \mathbf{P} and \mathbf{Q} are such that $\mathbf{P} = \begin{pmatrix} 3 & 7 \\ h & 4 \end{pmatrix}$ and $\mathbf{Q} = \begin{pmatrix} 5 & -4 \\ 3 & -2 \end{pmatrix}$. The determinant of $\mathbf{PQ} = 3$.

(a) (i) Determine the value of h . (3 marks)

(ii) Find \mathbf{P}^{-1} , the inverse of matrix \mathbf{P} . (2 marks)

- (b) Patel and Lagat purchased watches at sh m per watch and phones at sh n per phone. Patel purchased 12 watches and 28 phones for Ksh 24 600. Lagat purchased 15 watches and 40 phones for Ksh 34 500.

(i) Form two equations in m and n . (2 marks)

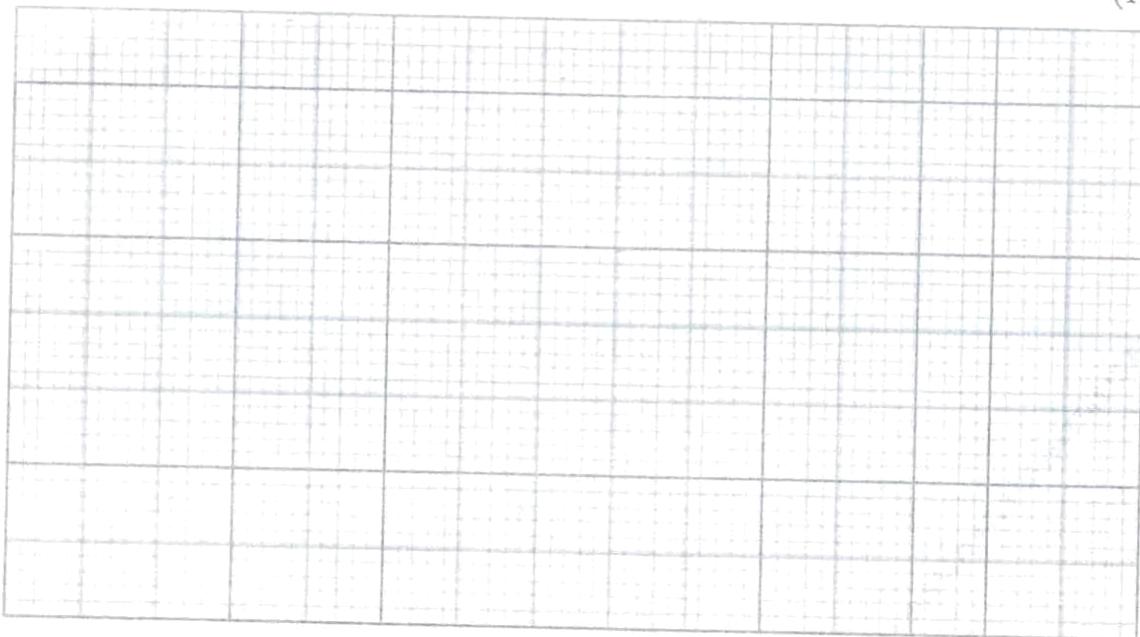
(ii) Use the matrix method to determine the price of a watch and that of a phone. (3 marks)



- 22** Members of the Environmental Club planted trees. The number of trees planted by each member is recorded as follows.

24	7	11	6	12	27	8	9	33	23
12	32	19	33	16	21	14	16	17	10
21	18	16	9	17	8	28	13	8	19
9	17	24	18	29	15	12	31	22	14

