THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

121/1 **Paper 1**

MATHEMATICS ALT A

Dec. 2022 – 2½ hours

Name ..... **Index Number** .....

Candidate's Signature ..... **Date** .....

230

Instructions to Candidates

(a) Write your name and index number in the spaces provided above.
(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 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.**

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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

0767

SECTION I (50 marks)

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

1. Solve for n

$$\frac{6n}{n-1} = \frac{25}{n}.$$

(3 marks)

2. A family used two-fifths of its monthly income on school fees. Three-quarters of the remaining amount was used on family upkeep while the rest was invested. The family invested Ksh 13 500 monthly.

Calculate the amount of money the family used on school fees every month. (4 marks)

3. Solve for x in the equation.

$5^{2x-1} - 25^{x} = 500$ (3 marks)

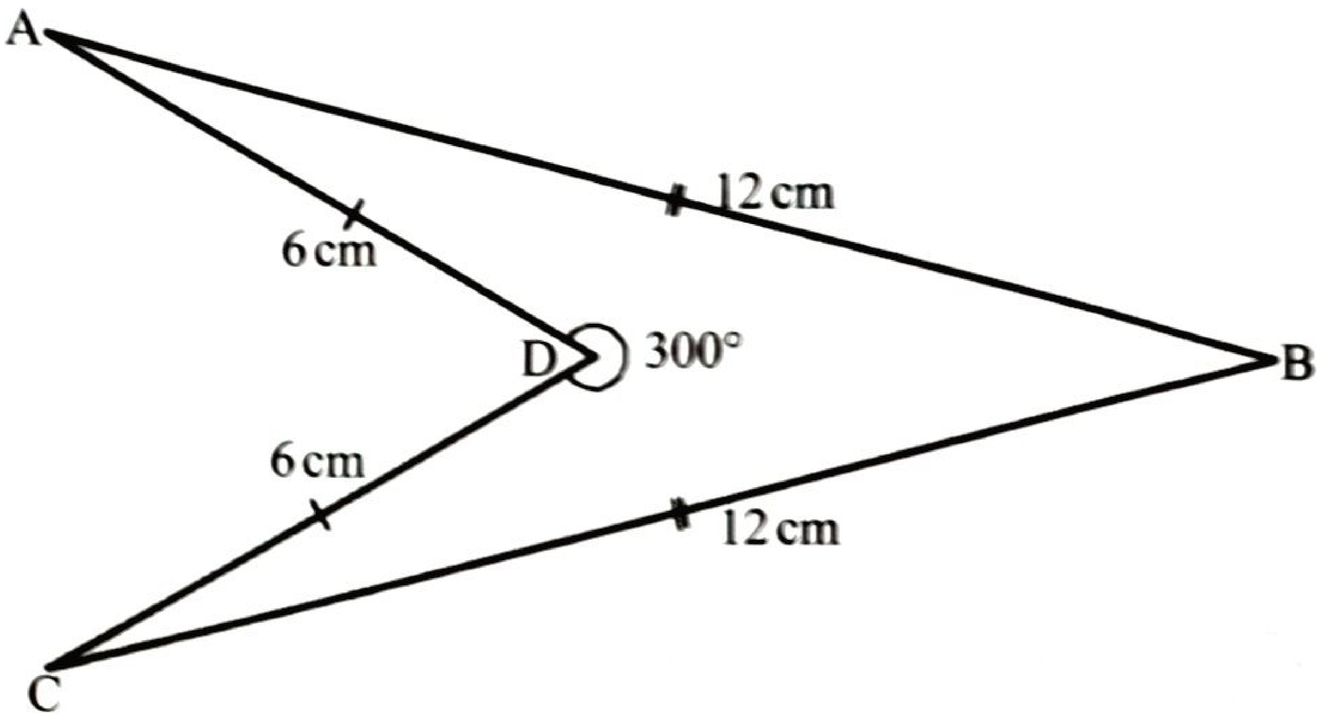
4. Kipkoech and Tanui began a 5 000 m race together at the starting line. Kipkoech and Tanui took 72 seconds and 80 seconds respectively to run a 400 m lap. The two athletes were together again at the starting line after some time.

Determine the number of laps that Tanui had to run to complete the race after they were together. (3 marks)

5. Simplify

$$\frac{18ax-(3a-4x)(3a+4x)}{3a-8x}$$ (3 marks)

6. In the quadrilateral ABCD, AD = CD = 6 cm and BA = BC = 12 cm. Angle ADC = 300°.



Calculate, correct to 2 decimal places, the area of the quadrilateral ABCD. (4 marks)

7. A watch loses 8 seconds every hour. It was set to read the correct time at 1100 h on Sunday.

Determine the time, in a 12-hour system, the watch will show on the following Thursday when the correct time is 0500 h. (3 marks)

8. A lorry left town A for town B and maintained an average speed of 50 km/h. A car left town A for town B 42 minutes later and maintained an average speed of 80 km/h. At the time the car arrived in town B, the lorry had 25 km to cover to town B.

Determine the distance between town A and B. (3 marks)

9. Port L is 120 km on a bearing of S30°W from port K. A ship left port K at 1000 h and sailed at a speed of 40 km/h along the bearing of S60°E.

Using scale drawing, determine the bearing of the ship from port L at 1400 h. (4 marks)

10. The image of P(−2, 5) under a translation T is P′(2, 2). Q′(9, −5) is the image of Q under the same translation T.

Determine the coordinates of Q. (3 marks)

11. A Kenyan bank bought and sold United Arab Emirates (UAE) dirhams on two different dates as shown below.

		Buying (Ksh)	**Selling (Ksh)**
1st August 2021	1 UAE dirham	28.40	28.90
16th August 2021	1 UAE dirham	28.00	28.40

A Kenyan tourist who travelled to UAE on 1st August 2021 converted Ksh 130 050 to UAE dirhams.

During her stay in UAE, she spent 3 520 UAE dirhams. She arrived back to Kenya on 16th August 2021. On the same day she converted the remaining amount of money to Kenya shillings at the same bank.

Calculate the amount of money in Kenya shillings that she received from the bank. (3 marks)

12. An electric post erected vertically is 20 m from point P on the same level ground. The angle of elevation of the top, T, of the post from P is 30°. Given that S is the mid point of the post, calculate, correct to 1 decimal place, the angle of elevation of S from P. (3 marks)

13. Given that $A = \begin{pmatrix} 2 & 6 \\ 2u & 5 \end{pmatrix}$, $B = \begin{pmatrix} 7 & -3 \\ -u & 5 \end{pmatrix}$ and $BA = \begin{pmatrix} 2 & v \\ 16 & w \end{pmatrix}$, determine the values of u, v and w. (3 marks)

14. The capacities of two similar containers are 54 ml and 250 ml respectively. The difference in the heights of the two containers is 4 cm.

Calculate the height of the larger container. (3 marks)

15. The table below shows the mean marks in a mathematics test of two classes.

Class	Number of students	Mean mark
X	43	65
Y	45	62

Calculate, correct to 2 decimal places, the mean mark of the classes. (2 marks)

16. The base, ABCDEF, of a right pyramid is a regular hexagon of side 2.5 cm. Point V is the vertex of the pyramid and the length of the slanting edges is 4 cm.

Draw a labelled net of the pyramid. **(3 marks)**

SECTION II (50 marks)

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

17. A contractor hired Wema and Tatu to transport 144 tonnes of stones to building sites A and B.

To transport 48 tonnes of stones for a distance of 28 km, the contractor paid Ksh 24 000.

