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Paper 1

055

MATHEMATICS  
ALT A

Mar. 2022 – 2½ hours



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

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

**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 question 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 16 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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**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**

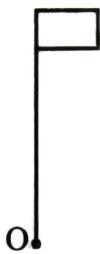


**SECTION I (50 marks)**

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

1. Evaluate  $\frac{1\frac{4}{5} + \frac{2}{3} \text{ of } 2\frac{1}{4} - \frac{3}{10}}{\frac{5}{6} + \frac{22}{39} \times 1\frac{2}{11}}$  (4 marks)
2. Two bells ring at intervals of 35 and 42 minutes respectively. The bells ring together at 8.48 a.m. Determine the time when the bells will ring together again. (3 marks)

3. Complete the figure below to show a rotational symmetry of order 3 about O. (3 marks)



4. Solve  $\frac{5}{3} - 2x < 1 - \frac{2}{3}x \leq 2 - x$ . Hence list the integral values that satisfy the inequalities. (3 marks)
5. The size of two interior angles of an irregular polygon each measures  $90^\circ$ . All the other remaining interior angles each measure  $150^\circ$ .  
Determine the number of sides of the polygon. (3 marks)

6. In a race Kipsang maintained an average speed of 5 m/s. When he was 310 m to the finishing line, Mutunga was 50 m behind him. However, Mutunga finished the race 10 m ahead of Kipsang.

Determine Mutunga's average speed. (3 marks)

7. Simplify  $(4 + 2y)^2 - (2y - 4)^2$ . (2 marks)

8. A table is sold at Ksh 4 500 and a chair at Ksh 2 000. A salesman earns a commission of 8% on every table and 5% on every chair sold. On a certain week, he sold 3 more chairs than tables and his total earnings were Ksh 3 980.

Determine the number of chairs he sold that week. (3 marks)



**9.** A translation T maps A $(-6, 2)$  onto A' $(3, 5)$ .

- (a) Determine the translation vector T.

(1 mark)

- (b) A point P' $(-4, 2)$  is the image of P under T. Determine the coordinates of P. (2 marks)

- 10.** The cost of one litre of Petrol is Ksh 110. John's vehicle covers 12 km on one litre of petrol. He used Ksh 2 805 on petrol to travel from town A to town B. Jane's vehicle consumes 12.5 litres of Petrol for every 100 km travelled.

Calculate the amount of money that Jane would use to travel from town A to B on the same road. (3 marks)

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11. Solve for  $\theta$  (2 marks)

$$\sin(2\theta - 15) = \cos 3\theta.$$

12. Line AB drawn below is a side of a trapezium ABCD.



- (a) Using a ruler and pair of compasses only, complete trapezium ABCD in which AB is parallel to DC,  $\angle BAD = 67.5^\circ$ , AD = 5 cm, BC = 5.5 cm and  $\angle ABC$  is acute. (3 marks)
- (b) Measure the length of DC. (1 mark)

13. Ali left Mombasa for Nairobi on Tuesday at 2.30 a.m. He arrived in Mtito Andei after 3 hours 12 minutes. He stayed in Mtito Andei for 36 hours and then left for Nairobi. He took 5 hours 25 minutes to arrive in Nairobi.

Determine the day and time in the 12 hour system Ali arrived in Nairobi. (3 marks)

14. The height of a cone is 12 cm. A frustum whose volume is one eighth the volume of the cone is cut off. Determine the height of the frustum. (3 marks)

15. Solve the equation  $8^{x+1} - 2^{3x-1} = 120$ . (4 marks)

16. A curve is given by  $y = 2x^3 - 3x^2 - 12x + 12$ .

(a) Find the gradient function of the curve.

(1 mark)

(b) Determine the equation of the normal to the curve at the point  $(1, -1)$ , in the form  $y = mx + c$ , where  $m$  and  $c$  are constants. (3 marks)

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## SECTION II (50 marks)

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

17. A factory packs fruit jam in cylindrical tins of radius 5 cm and height 15 cm. The tins are then packed into rectangular cartons each measuring 60 cm long, 30 cm wide and 30 cm high.

(a) Determine the maximum number of tins that can be packed in one carton. (2 marks) 55

- (b) An empty carton and an empty tin weighs 560 g and 300 g respectively. The jam packed in one tin weighs 990 g. A pick-up which can carry a maximum of 600 kg is used to transport the jam.

Determine the maximum number of cartons the pick-up can carry. (4 marks)

- (c) The factory delivered a pick-up full of cartons of jam to a retailer. The factory sells one carton to a retailer for Ksh 2 880. The retailer sells each tin at Ksh 110.