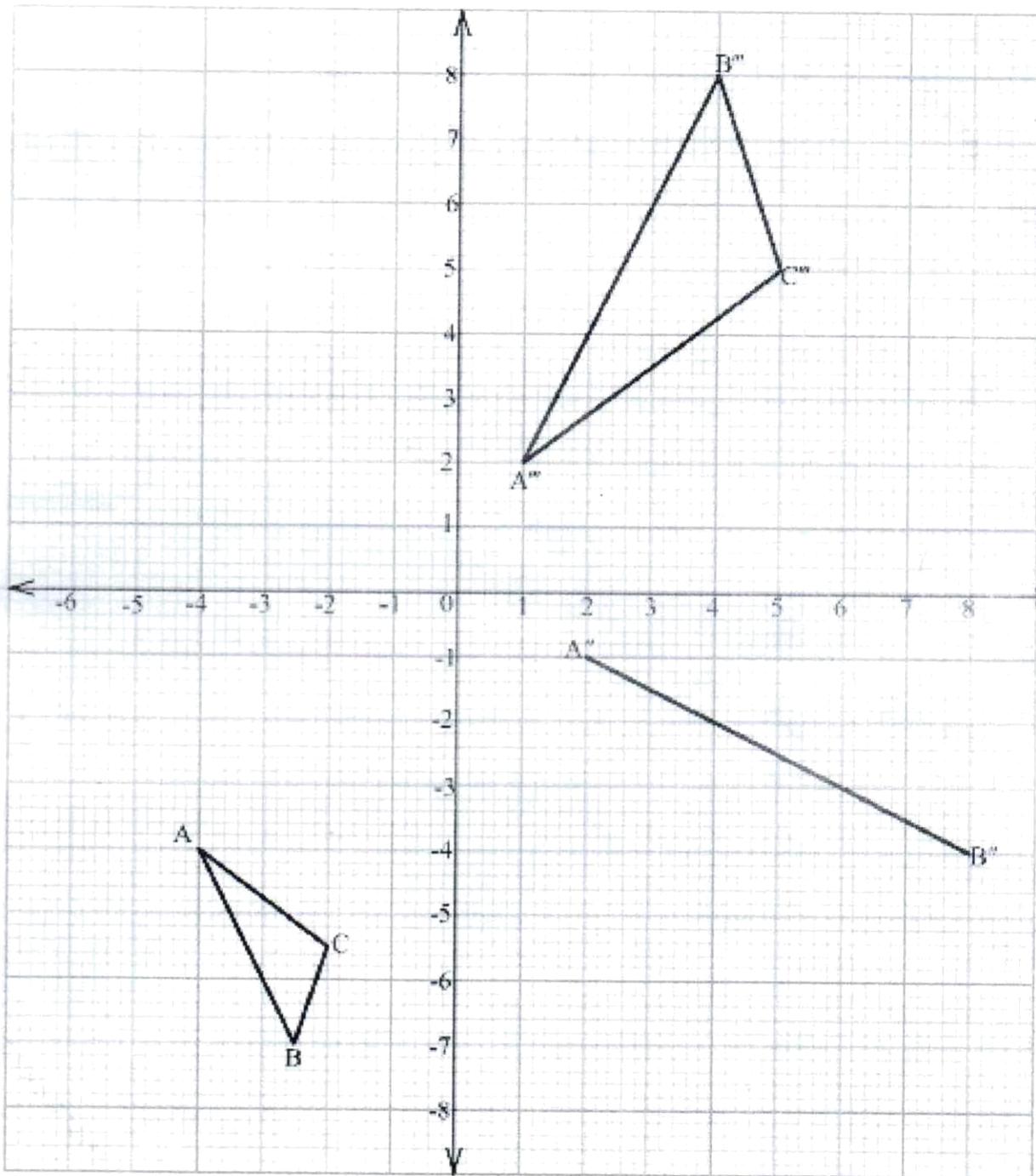
- (a) (i) Using a class width of 5 and starting with the class 6 - 10, make a frequency distribution table for the data. (2 marks)
- (ii) State the modal class. (1 mark)
- (iii) Estimate the mean number of trees planted. (3 marks)
- (b) On the grid provided and on the same axes represent the data using:
- (i) a histogram; (3 marks)
 (ii) a frequency polygon. (1 mark)



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- 23 On the cartesian plane below, triangle ABC has vertices $A(-4, -4)$, $B(-2.5, -7)$ and $C(-2, -5.5)$ while triangle A''B''C'' has vertices $A''(1, 2)$, $B''(4, 8)$ and $C''(5, 5)$. The line joining $A''(2, -1)$, $B''(8, -4)$ is part of another triangle A''B''C''.