(a) Wema transported 96 tonnes of stones to site A, a distance of 49 km.

(i) Calculate the amount of money that was paid to Wema. (2 marks)

(ii) For every 8 tonnes of stones Wema transported to site A, he spent Ksh 3 000.

Calculate the profit Wema made. (3 marks)

(b) Tatu transported the remaining 48 tonnes of stones to site B, a distance of 84 km. If Tatu made 44% profit, calculate the amount of money Tatu spent to transport the stones. (3 marks)

(c) Determine the ratio of the profit made by Wema to that made by Tatu. (2 marks)

18. A shot put is spherical and has mass of 7.26 kg. It is made of a metal with a density of $6.93\ g/cm^3$.

(Take $\pi = \frac{22}{7}$).

(a) Determine the radius of the shot put, correct to 1 decimal place. (3 marks)

(b) A bucket is in the shape of a frustum of a cone. The base radius of the bucket is 7 cm.

The bucket contains water to a height of 15 cm. The radius of the surface of the water is 10.5 cm.

(i) Find the volume of the water in the bucket. (3 marks)

(ii) The shot put ball is completely submerged in the water in the bucket.

Calculate the new height of the water in the bucket. (4 marks)

19. A triangle ABC is right angled at point A. The vertices of the triangle are A(1, −2), B(5, 4) and C(m, n).

The equation of line BC is $5y - x = 15$.

(a) Determine:

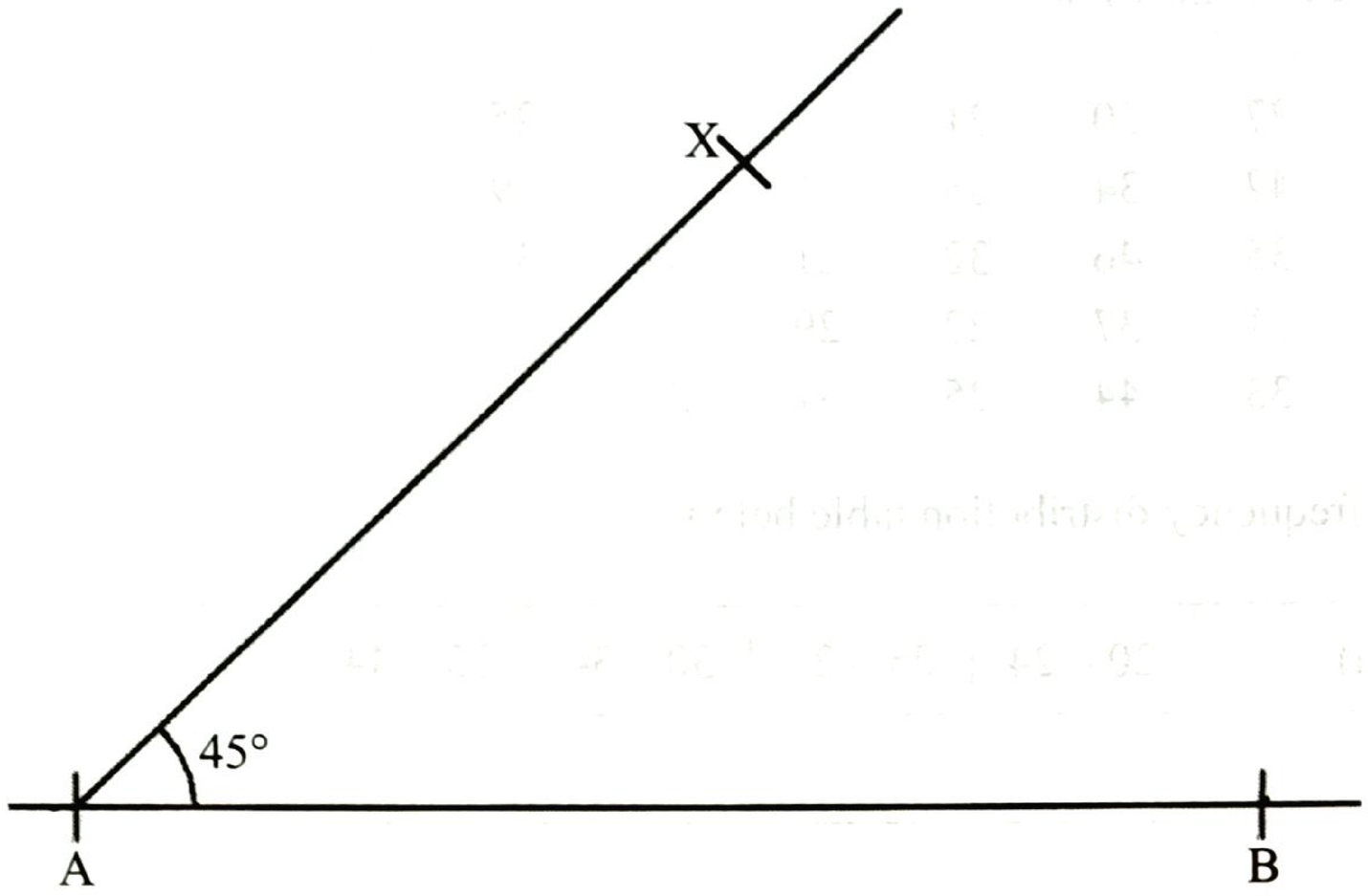
(i) the equation of line AC in the form $ax + by + c = 0$, where a, b and c are integers. (4 marks)

(ii) the coordinates of point C. (3 marks)

(b) A line passes through point A and is parallel to line BC.

Determine the x-intercept of the line. (3 marks)

20. In the figure below, line AB = 10 cm and is part of a trapezium ABCD. Point X is such that angle BAX = 45°.



(a) Using a ruler and a pair of compasses only:

(i) locate point D on line AX such that AD : DX = 3:1. (3 marks)

(ii) complete trapezium ABCD such that line DC is parallel to line AB and angle ABC = 67.5°. (3 marks)

(iii) draw a perpendicular line from D to meet AB at E. Measure DE. (2 marks)

(b) Calculate the area of the trapezium ABCD. (2 marks)

21. The amount of money, in Kenya shillings, spent on airtime by a group of 30 people in a period of an hour was recorded as shown below.

