

3.3 MATHEMATICS (121 AND 122)

3.3.1 Mathematics Alt.A Paper 1 (121/1)

SECTION I (50 marks)

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

1 Evaluate $\frac{22 - 14}{6 \times 2} - \frac{4^2 \times 6 - 12}{72 \div 8 \times 3}$. (2 marks)

2 The production of milk, in litres, of 14 cows on a certain day was recorded as follows: 22, 26, 15, 19, 20, 16, 27, 15, 19, 22, 21, 20, 22 and 28. Determine:

(a) the mode; (1 mark)

(b) the median. (2 marks)

3 Use logarithms, correct to 4 decimal places, to evaluate:

$$\sqrt[3]{\frac{1.794 \times 0.038}{1.243}}$$

(4 marks)

4 Simplify the expression:

$$\frac{16m^2 - 9n^2}{4m^2 - mn - 3n^2}$$

(3 marks)

5 A wholesaler sold a radio to a retailer making a profit of 20%. The retailer later sold the radio for Ksh 1 560 making a profit of 30%. Calculate the amount of money the wholesaler had paid for the radio. (3 marks)

6 A point P on the line AB shown below is such that $AP = \frac{2}{7} AB$. By construction locate P. (3 marks)



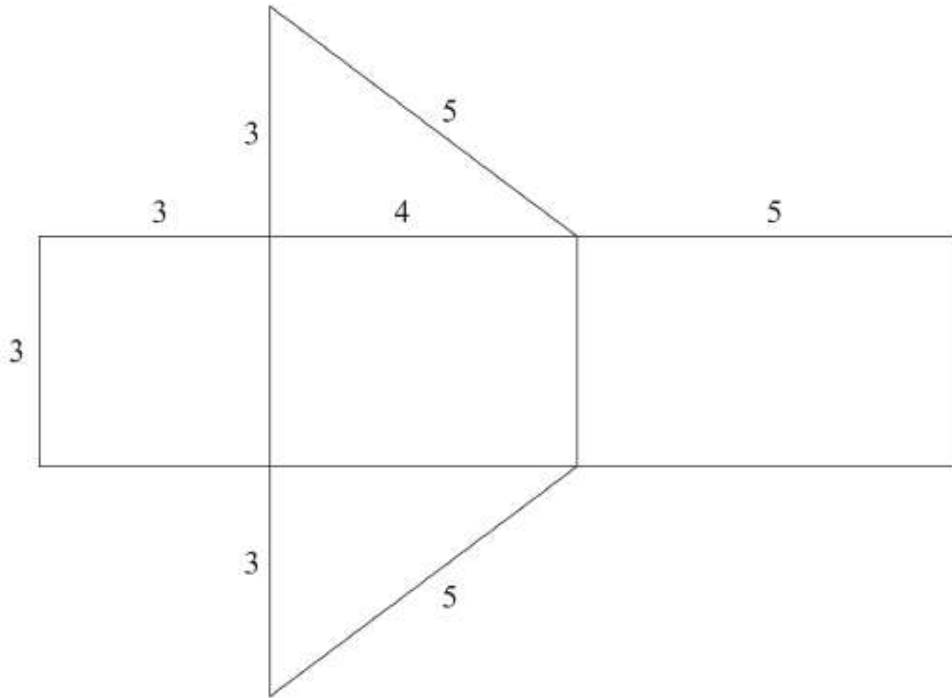
7 Chelimo's clock loses 15 seconds every hour. She sets the correct time on the clock at 0700h on a Monday. Determine the time shown on the clock when the correct time was 1900h on Wednesday the same week. (3 marks)

8 Given that $\sin(x + 20)^\circ = -0.7660$, find x , to the nearest degree, for $0^\circ \leq x \leq 360^\circ$. (3 marks)

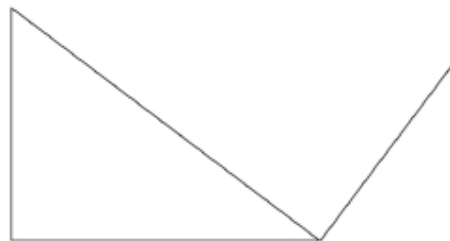
- 9 A number m is formed by writing all the prime numbers between 0 and 10 in an ascending order. Another number n is formed by writing all the square numbers between 0 and 10 in a descending order.