(a)



17

18

Triangle A'B'C' is the image of triangle ABC under an enlargement centre $(-3, -2)$ and scale factor $\frac{1}{2}$. The gradient of the curve $y = x^3 + 5x^2 + Px - 18$ at $x = -1$ is -15 . (3 marks)

(a) Find:

(i) the value of P; (3 marks)

(b) Triangle A''B''C'' is the image of triangle A'B'C' under rotation centre O(0, 0).

(i) State the angle of rotation. (1 mark)

(ii) Complete triangle A''B''C''. (2 marks)

(iii) the equation of the normal to the tangent to the curve at $x = -1$. (3 marks)

(c) Triangle A'''B'''C''' is the image of triangle A''B''C'' under a reflection.

(i) Draw the mirror line. (1 mark)

(ii) Determine the equation of the mirror line in the form $y = mx + c$. (2 marks)

(b) Find the coordinates of the turning points of the curve. (4 marks)

(d) Describe fully a single transformation that maps triangle A'B'C' onto triangle A'''B'''C'''.

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THE KENYA NATIONAL EXAMINATIONS COUNCIL

Kenya Certificate of Secondary Education

121/2



MATHEMATICS Alt. A

Paper 2

Nov. 2024 — 2½ hours

Candidate's signature: Date:

Instructions to Candidates

- (a) Confirm that this question paper has your name and the correct index number.
- (b) Sign and write the date of examination in the spaces provided above.
- (c) This paper consists of **two** sections: **Section I** and **Section II**.
- (d) Answer **all** the questions in **Section I** and only **five** questions from **Section II**.
- (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 19 printed pages.**
- (i) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
- (j) **Candidates should answer the questions in English**

Section I

For Examiner's Use Only

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**

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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)

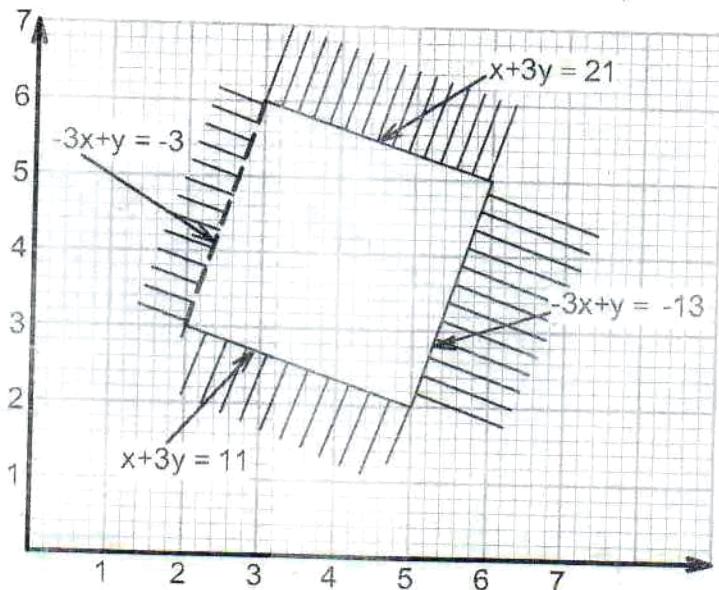
- 2 The quadratic equation $5x^2 + kx + 20 = 0$ has only one root. Determine the possible values of k. (2 marks)

- 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)