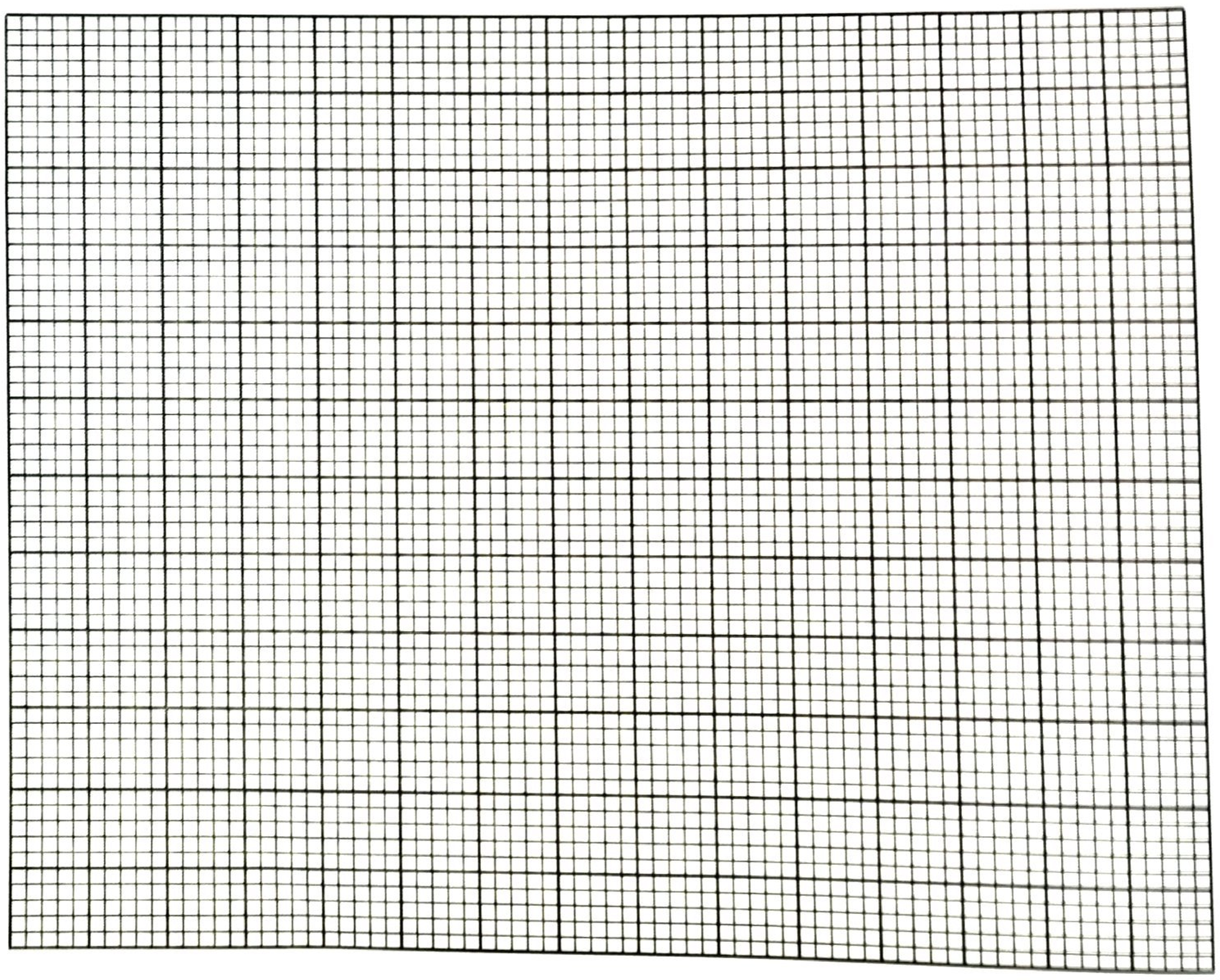
27	20	21	24	22	25
42	34	55	26	30	39
35	46	32	21	38	34
31	37	27	29	32	56
33	44	25	31	28	30

(a) Complete the frequency distribution table below.

Amount (Ksh)	20 – 24	25 – 29	30 – 34	35 – 44	45 – 59
Frequency					

(2 marks)

(b) On the grid below, draw a histogram to represent the data.



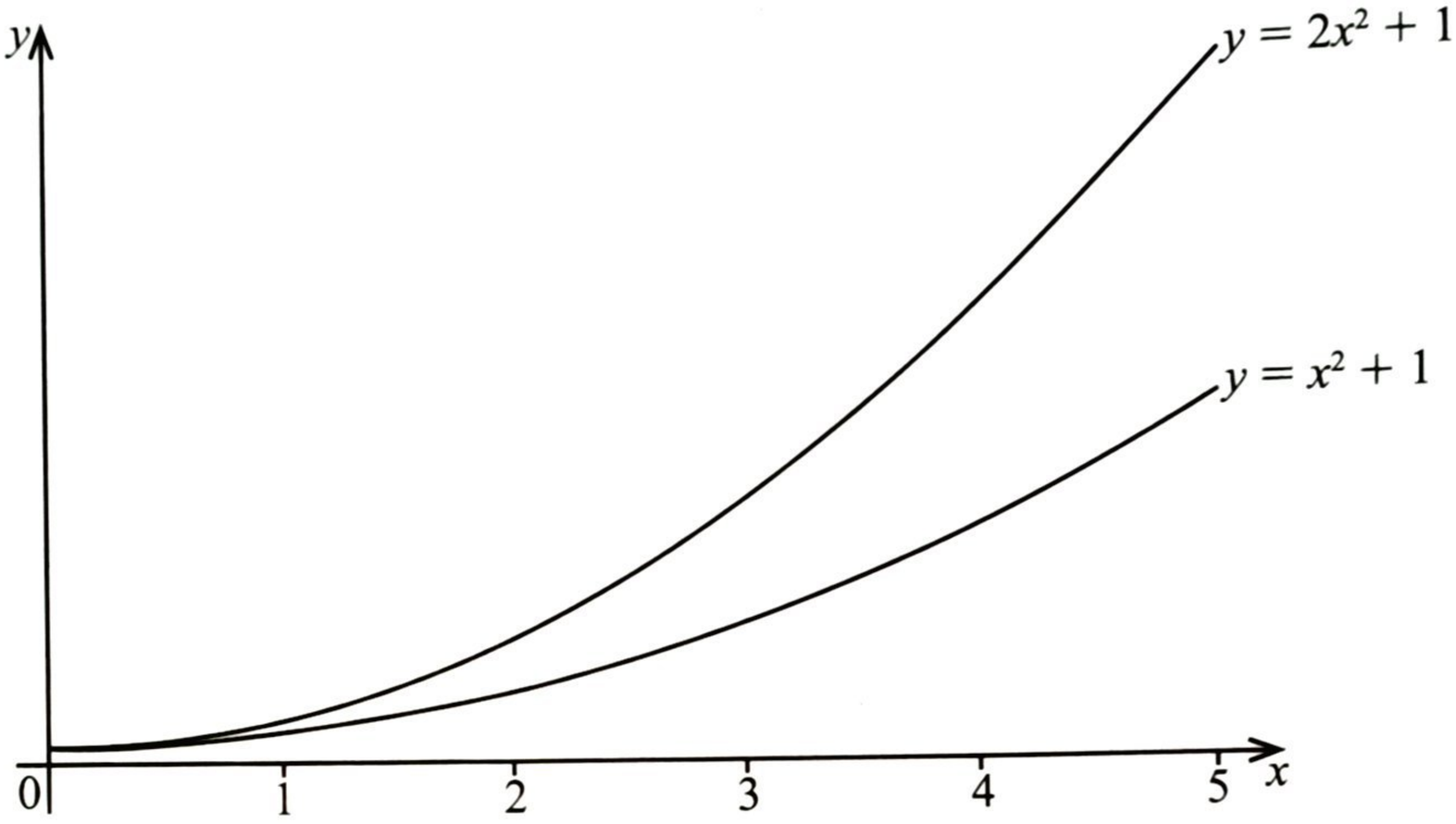
(3 marks)

(c) Use the histogram to determine:

(i) the median amount of money spent on airtime by the 30 people. (3 marks)

(ii) the number of people who spent more than Ksh 41.50 on airtime over that period. (2 marks)

22. The diagram below is a sketch of two curves $y = 2x^2 + 1$ and $y = x^2 + 1$ drawn on the same grid.



(a) Using the trapezium rule with 5 strips, estimate the area bounded by the curves $y = 2x^2 + 1, y = x^2 + 1$ and the lines $x = 0$ and $x = 5$. (5 marks)

(b) Using the mid ordinate rule with 5 strips, estimate the area bounded by the curves $y = 2x^2 + 1, y = x^2 + 1$ and the lines $x = 0$ and $x = 5$. (5 marks)

23. A supermarket sold 530 packets of milk daily when the price was Ksh 50 per packet.

Whenever the price per packet was increased by Ksh 4, the number of packets sold daily decreased by 20.