- (a) Find $m - n$; (2 marks)
 (b) Express $(m - n)$ as a product of its prime factors. (1 mark)

- 10 The figure below shows a net of a solid. (Measurements are in centimetres).

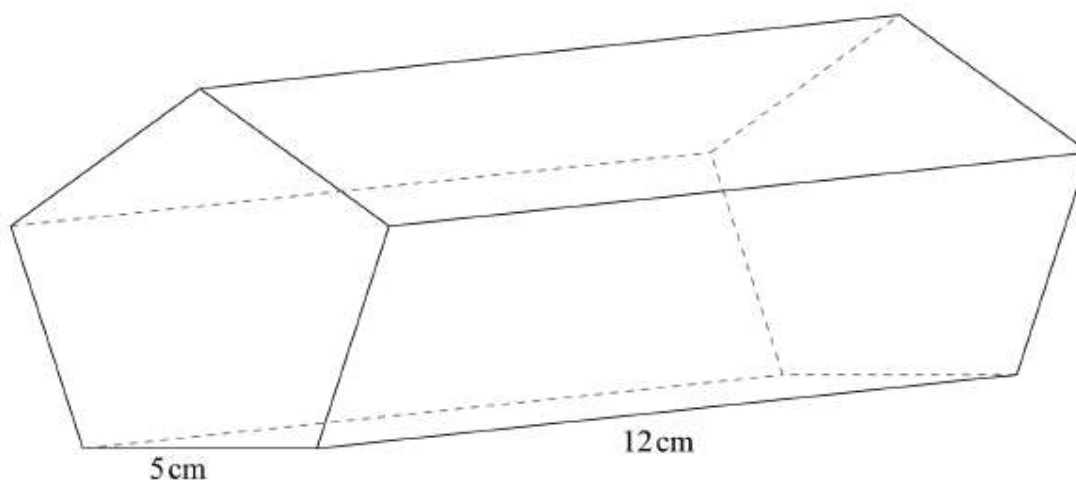


- Below is a part of the sketch of the solid whose net is shown above. Complete the sketch of the solid, showing the hidden edges with broken lines. (3 marks)



- 11 The interior angles of an octagon are $2x$, $\frac{1}{2}x$, $(x + 40)^\circ$, 110° , 135° , 160° , $(2x + 10)^\circ$ and 185° . Find the value of x . (2 marks)
- 12 A straight line passes through points $(-2, 1)$ and $(6, 3)$. Find:
- (a) the equation of the line in the form $y = mx + c$; (2 marks)
 (b) the gradient of a line perpendicular to the line in (a). (1 mark)

- 13 A triangle ABC is such that $AB = 5$ cm, $BC = 6$ cm and $AC = 7$ cm.
- (a) Calculate the size of angle ACB, correct to 2 decimal places. (2 marks)
- (b) A perpendicular drawn from A meets BC at N. Calculate the length AN correct to one decimal place. (2 marks)
- 14 A cylindrical pipe $2\frac{1}{2}$ metres long has an internal diameter of 21 millimetres and an external diameter of 35 millimetres. The density of the material that makes the pipe is 1.25 g/cm³. Calculate the mass of the pipe in kilograms. (Take $\pi = \frac{22}{7}$). (4 marks)
- 15 The figure below represents a pentagonal prism of length 12 cm. The cross-section is a regular pentagon of side 5 cm.