Calculate the percentage profit made by the retailer. (4 marks) 1085



18. (a) The length of each side of an equilateral triangle ABC is 10 cm. Calculate the area of the triangle, correct to 2 decimal places. (2 marks)
- (b) Triangle ABC in 18(a) forms the base of a solid triangular pyramid VABC. The perpendicular height of the pyramid is 15 cm.  
Calculate the volume of the pyramid. (2 marks)
- (c) The pyramid VABC in 18(b) above is recast into a cone of base radius 3.5 cm.  
Calculate, correct to 2 decimal places:  
(i) the height of the cone; (2 marks)  
(ii) the surface area of the cone. (4 marks)

19. Elimu School bought 25 textbooks and 35 exercise books for Ksh 13 500 from bookshop A. From the same bookshop Soma School bought 21 textbooks and 38 exercise books and spent Ksh 1 300 less than Elimu School.

Take  $x$  to represent the price of a textbook and  $y$  to represent the price of an exercise book.

- (a) Form two equations representing the above information. (2 marks)

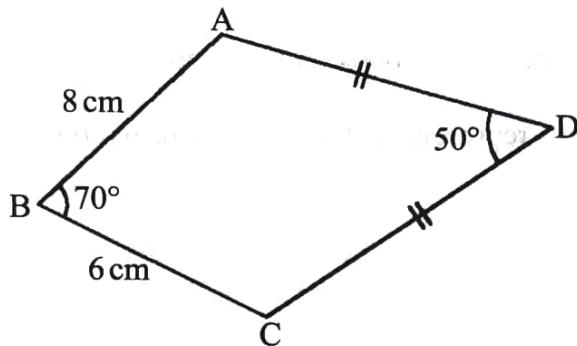
- (b) Use matrix method to determine the price of each item. (5 marks)

- (c) In bookshop B, the cost of a textbook was 5% less and that of an exercise book was 5% more than in bookshop A. Kasuku School bought the same number of textbooks and exercise books as Elimu School in bookshop B.

Calculate the difference in the amount spent by Kasuku School and Elimu School.

(3 marks)

20. The figure below is a quadrilateral ABCD in which  $AB = 8 \text{ cm}$ ,  $BC = 6 \text{ cm}$ ,  $CD = AD$ ,  $\angle ABC = 70^\circ$  and  $\angle ADC = 50^\circ$ .



(a) Calculate, correct to one decimal place:

(i) the length AC. (2 marks)

(ii) the length DC. (2 marks)

(iii) the size of angle BAD. (3 marks)

(b) Calculate the area of the quadrilateral ABCD, correct to one decimal place. (3 marks)



21. (a) Solve for  $x$

$$(x - 4)^2 = (x - 8)(2x + 7). \quad (4 \text{ marks})$$

(b) John cycled 6 km from his home to school at an average speed of  $(2x - 3)$  km/h.

Peter walked 2.4 km from his home to the school at an average speed of  $x$  km/h. Peter took 16 minutes less than John.

Determine the time, in minutes, that John took to reach the school. (6 marks)

22. The position vectors of A and B are  $\begin{pmatrix} -4 \\ 6 \end{pmatrix}$  and  $\begin{pmatrix} -8 \\ 2 \end{pmatrix}$  respectively.

Point M is the midpoint of  $\mathbf{AB}$  and point N is the midpoint of  $\mathbf{OA}$ .

(a) Find:

(i) the vector  $\mathbf{AB}$ . (2 marks)

(ii) the coordinates of points M and N. (2 marks)

(iii) the magnitude of  $\mathbf{NM}$ . (3 marks)

(b) The coordinates of a point C is  $(2, a)$ . Vector  $\mathbf{CA}$  is parallel to vector  $\mathbf{OB}$ .

Determine the value of  $a$ . (3 marks)

23. The masses of 40 adults who attended a health clinic were recorded as follows.

64	50	58	73	51	42	58	46
58	60	45	48	69	48	50	43
52	64	58	46	59	54	41	61
73	49	74	55	44	73	53	67
62	47	66	52	60	61	54	70

- (a) Complete the frequency distribution table below for the above information. Use classes of size 5 starting with the class 40 – 44. (4 marks)

Mass (kg)	Frequency ( $f$ )	Mid points ( $x$ )	$fx$	$cf$
40 – 44				
45 – 49				
50 – 54				
55 – 59				
60 – 64				
65 – 69				
70 – 74				
75 – 79				

- (b) State the modal class. (1 mark)

- (c) Estimate:

- (i) the mean mass. (2 marks)

- (ii) the median mass. (3 marks)

24. The equation of a curve is given as  $y = \frac{1}{3}x^3 - \frac{1}{2}x^2 - 2x - \frac{1}{3}$ .

(a) Find:

(i) the value of  $y$  when  $x = -2$ .