If n represents the number of times the price was increased:

(a) write an expression in terms of n for:

(i) the price of a packet of milk after the price was increased. (1 mark)

(ii) the number of packets of milk sold after the price was increased. (1 mark)

(iii) the total sales, in simplified expanded form, after the price of a packet of milk was increased. (2 marks)

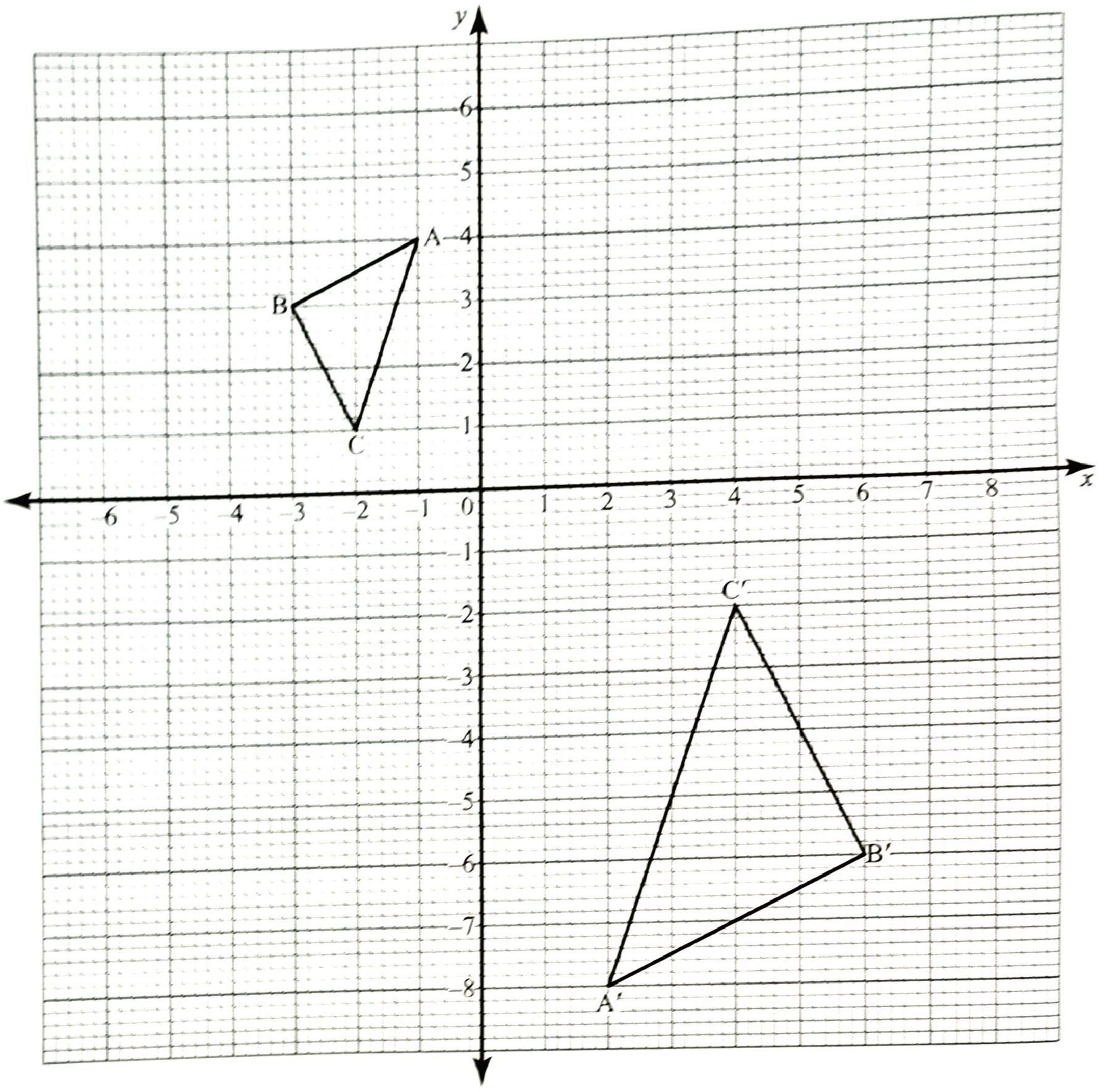
(b) Determine:

(i) the number of times the price was increased to attain maximum sales. (3 marks)

(ii) the price of a packet of milk for maximum sales. (1 mark)

(iii) the maximum sales. (2 marks)

24. Triangle ABC and A′B′C′ are drawn on the grid provided.



(a) Describe fully a single transformation that mapped triangle ABC onto triangle A′B′C′.
(2 marks)

(b) On the same grid, draw:

(i) triangle A″B″C″ the image of triangle A′B′C′ under a rotation of +90° about O (0, 0). (2 marks)

(ii) triangle A‴B‴C‴, the image of triangle A″B″C″ under a reflection in the line $y = -x$. (2 marks)

(c) Draw the line of symmetry of triangle A′B′C′ and hence determine its equation in the form $y = mx + c$, where m and c are constants. (4 marks)

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121/2 **Paper 2**

MATHEMATICS ALT A

Dec. 2022 – 2½ hours

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Grand Total

SECTION I (50 marks)

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

1. An investor took a loan from a bank that charged interest. The loan and the interest accrued were repaid in monthly instalments. The investor repaid Ksh 1 500 in the first month and in each subsequent month the instalments were reducing by Ksh 50 until the loan was fully repaid. Determine the maximum amount that may be paid for that loan. (3 marks)

2. Two machines A and B working independently can take 8 hours and 10 hours respectively to do a task. A third machine C and machine A working together can do the same task in 5 hours. Determine the time it would take machine B and machine C working together to do the same task. (3 marks)

3. Simplify $\frac{3+\sqrt{5}}{7-3\sqrt{5}}$, leaving the answer in the form $a+b\sqrt{c}$ where a, b and c are integers. (2 marks)

4. The market value of a certain precious stone varies directly as the square of its mass. One such stone of mass 10 kg has a value of Ksh 600 000.