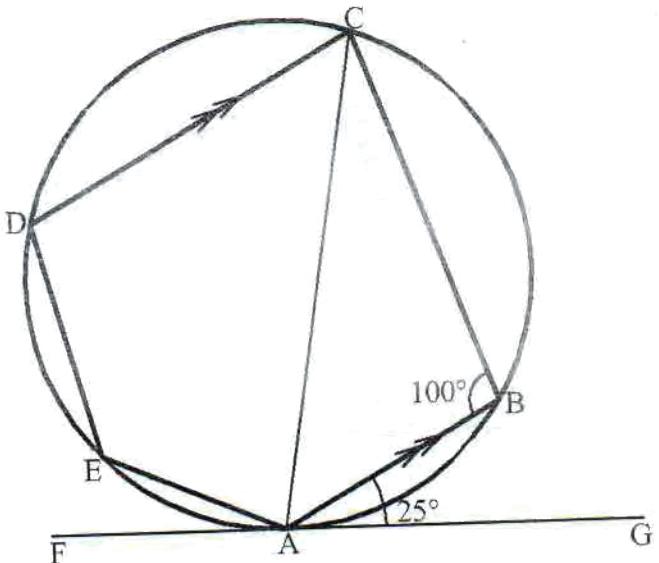


- 6 An aircraft flew due west from point A(39.64°N , 50°E) to point B(39.64°N , 20°W). Calculate the distance covered by the aircraft correct to the nearest km.
 (Take $\pi = \frac{22}{7}$ and $R = 6370\text{ km}$) (3 marks)

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- 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° and $\angle ABC = 100^\circ$.



2

Determine the size of:

- (a) $\angle BAC$; (1 m)

3

- (b) \angle AED. (2 marks)



5

- 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)

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)

(5)

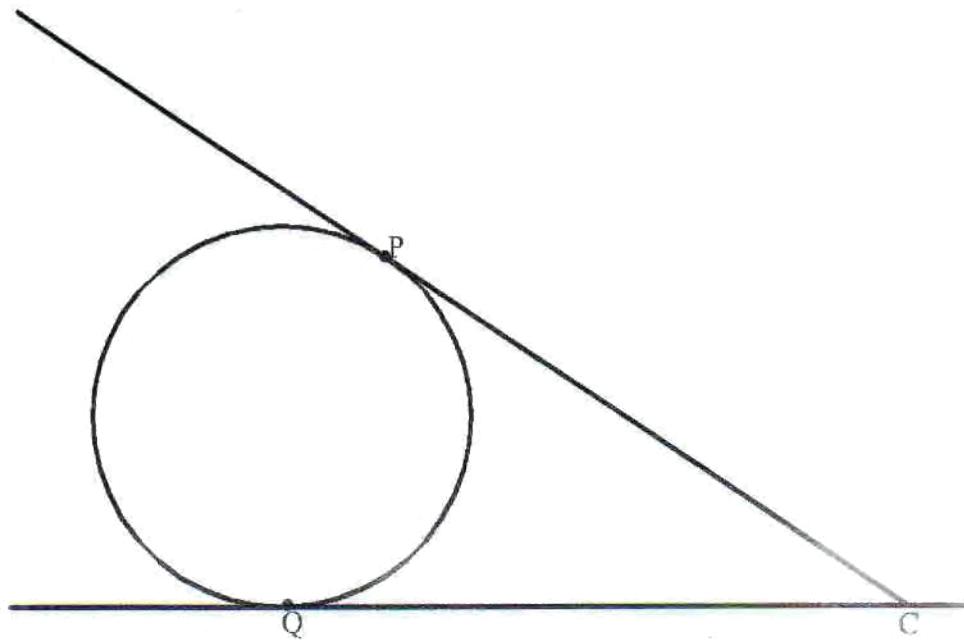
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rn over

Turn over

- 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)



- 10**
- 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 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)