(2 marks)

(ii) the equation of the tangent to the curve at  $x = -2$ .

(4 marks)

- (b) Determine the coordinates of the turning points of the curve.

(4 marks)

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Paper 2

**MATHEMATICS**  
**ALT A**

**Mar. 2022 – 2½ hours**



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

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

**Instructions to candidates**

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**Section I**

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**Grand Total**

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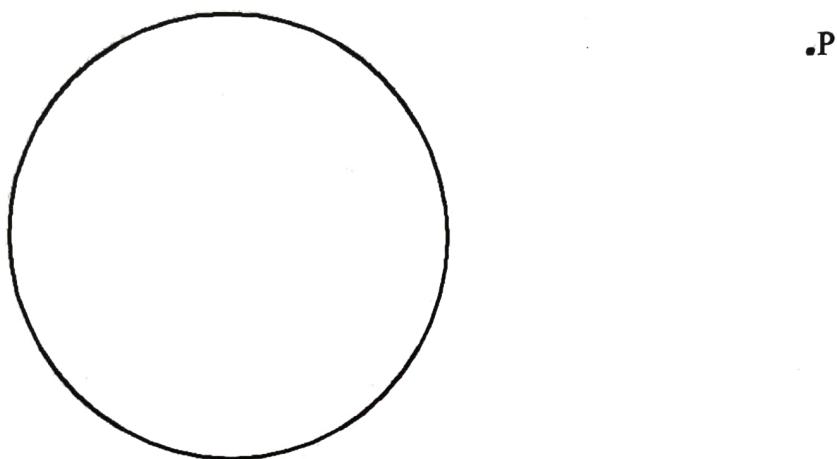
## **SECTION I (50 marks)**

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

1. An empty tank of capacity 18480 litres is to be filled with water using a cylindrical pipe of diameter 0.028 m. The rate of flow of water from the pipe is 2 m/s. Find the time in hours it would take to fill up the tank. (Take  $\pi = \frac{22}{7}$ ). (3 marks)
  2. The first term of a Geometric Progression (G.P) is 2. The common ratio of the G.P is also 2. The product of the last two terms of the G.P is 512. Determine the number of terms in the G.P. (3 marks)
  3. The expression  $ax^2 - 30x + 9$  is a perfect square, where a is a constant. Find the value of a. (2 marks)

4. Make  $x$  the subject of the formula  $y = \frac{bx}{\sqrt{cx^2 - a}}$ . (3 marks)

5. The figure below shows a circle and a point P outside the circle

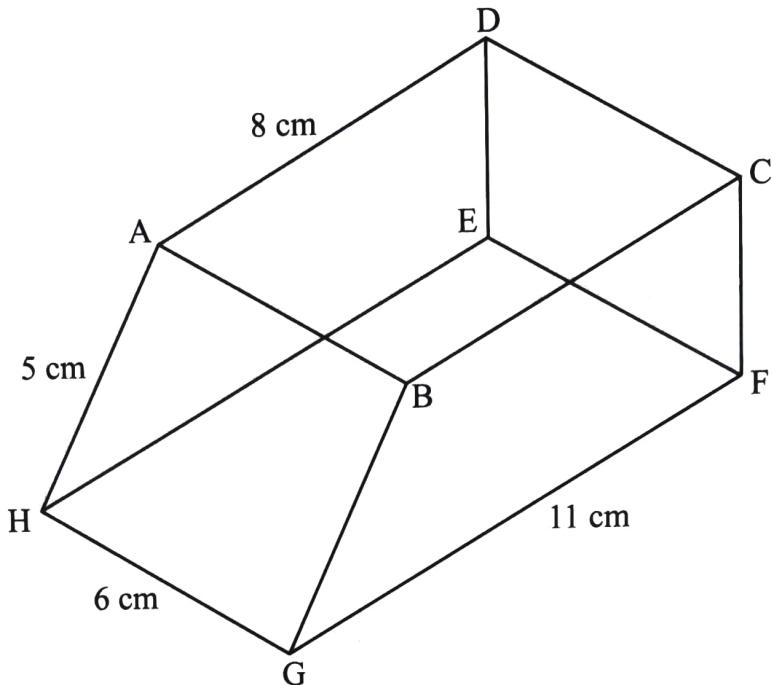


Using a ruler and pair of compasses, construct a tangent to the circle from P. (4 marks)

6. Four quantities P, Q, R and S are such that P varies directly as the square root of Q and inversely as the square of the difference of R and S. Quantity Q is increased by 44% while quantities R and S are each decreased by 10%.