Calculate the value of a similar stone whose mass is 18.5 kg. (3 marks)

5. The perimeter of a rectangle is 48 cm while it area is 108 cm^2. Form a quadratic equation to represent the situation and hence determine the dimensions of the rectangle. (3 marks)

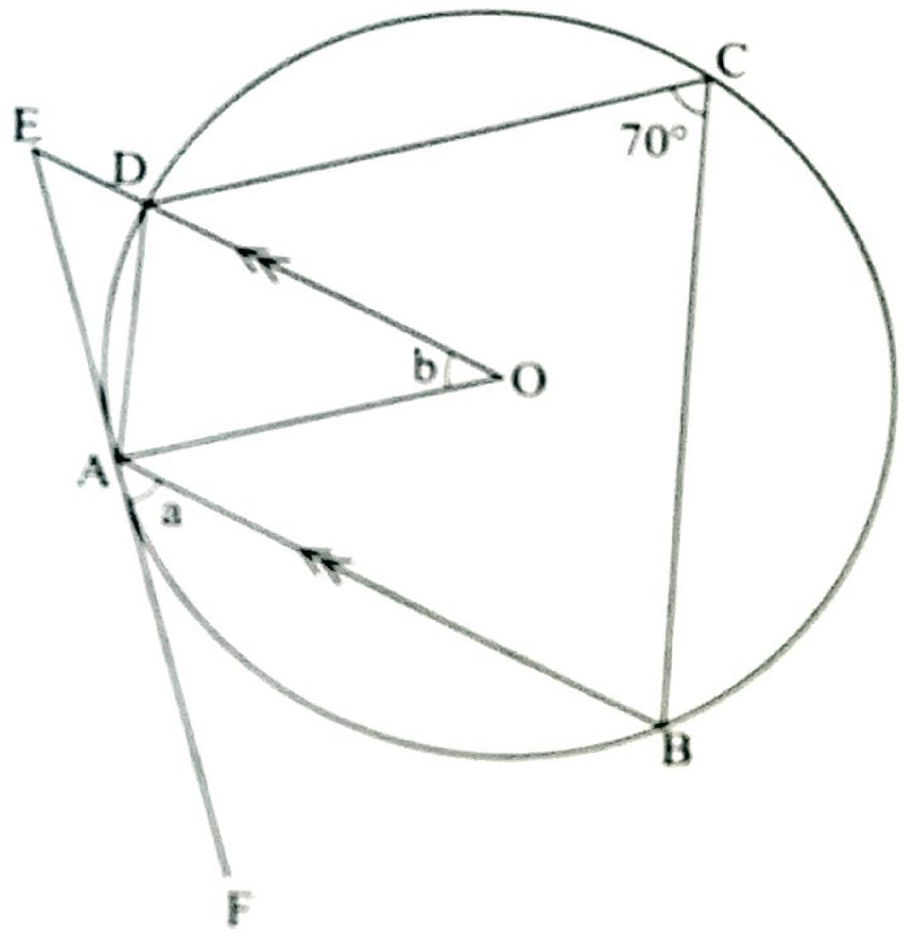
6. Two parallel chords AB = 4 cm and CD = 10 cm lie on opposite sides of a centre O of a circle. The perpendicular distance between the two chords is 7 cm.

Calculate the radius of the circle leaving the answer in surd form. (3 marks)

7. A rectangle ABCD in which AB = 12 cm and BC = 5 cm is the base of a right pyramid whose apex is V. VA = VB = VC = VD = 13 cm. Point M is the mid point of the edge VC.

Calculate, correct to 2 decimal places, the length of line AM. **(3 marks)**

8. In the figure below, O is the centre of the circle. Points A, B, C and D lie on the circumference of the circle. Line AB is parallel to the straight line EDO and line FAE is a tangent to the circle at A. $\angle FAB = a°$, $\angle DOA = b°$, $\angle DCB = 70°$