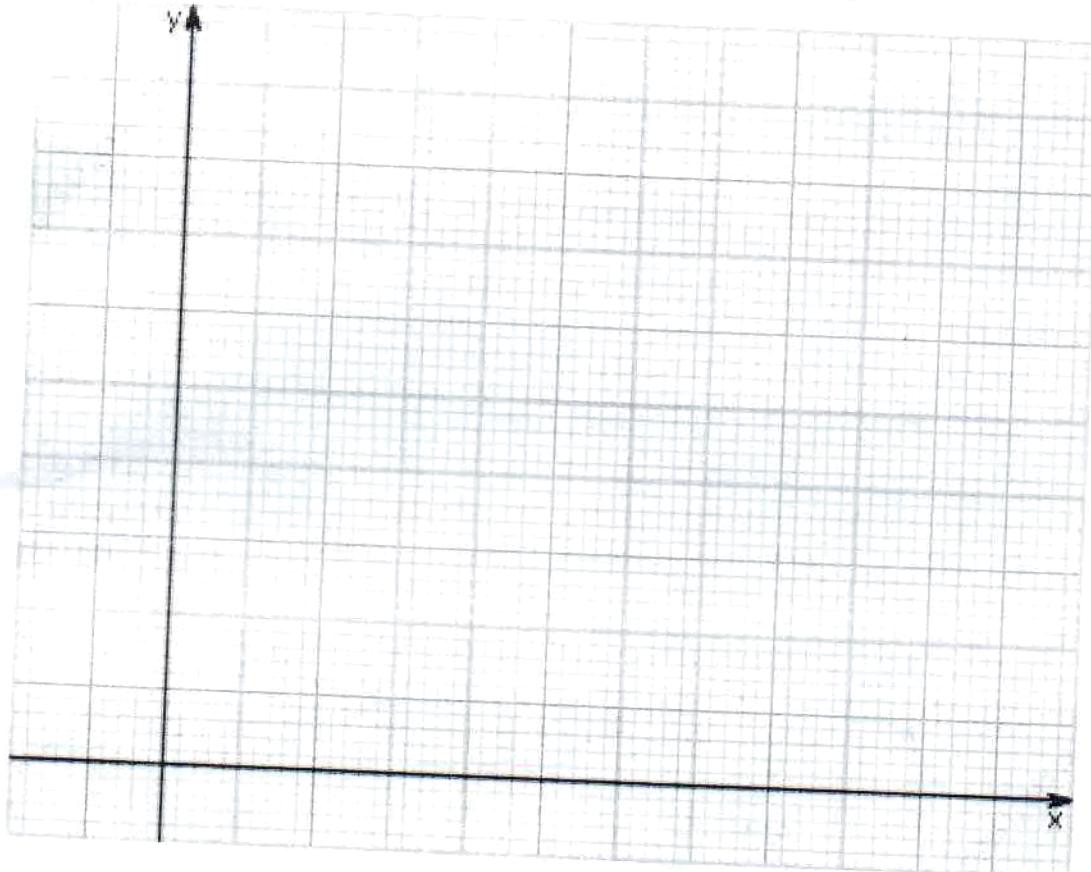
11

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- 16** 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 $V = 8$.

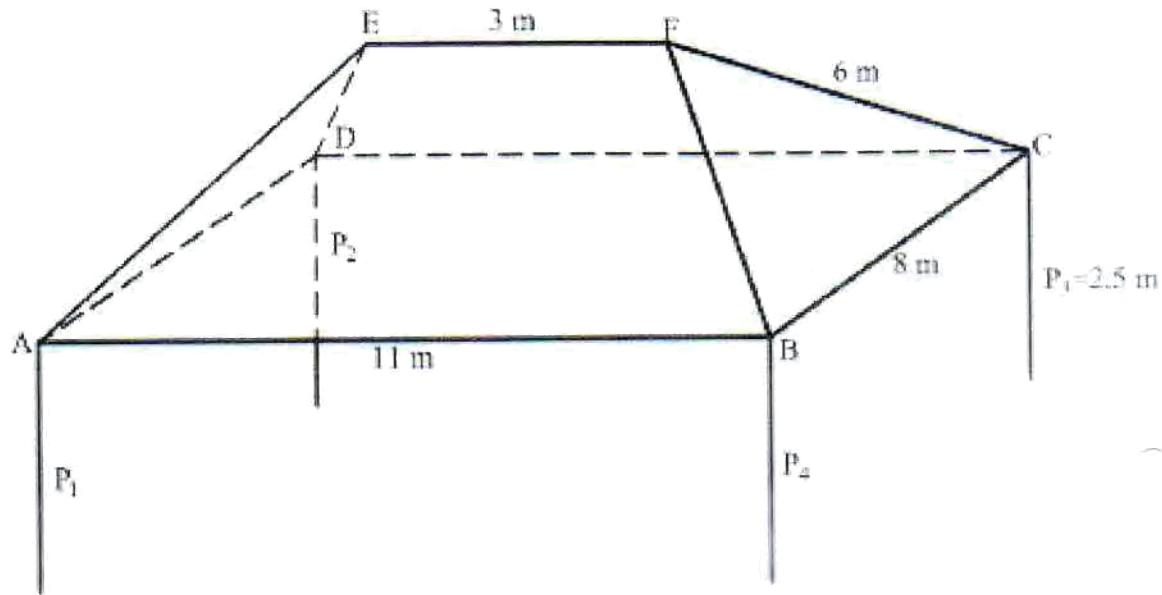
- (i) Determine the equation connecting T, U and V. (3 marks)

- (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.