Find the corresponding percentage change in P correct to 1 decimal place. (4 marks)

7. The figure below represents a prism ABCDEFGH of length 6 cm. The cross section BCFG of the prism is a trapezium in which  $GF = 11 \text{ cm}$ ,  $BC = 8 \text{ cm}$ ,  $BG = 5 \text{ cm}$  and  $\angle GFC = \angle BCF = 90^\circ$ .



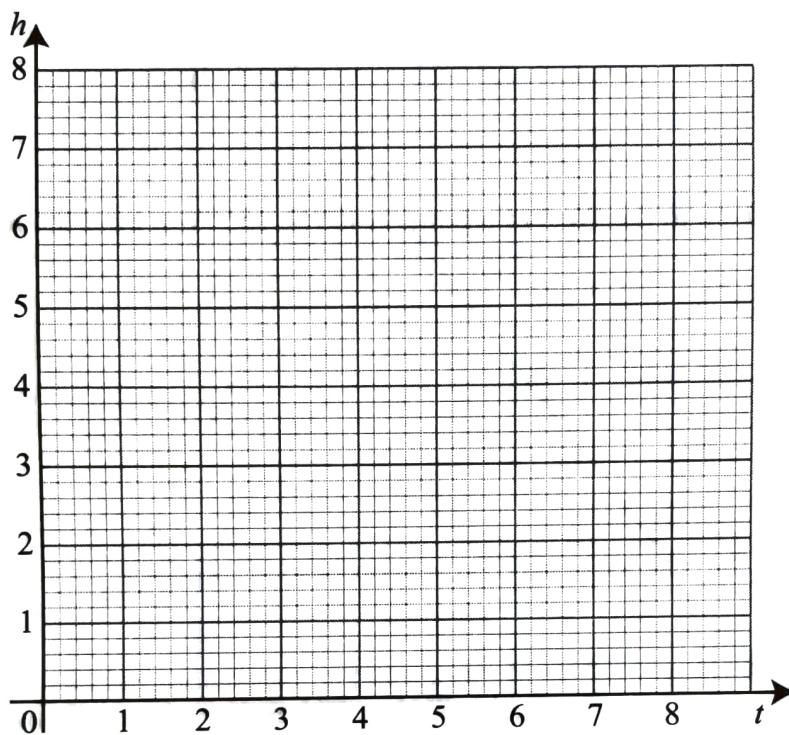
Calculate correct to 1 decimal place the angle between the line FA and the plane GFEH.  
(3 marks)

8. The cash price of a gas cooker is Ksh 20 000. A customer bought the cooker on hire purchase terms by paying a deposit of Ksh 10 000 followed by 18 equal monthly instalments of Ksh 900 each. Annual interest, compounded quarterly, was charged on the balance for the period of 18 months. Determine, correct to 1 decimal place, the rate of interest per annum. (4 marks)

9. The table below shows the values of  $t$  and the corresponding values of  $h$  for a given relation.

$t$	1	2	3	4	5	6	7	8
$h$	8	4	2.7	2	1.6	1.3	1.1	1

- (a) On the grid provided, draw a graph to represent the information on the table given.  
(2 marks)

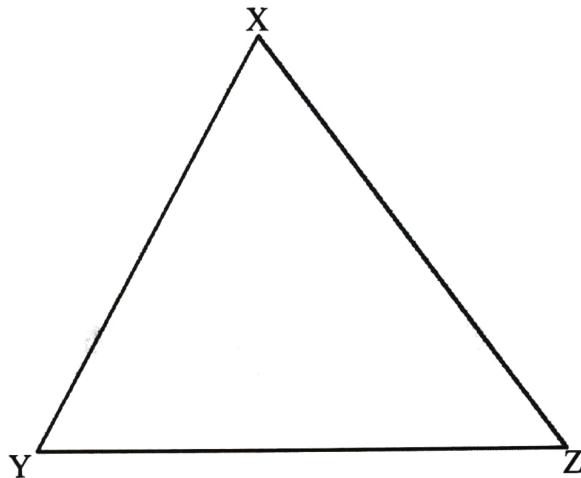


- (b) Use the graph to determine, correct to 1 decimal place, the rate of change of  $h$  at  $t = 3$ .  
(2 marks)