Calculate the surface area of the prism correct to 4 significant figures. (4 marks)

- 16 Given the inequalities $x - 5 \leq 3x - 8 < 2x - 3$.
- (a) Solve the inequalities; (2 marks)
- (b) represent the solution on a number line. (1 mark)

SECTION II (50 marks)

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

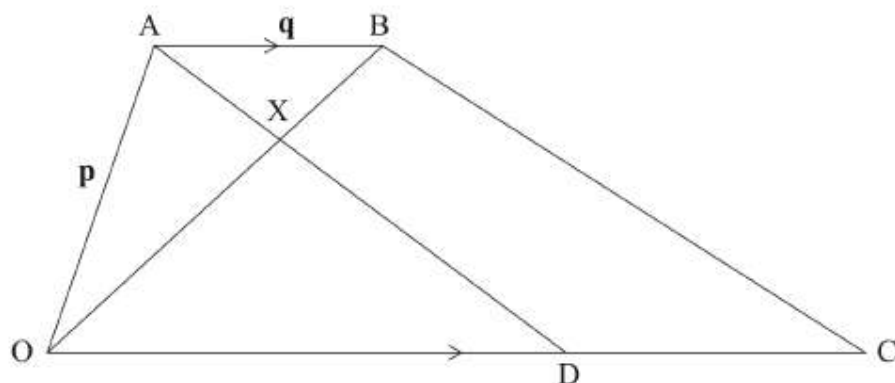
- 17 A farmer had 540 bags of maize each having a mass of 112 kg. After drying the maize, the mass decreased in the ratio 15:16.
- (a) Calculate the total mass lost after the maize was dried. (3 marks)

- (b) A trader bought and repacked the dried maize in 90 kg bags. He transported the maize in a lorry which could carry a maximum of 120 bags per trip.
- Determine the number of trips the lorry made. (3 marks)
 - The buying price of a 90 kg bag of maize was Ksh 1 500. The trader paid Ksh 2 500 per trip to transport the maize to the market. He sold the maize and made a profit of 26%. Calculate the selling price of each bag of the maize. (4 marks)
- 18** (a) Solve the equation, $\frac{x+3}{24} = \frac{1}{x-2}$. (4 marks)
- (b) The length of a floor of a rectangular hall is 9 m more than its width. The area of the floor is 136 m².
- Calculate the perimeter of the floor. (4 marks)
 - A rectangular carpet is placed on the floor of the hall leaving an area of 64 m². If the length of the carpet is twice its width, determine the width of the carpet. (2 marks)
- 19** A trader bought 2 cows and 9 goats for a total of Ksh 98 200. If she had bought 3 cows and 4 goats she would have spent Ksh 2 200 less.
- Form two equations to represent the above information. (2 marks)
 - Use matrix method to determine the cost of a cow and that of a goat. (4 marks)
 - The trader later sold the animals she had bought making a profit of 30% per cow and 40% per goat.
 - Calculate the total amount of money she received. (2 marks)
 - Determine, correct to 4 significant figures, the percentage profit the trader made from the sale of the animals. (2 marks)
- 20** Two towns, A and B are 80 km apart. Juma started cycling from town A to town B at 10.00 am at an average speed of 40 km/h. Mutuku started his journey from town B to town A at 10.30 am and travelled by car at an average speed of 60 km/h.
- Calculate:
 - the distance from town A when Juma and Mutuku met; (5 marks)
 - the time of the day when the two met. (2 marks)
 - Kamau started cycling from town A to town B at 10.21 am. He met Mutuku at the same time as Juma did. Determine Kamau's average speed. (3 marks)

21 The displacement, s metres, of a moving particle from a point O , after t seconds is given by,
 $s = t^3 - 5t^2 + 3t + 10$.