17



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)

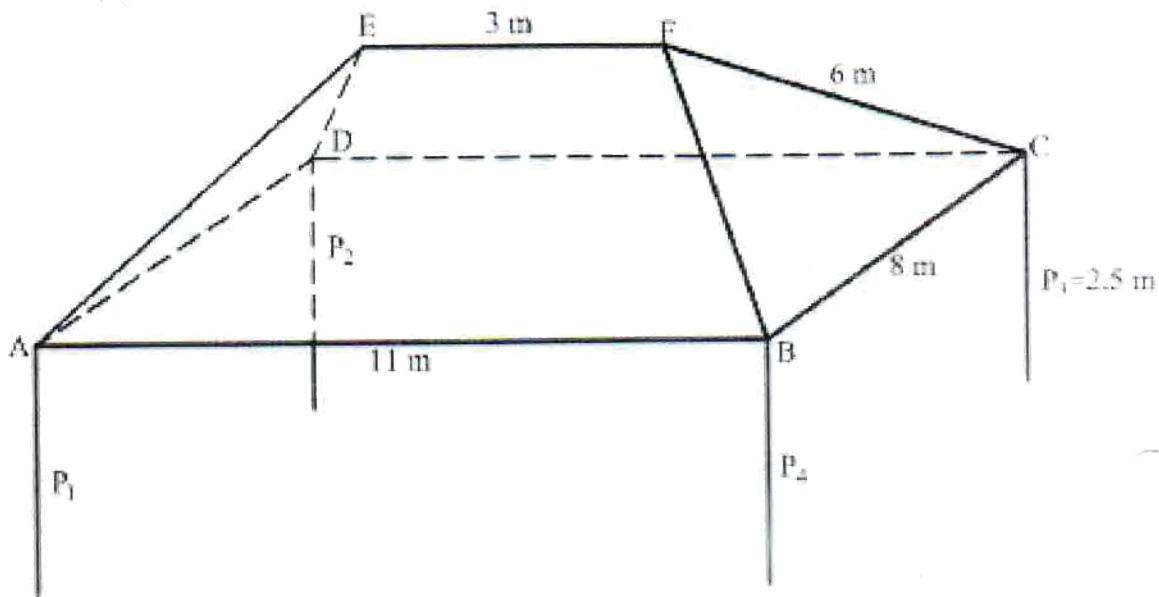
(c) The angle between edge FB and edge FC. (2 marks)

(d) The angle between the plane FBC and the ground. (2 marks)



- 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.

17



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)