10. The equation of a trigonometric wave is  $y = 4 \sin(ax - 70)^\circ$ . The wave has a period of  $180^\circ$ .
- (a) Determine the value of  $a$ . (1 mark)
- (b) Deduce the phase angle of the wave. (1 mark)
11. A point Q is 2000 nm to the West of a point P( $40^\circ\text{N}$ ,  $155^\circ\text{W}$ ). Find the longitude of Q to the nearest degree. (3 marks)
12. A box contains 3 brown balls and 9 green balls. The balls are identical except for the colours. Two balls are picked at random without replacement.
- (a) Draw a tree diagram to show all the possible outcomes. (1 mark)

- (b) Determine the probability that the balls picked are of different colours. (2 marks)

13. The figure below shows triangle XYZ.



Using a ruler and a pair of compasses, locate a point M on the triangle such that M is 2 cm from line YX and is equidistant from lines YX and YZ. Measure length YM. (3 marks)

14. The position vectors of points P, Q and R are  $\mathbf{OP} = 6\mathbf{i} - 2\mathbf{j} + 3\mathbf{k}$ ,  $\mathbf{OQ} = 12\mathbf{i} - 5\mathbf{j} + 6\mathbf{k}$  and  $\mathbf{OR} = 8\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$ . Show that P, Q and R are collinear points. (3 marks)

15. In a transformation an object of area  $x \text{ cm}^2$  is mapped on to an image whose area is  $13x \text{ cm}^2$ .

Given that the matrix of the transformation is  $\begin{pmatrix} x & 7 \\ x-1 & 3x \end{pmatrix}$ , find the possible values of  $x$ .  
(3 marks)

16. Find the area enclosed by the curve  $y = x^2 + 2x$  the straight lines  $x = 1$ ,  $x = 3$  and the  $x$ -axis.

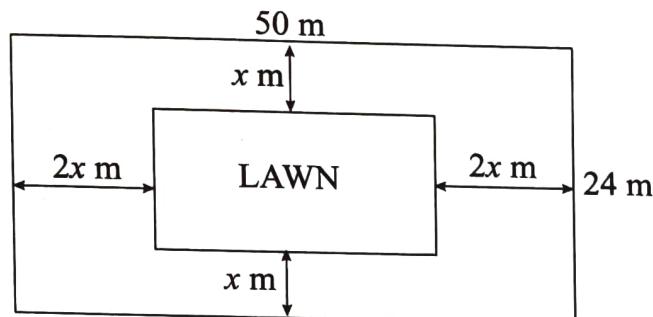
(3 marks)

**SECTION II (50 marks)**

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

17. Pump P can fill an empty water tank in  $7\frac{1}{2}$  hours while pump Q can fill the same tank in  $11\frac{1}{4}$  hours. On a certain day, when the tank was empty, both pumps were opened for  $2\frac{1}{2}$  hours.
- (a) Determine the fraction of the tank that was still empty at the end of the  $2\frac{1}{2}$  hours. (4 marks)
- (b) Pump P was later opened alone to completely fill the tank. Determine the time it took pump P to fill the remaining fraction of the tank. (2 marks)
- (c) The two pumps P and Q are operated by different proprietors. Water from the full tank was sold for Ksh 15 750. The money was shared between the two proprietors in the ratio of the quantity of water supplied by each.
- | Determine the amount of money received by the proprietor of pump P. (4 marks)

18. A rectangular plot measures 50 m by 24 m. A lawn, rectangular in shape, is situated inside the plot with a path surrounding it as shown in the figure below.



The width of the path in  $x$  m between the lengths of the lawn and those of the plot and  $2x$  m between the widths of the lawn and those of the plot.

- (a) Form and simplify an expression in  $x$  for the area of the:

(i) lawn;

(2 marks)

(ii) path.

(1 mark)

(b) The area of the path is  $1\frac{1}{2}$  times the area of the lawn.