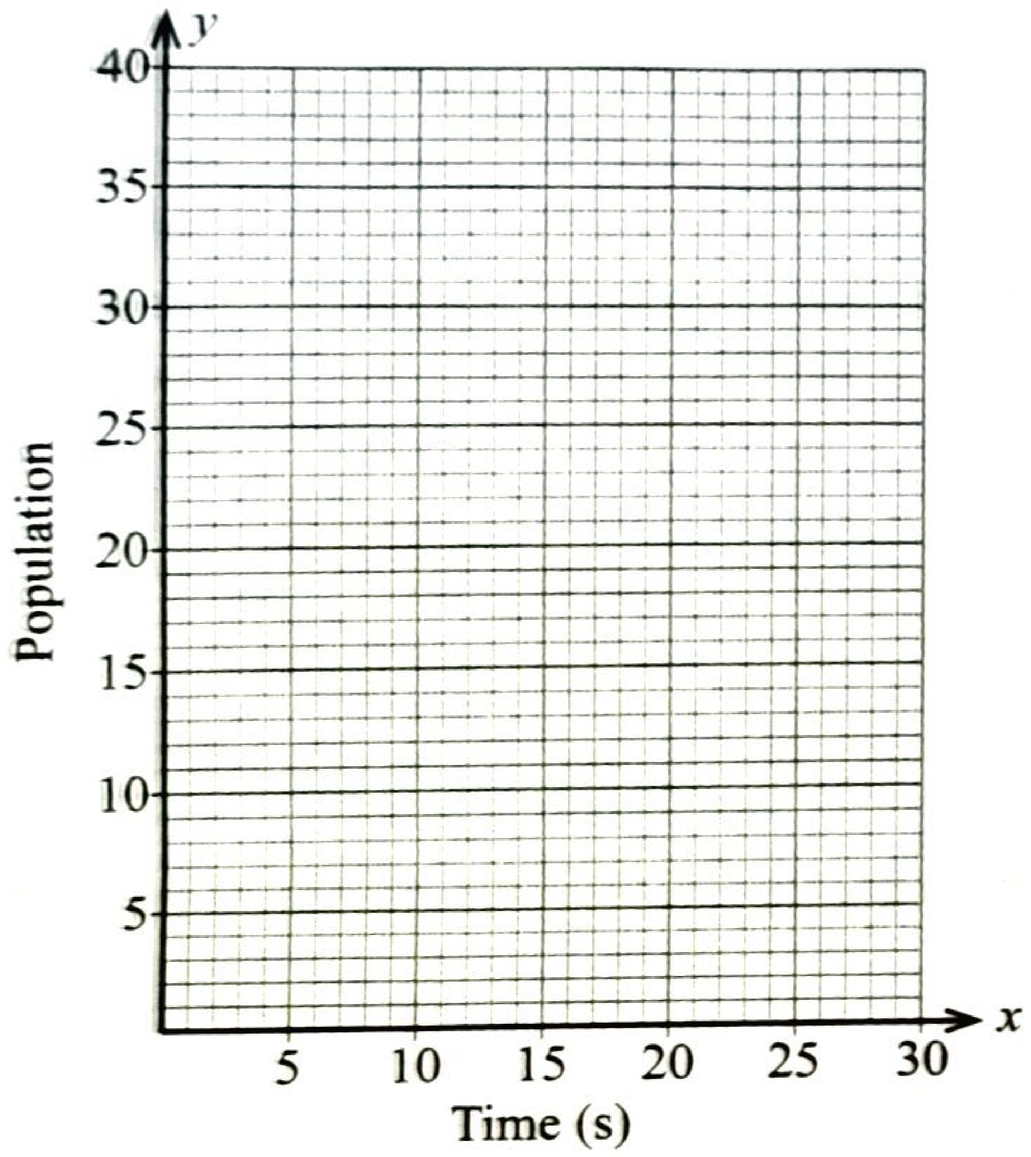


Determine the values of a and b. **(4 marks)**

9. The population growth of a colony of bacteria was recorded at intervals of 5 seconds(s) as shown in the table below

t(s)	0	5	10	15	20	25
Number of bacteria	5	7	11	16	24	36

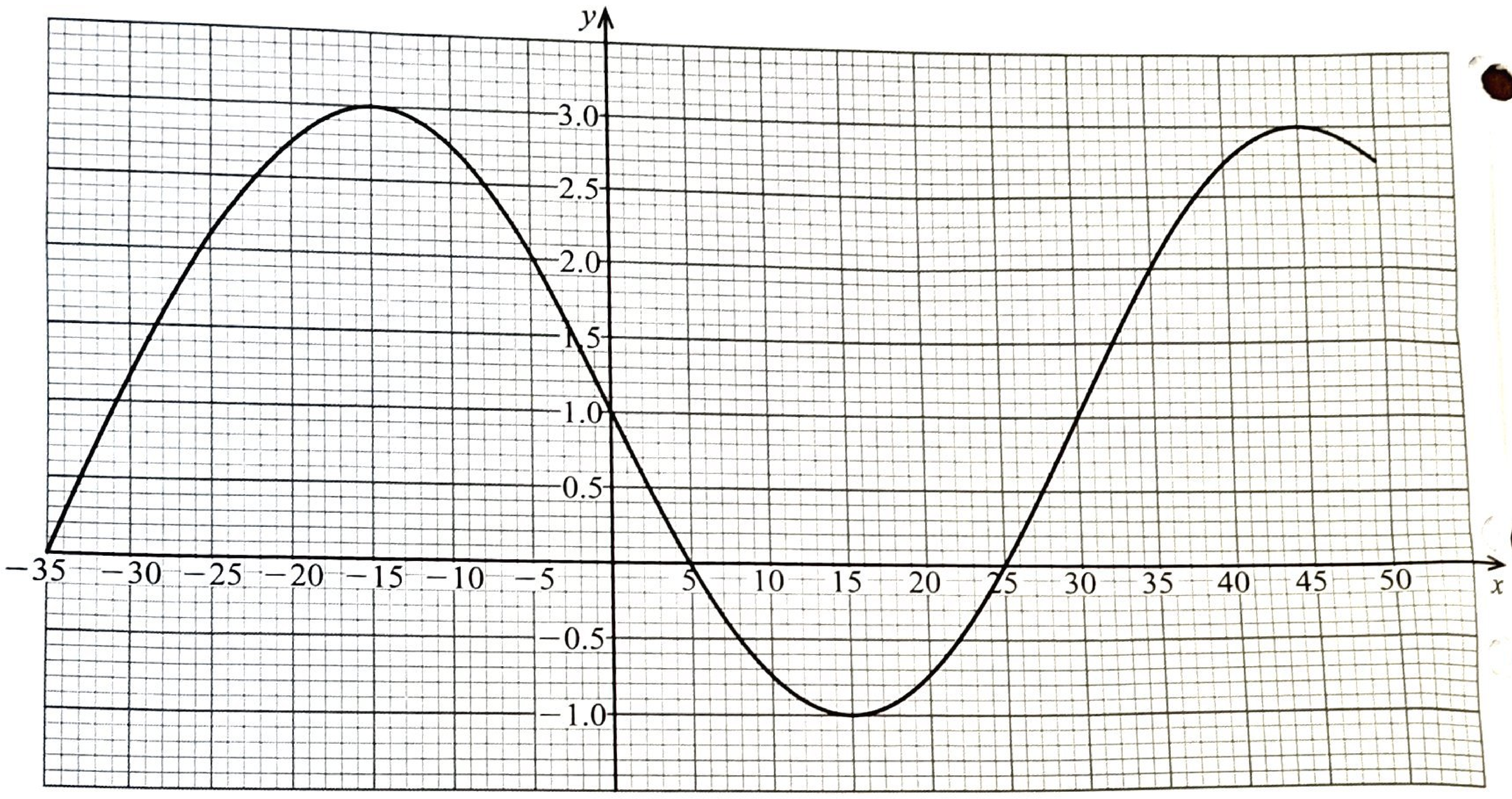
(a) On the grid provided, draw a graph of the population of bacteria against time. (2 marks)



(b) Use the graph to determine, correct to 2 decimal places, the average rate of change of the population of bacteria between t = 5 seconds and t = 20 seconds. (2 marks)

10. A circle centre C(5, 5) passes through points A(1, 3) and B(a, 9). Find the equation of the circle and hence the possible values of a. (3 marks)

11. The figure below represents the curve of the function $y = 1 - A \sin wx$ for the range $-35° \leq x \leq 50°$.



Determine the values of A and w. (3 marks)

12. The data below represents the number of animals owned by 7 neighbours:

9, 5, 14, 6, 8, 13 and 15.

Calculate, correct to the nearest whole number, the standard deviation of the number of animals. (3 marks)

13. The table below shows income tax rates in a certain year.

Monthly taxable income in Kenya shillings	Tax rates in each shilling (%)
0 – 12 298	10
12 299 – 23 885	15
23 886 – 35 472	20

A tax relief of Ksh 1 408 per month was allowed. Calculate the monthly income tax paid by an employee whose monthly taxable income was Ksh 26 545.75. (3 marks)

14. Point P(8, 4, –1) divides line AB internally in the ratio 4 : 1. The position vector of point A with respect to the origin O is $\begin{pmatrix} -4 \\ 8 \\ 3 \end{pmatrix}$. Determine the coordinates of point B. (3 marks)

15. An aircraft took off from an airport A(0°, 40°W) at 1100 h local time. The aircraft landed at airport B(0°, 65°W) at 1200 h local time.

Determine the speed of the aircraft in knots. (4 marks)

16. The velocity v *m/s* of a particle moving in a straight line is $(-2t + 4)$ *m/s*. Determine the distance moved by the particle during the first second of its motion. (3 marks)

SECTION II (50 marks)

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

17. A wholesaler stocks two types of rice: Refu and Tamu. The wholesale prices of 1 kg of Refu and 1 kg of Tamu are Ksh 80 and Ksh 140 respectively. The wholesaler also stocks blend A rice which is a mixture of Refu and Tamu rice mixed in the ratio 3 : 2.

(a) (i) A retailer bought 10 kg of blend A rice. To this blend, the retailer added some Tamu rice to prepare a new mixture blend X. The ratio of Refu rice to Tamu rice in blend X was 1 : 2.

Determine the amount of Tamu rice that was added. (3 marks)

(ii) The retailer sold blend X rice making a profit of 20%. Determine the selling price of 1 kg of blend X. (3 marks)

(b) The wholesaler prepared another mixture, blend B, by mixing x kg of blend A rice with y kg of Tamu rice. Blend B has a wholesale price of Ksh 130 per kg.

Determine the ratio $x : y$. (4 marks)

18. Two bags P and Q contain identical marbles except for the colours. Bag P contains 3 green and 4 red marbles. Bag Q contains 2 green and 3 red marbles.

(a) Find the probability of picking a red marble from bag P. (1 mark)

(b) Two marbles were picked at random from bag P, one at a time, without replacement.

(i) Draw a probability tree diagram to show all the possible outcomes. (1 mark)

(ii) Find the probability that the two marbles picked were of the same colour. (2 marks)

(iii) Find the probability that at least one red marble was picked. (2 marks)

(c) The marbles picked from bag P in (b) were both put into bag Q. A marble was then picked at random from bag Q.

Calculate the probability that the marble picked was:

(i) green in colour (3 marks)

(ii) red in colour (1 mark)

19. A transformation matrix $T_1 = \begin{pmatrix} 1.5 & 0 \\ 0 & 2 \end{pmatrix}$ maps a triangle ABC onto triangle A′B′C′. Another transformation matrix $T_2 = \begin{pmatrix} 3 & -2 \\ 2 & -1 \end{pmatrix}$ maps triangle A′B′C′ into triangle A″B″C″. The coordinates of point C″ is (10, 8) and the area of triangle A″B″C″ is 15 square units.