13

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

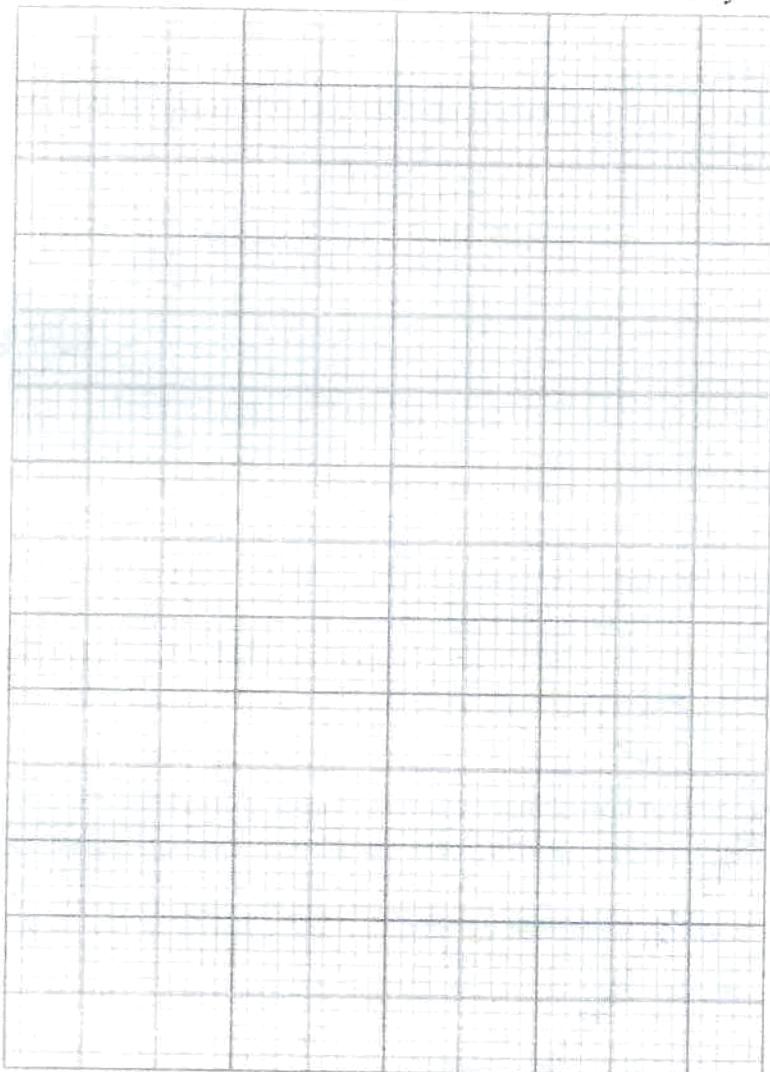
- (a) Complete the table by filling in the missing values of y correct to 1 decimal place.

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

(2 marks)

(s)

- (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)



(k)

(s)

- (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)

at
(s)

- 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.

(i) Calculate the amount that Fadhili withdrew. (2 marks)

(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)



15

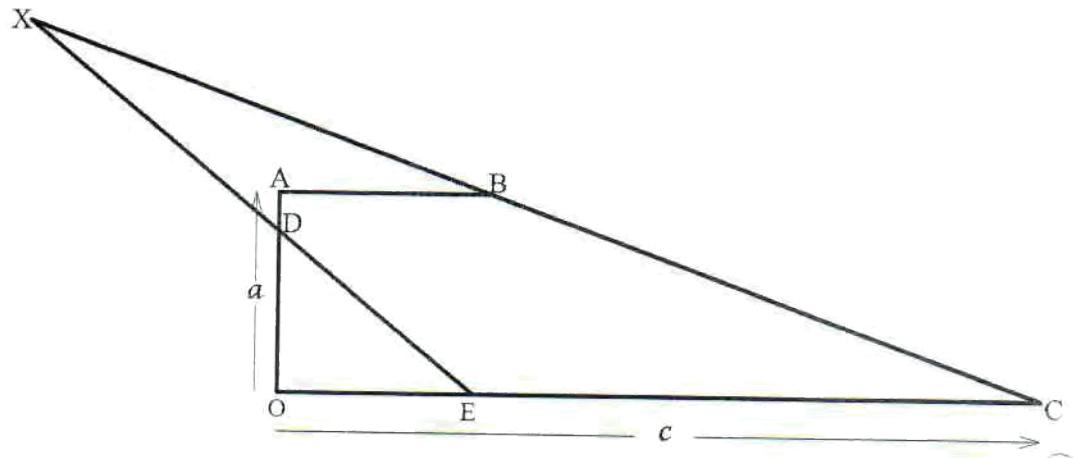
- 22 The probabilities of obtaining scores 1, 2, 3, 4 and 5 using a biased pentagonal spinner were recorded as shown in the following table.