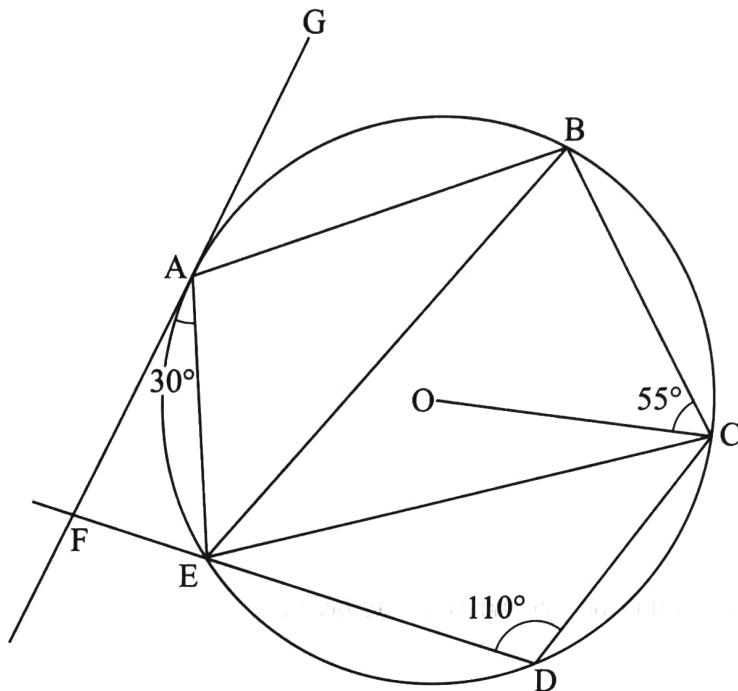
(i) Form an equation in  $x$  and hence solve for  $x$ .

(4 marks)

(ii) Determine the perimeter of the lawn.

(3 marks)

19. In the figure below, points A, B, C, D and E lie on the circumference of a circle centre O. Line FAG is a tangent to the circle at A. Chord DE of the circle is produced to intersect with the tangent at F. Angle  $\angle FAE = 30^\circ$ ,  $\angle EDC = 110^\circ$  and  $\angle OCB = 55^\circ$ .



(a) Determine the size of:

(i)  $\angle AEC$ . (3 marks)

(ii)  $\angle AEB$ . (3 marks)

(b) Given that  $AB = 5 \text{ cm}$ ,  $ED = 4.4 \text{ cm}$  and  $FE = 2.5 \text{ cm}$ . Calculate correct to 1 decimal place:

(i) the radius of the circle. (2 marks)

(ii) the length of line AF. (2 marks)



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

Monthly taxable income in Kenya shillings	Tax rates
0 – 12 298	10%
12 299 – 23 885	15%
23 886 – 35 472	20%
35 473 – 47 059	25%
47 060 and above	30%

In the year, the monthly earnings of Kanini were as follows:

Basic salary	Ksh 64 500
House allowance	Ksh 12 000

Kanini contributes 7.5 % of her basic salary to a pension scheme. This contribution is exempted from taxation. She is entitled to a personal tax relief of Ksh 1 408 per month.

Calculate:

(a) Kanini's monthly taxable income. (2 marks)

(b) the tax payable by Kanini that month. (6 marks)