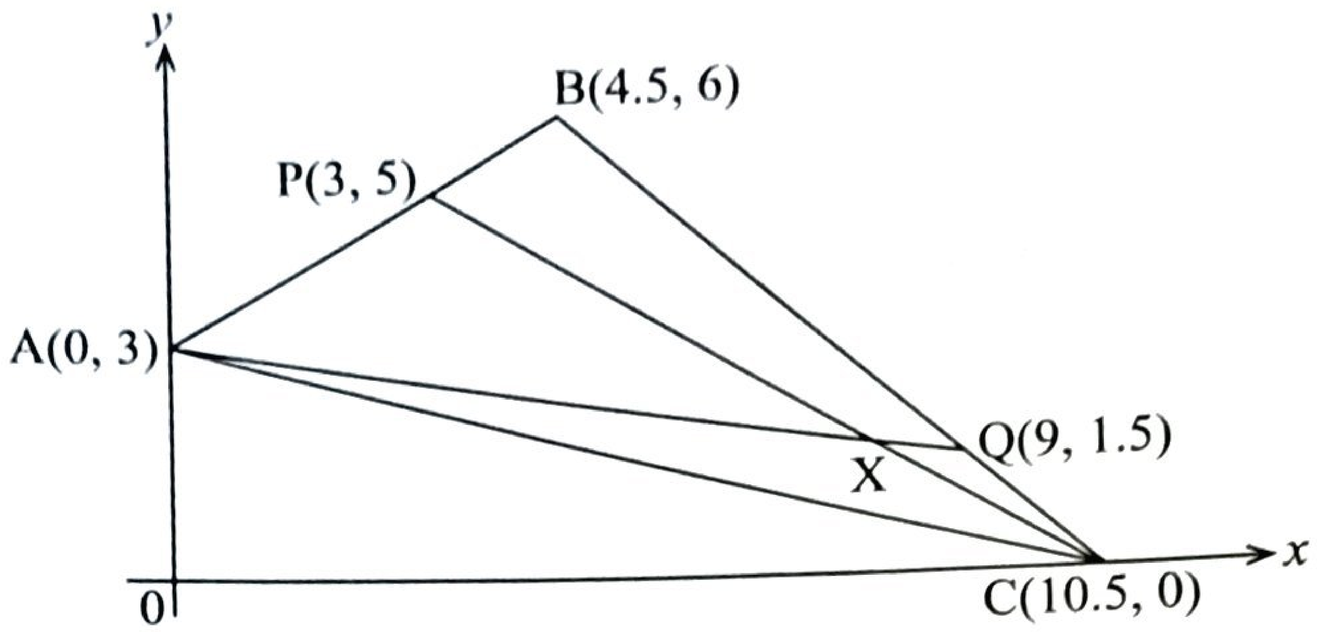
(a) (i) Determine the coordinates of C. (5 marks)

(ii) Determine the area of triangle ABC. (3 marks)

(b) The coordinates of points B and B″ are (x, y) and $(6x + 1, 8)$ respectively.

Determine the value of y. (2 marks)

20. In the diagram below, the vertices of triangle ABC are A(0, 3), B(4.5, 6) and C(10.5, 0). Points P(3, 5) and Q(9, 1.5) lie on lines AB and BC respectively.



(a) Find:

(i) **AQ** (1 mark)

(ii) **CP** (1 mark)

(b) Lines AQ and CP intersect at X such that $\mathbf{CX} = k\mathbf{CP}$ and $\mathbf{AX} = m\mathbf{AQ}$ where k and m are scalars.

(i) By expressing **OX** in two different ways, determine the values of k and m. (6 marks)

(ii) Determine the exact coordinates of point X. (2 marks)

21. (a) Juma bought a house 4 years ago for Ksh 2 500 000. The value of the house rose steadily over 4 years to its current value of Ksh 3 700 000.

Calculate, correct to 2 decimal places, the annual rate of appreciation in the value of the house. (3 marks)

(b) At the time Juma bought the house in 21(a), Tony also bought a car valued at Ksh 5 100 000. The value of the car depreciated steadily at a rate of 2% every 4 months.

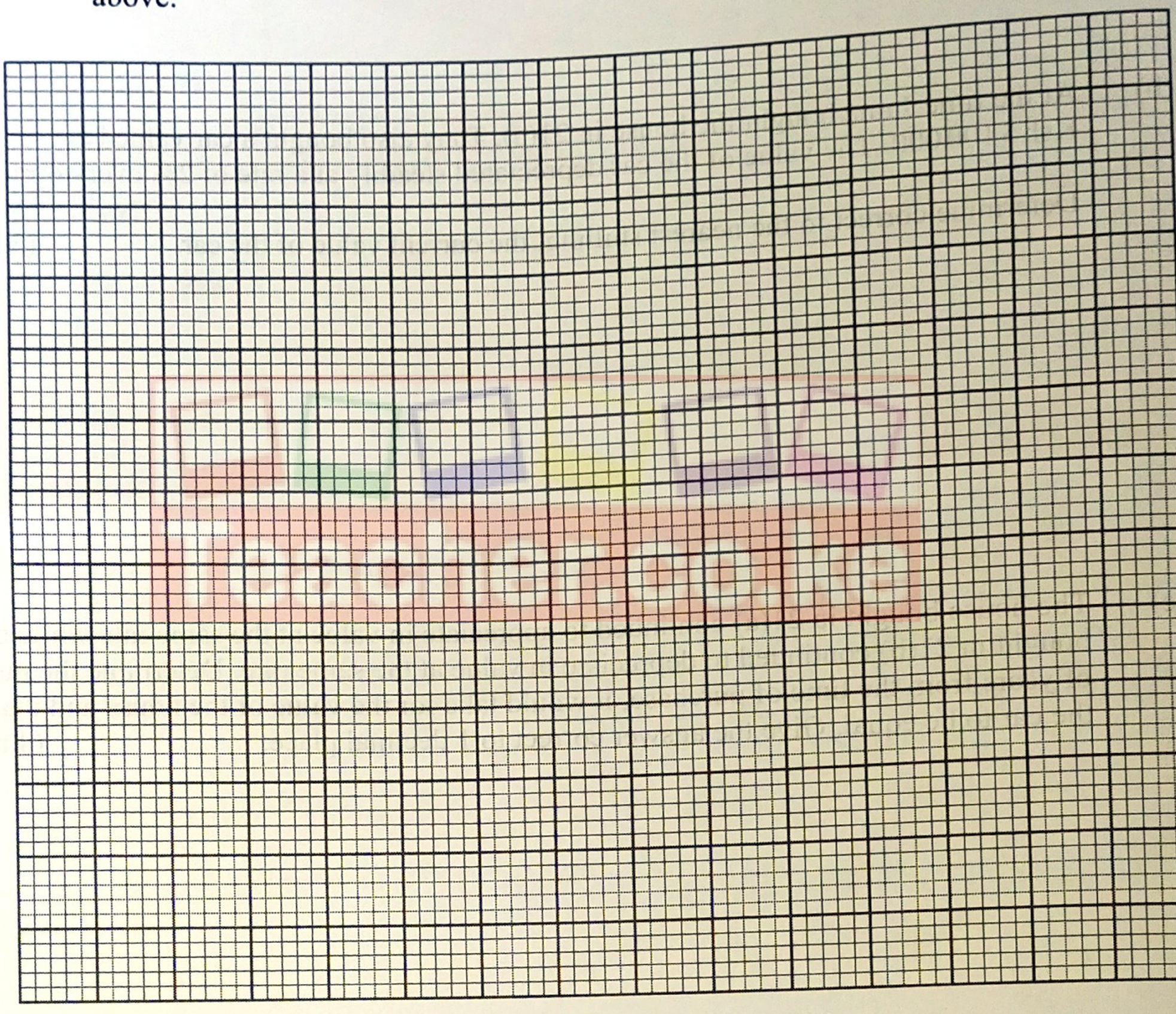
Determine correct to the nearest shilling, the current value of the car. (3 marks)

(c) The house bought in 21(a) continued to appreciate in value at the same rate while the car bought in 21(b) continued to depreciate in value at the same rate. Determine the number of years from the time of purchase, it would take for the value of the house and that of the car to be equal. Give the answer correct to 1 decimal place. (4 marks)

22. Fifty teachers in a sub county attended a workshop. The table below shows the distribution of the distances (d) in kilometres travelled by the teachers from their respective school to the training venue.