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

- (a) Determine:
- the value of k ; (2 marks)
 - the probability of obtaining a score of 4. (1 mark)
- (b) The spinner was spun twice.
- Work out the probability of obtaining an even number in the first spin and an odd number in the second spin. (4 marks)
 - The total score, S , for the two spins was obtained. Determine the probability that $S \geq 9$. (3 marks)



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



- (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 m)

(ii) \mathbf{CB} . (1 m)

(b) Line \mathbf{ED} and \mathbf{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 m)



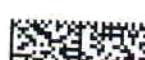
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- (c) Determine the values of h and k . (5 marks)

)

)

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

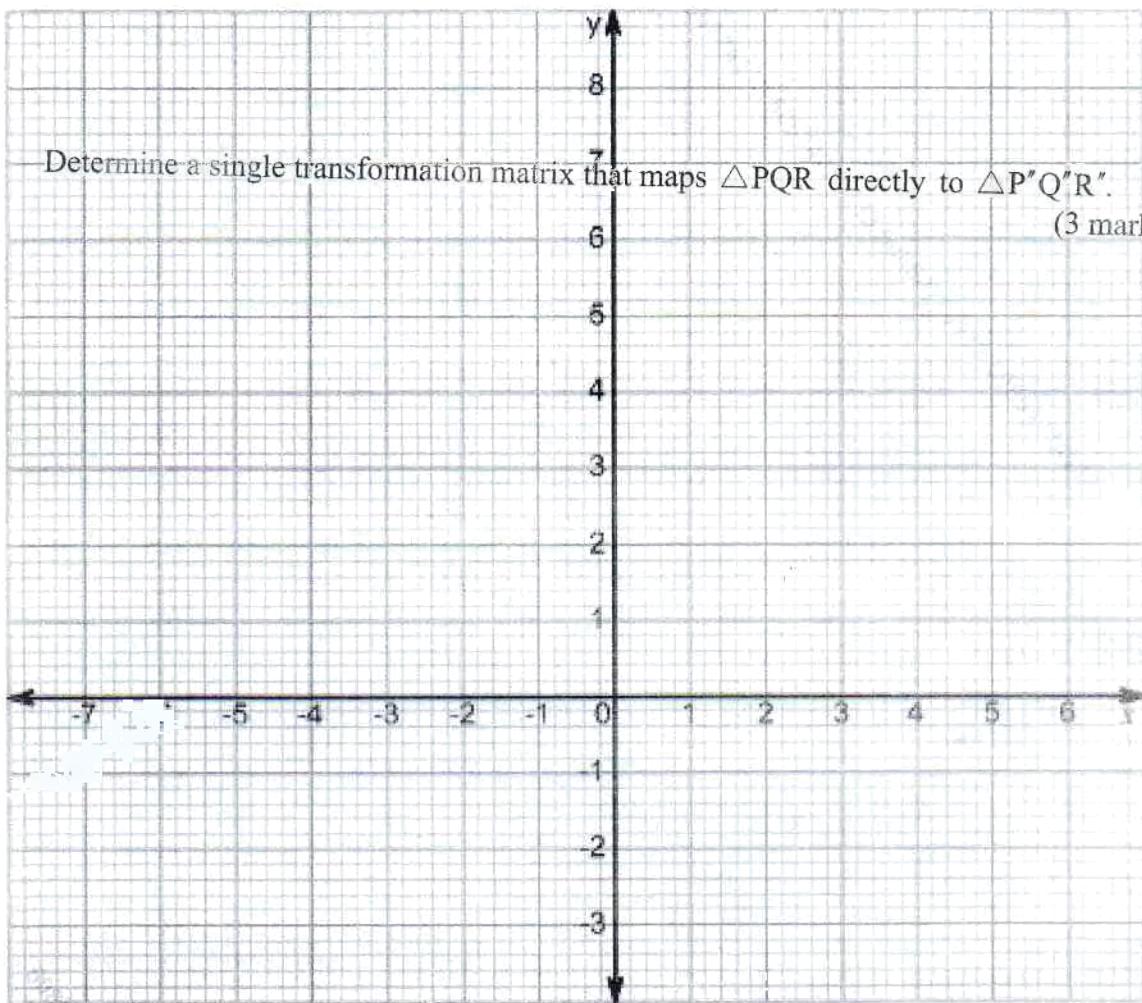


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- 24 PQR is a triangle with vertices P(5, -1), Q(3, -1) and R(3, -3).

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