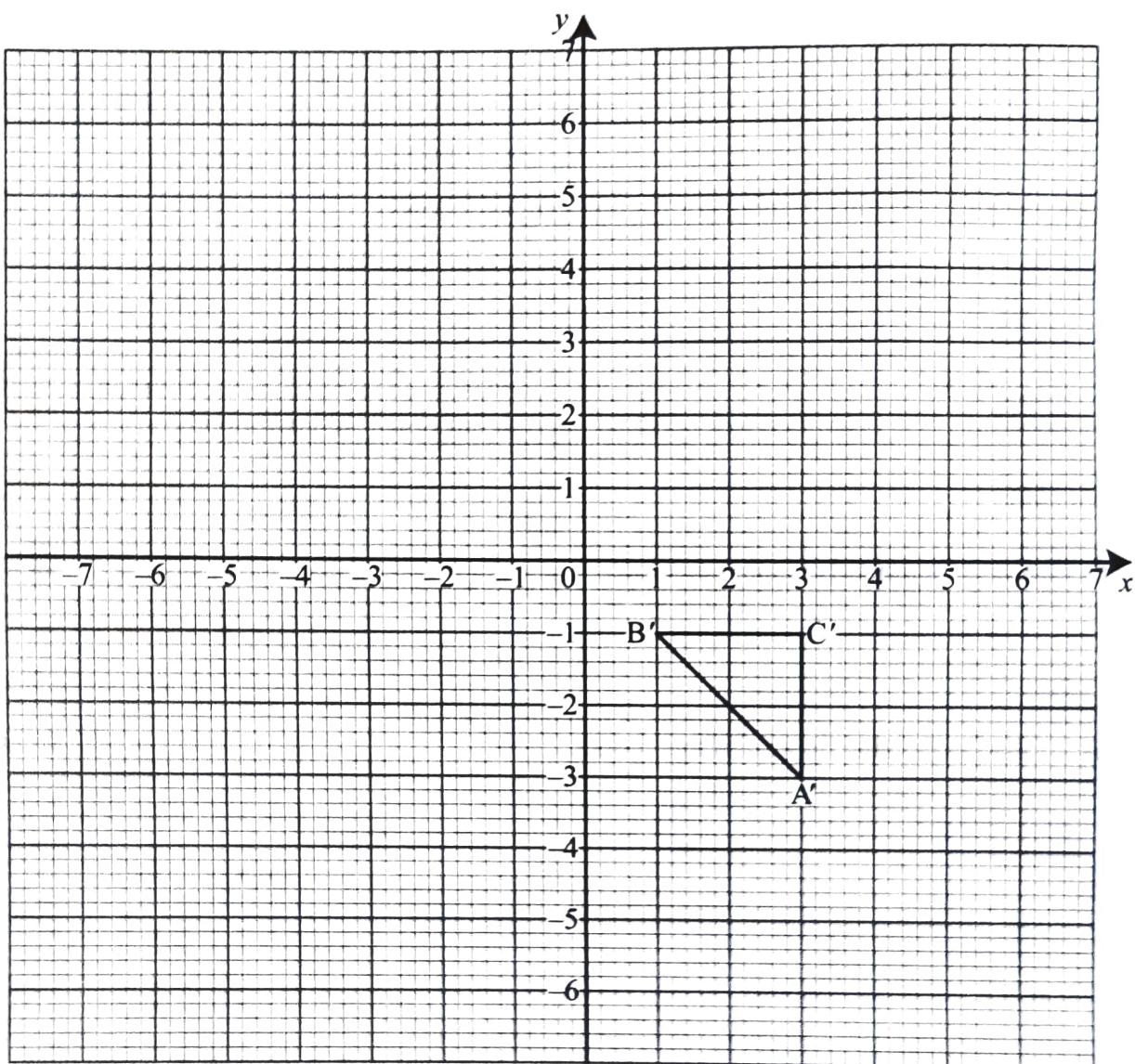
(c) Kanini's net pay that month. (2 marks)



21. The vertices of the triangle shown on the grid are  $A' (3, -3)$ ,  $B' (1, -1)$  and  $C' (3, -1)$ .

Triangle  $A'B'C'$  is the image of triangle  $ABC$  under a transformation whose matrix

is  $\begin{pmatrix} 0 & 1 \\ 1 & -2 \end{pmatrix}$ .



- (a) Find the coordinates of triangle  $A$ ,  $B$  and  $C$ .

(4 marks)

- (b) Triangle A''B''C'' is the image of triangle A'B'C' under a transformation matrix

$$\begin{pmatrix} -2 & 0 \\ 0 & -1 \end{pmatrix} \quad (2 \text{ marks})$$

Determine the coordinates of A'', B'' and C''.

- (c) On the same grid provided, draw triangles ABC and A''B''C''. (2 marks)

- (d) Determine a single matrix that maps ABC onto A''B''C''. (2 marks)

22. Workers in a factory commute from their homes to the factory. The table below shows the distances in kilometres, covered by the workers.

Distance (km)	1 – 5	6 – 10	11 – 15	16 – 20	21 – 25	26 – 30
Number of workers	3	6	$t$	7	4	2

The mean distance covered was 14.5 km.

- (a) Determine the value of  $t$  and hence the standard deviation of the distances correct to 2 decimal places. (6 marks)
- (b) Calculate, correct to 2 decimal places, the interquartile range of the distances. (4 marks)

23. (a) Complete the table below giving the values correct to 1 decimal place.