Distance d (km)	0 – 4	5 – 9	10 – 14	15 – 19	20 – 24	25 – 29
No. of teachers	4	7	11	14	9	5

(a) On the grid provided, draw a cumulative frequency graph to represent the information above. (4 marks)



(b) Use the graph to estimate:

(i) the median distance (1 mark)

(ii) the number of teachers who travelled a distance d km where $15 \leq d \leq 23$ (3 marks)

(c) Each of the 75% of all the teachers who travelled a distance d km where $d \leq 10$ km, used a motor bike and each was charged Ksh 50.

Determine the total amount of money raised by the motor bike operators. (2 marks)

23. In an inter school mathematics contest, schools can register teams in junior and senior categories. Information on number of students and the participation fee per team in each category is given in the table below.

	Junior category	Senior category
No. of students per team	6	4
Participation fees per team	Ksh 2 000	Ksh 3 000

The organising committee projected to register x junior teams and y senior teams.

(a) For the contest to take place, the following conditions must be satisfied:

(i) At least two junior teams must be registered

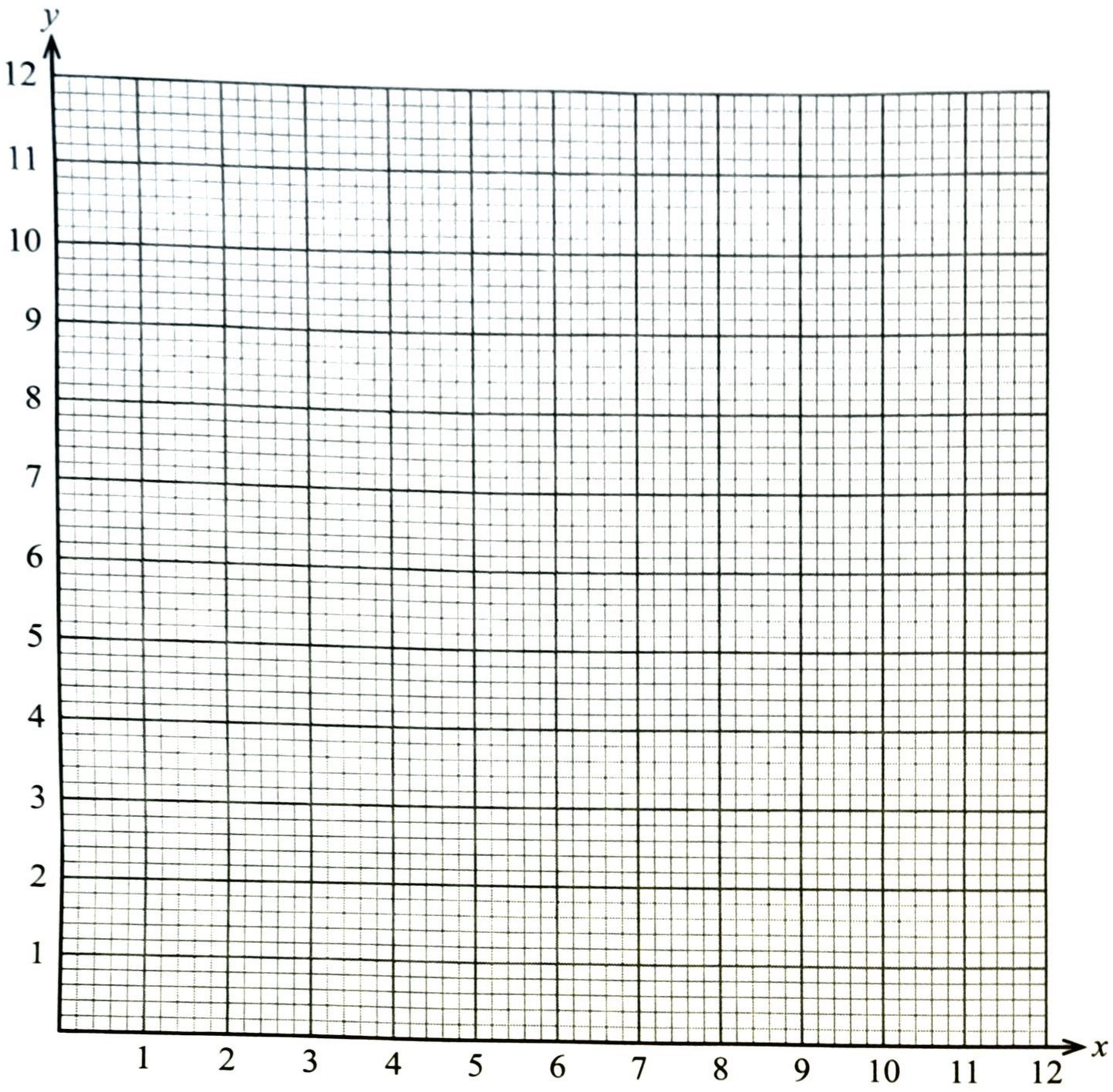
(ii) The number of senior teams must be more than half the number of junior teams

(iii) The total number of participating students from the two categories must not exceed 48

(iv) The total amount of money raised from the participation fees must be more than Ksh 12,000

Write down inequalities in x and y that satisfy the conditions. (4 marks)

(b) Represent the inequalities in (a) on the grid provided. (4 marks)

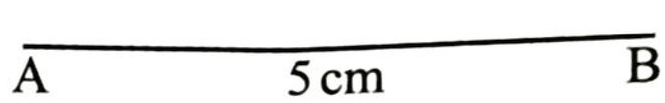


(c) The organising committee expected to make a profit of Ksh 200 for every junior team and Ksh 500 for every senior team that participated.

Determine the number of teams of each category that should be registered in order to maximise the profit. (2 marks)

24. In this question use a ruler and a pair of compasses.

The line AB drawn below is a side of triangle ABC in which $\angle ABC = 90°$ and $\angle BAC = 60°$.



(a) Complete triangle ABC. (2 marks)

(b) Construct the locus of points P such that $\angle ABC = 30°$. (2 marks)

(c) Locate by construction points Q_1 and Q_2 which satisfy the conditions below.

(i) Q_1 and Q_2 lie on the same side of line AB as C.

(ii) Area of $\triangle AQ_1B$ = Area of $\triangle AQ_2B = \frac{3}{4}$ Area of $\triangle ABC$.

(iii) $\angle AQ_1B = \angle AQ_2B = 30°$. Measure the length of line Q_1Q_2. (3 marks)

(d) Calculate the area above line Q_1Q_2 bounded by the locus of points P. (3 marks)

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