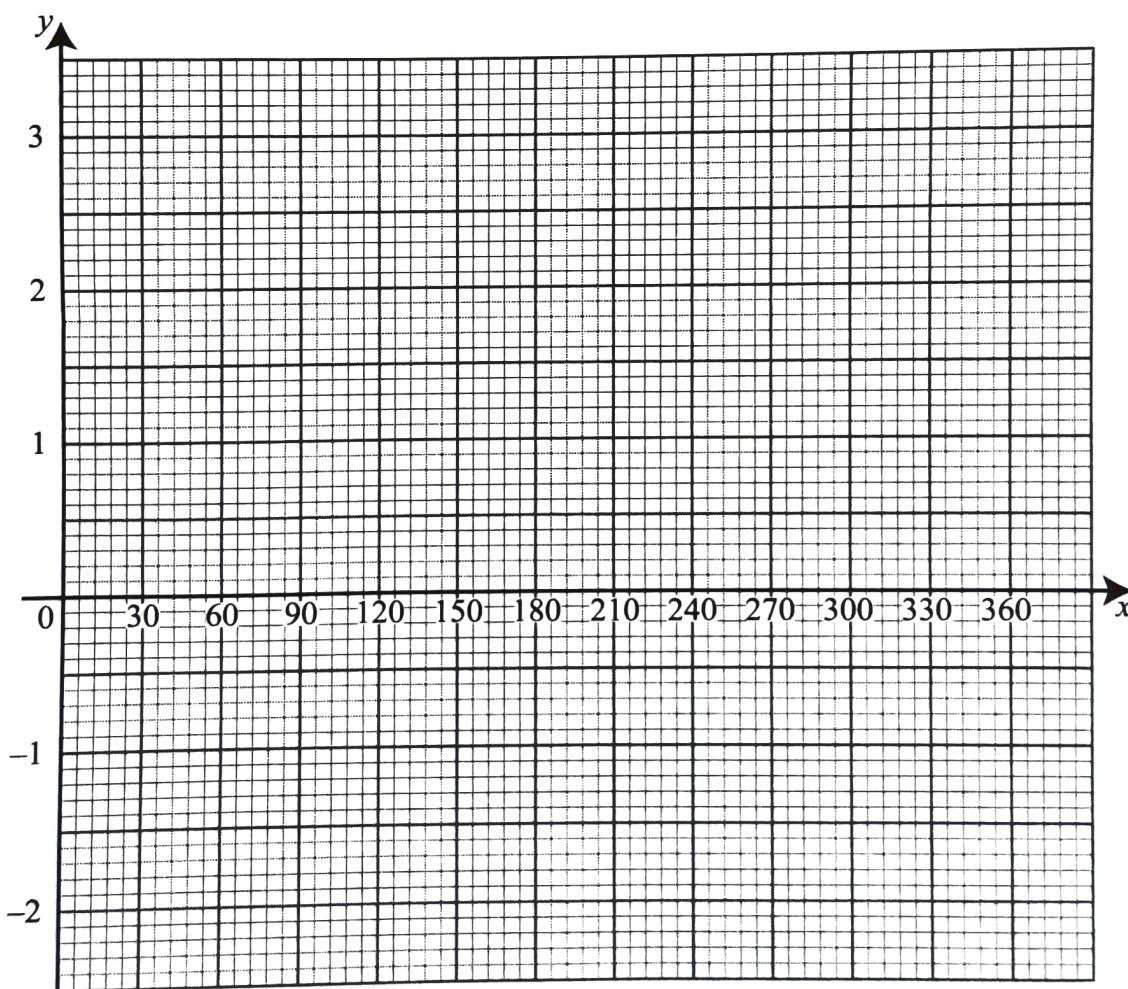
$x^\circ$	0	30	60	90	120	150	180	210	240	270	300	330	360
$y = 2\sin\left(\frac{3}{4}x\right) - 2\cos\left(\frac{3}{4}x\right)$	-2	-1.1	0		2		2.8		2	1.1	0		-2
$y = 1 + 2\cos x$	3		2	1	0	-0.7	-1		0	1		2.7	3

(2 marks)

- (b) On the grid provided and using the same axis, draw the graphs of

$$y = 2\sin\left(\frac{3}{4}x\right) - 2\cos\left(\frac{3}{4}x\right) \text{ and } y = 1 + 2\cos x \text{ for } 0^\circ \leq x \leq 360^\circ.$$

(4 marks)



(c) Using the graphs in part (b):

(i) find the values of  $x$  for which  $\sin\left(\frac{3}{4}x\right) = 1 + \cos\left(\frac{3}{4}x\right)$ . (2 marks)

(ii) determine the range of  $x$  for which  $2\sin\left(\frac{3}{4}x\right) - 2\cos\left(\frac{3}{4}x\right) > 1 + 2\cos x$ . (2 marks)

24. A particle was moving along a straight line. The acceleration of the particle after  $t$  seconds was given by  $(4t - 13) \text{ ms}^{-2}$ . The initial velocity of the particle was  $18 \text{ ms}^{-1}$ .

(a) Determine the value of  $t$  when the particle is momentarily at rest. (5 marks)

(b) Find the distance covered by the particle between the time  $t = 1$  second and  $t = 3$  seconds. (5 marks)

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