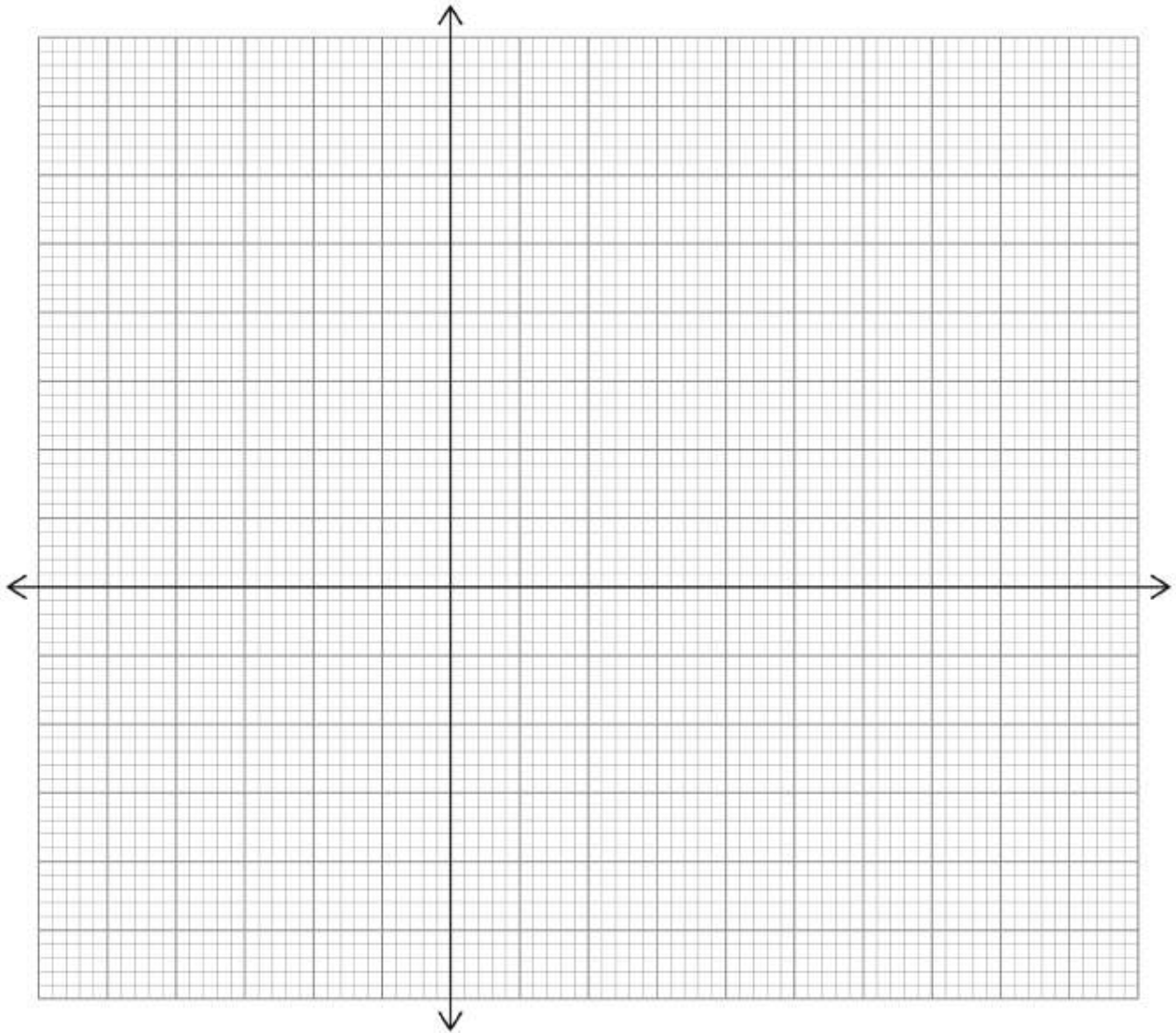
- (a) Find s when $t = 2$. (2 marks)
- (b) Determine:
- (i) the velocity of the particle when $t = 5$ seconds; (3 marks)
- (ii) the value of t when the particle is momentarily at rest. (3 marks)
- (c) Find the time, when the velocity of the particle is maximum. (2 marks)

22 In the figure below, $OABC$ is a trapezium. AB is parallel to OC and $OC = 5AB$. D is a point on OC such that $OD:DC = 3:2$.



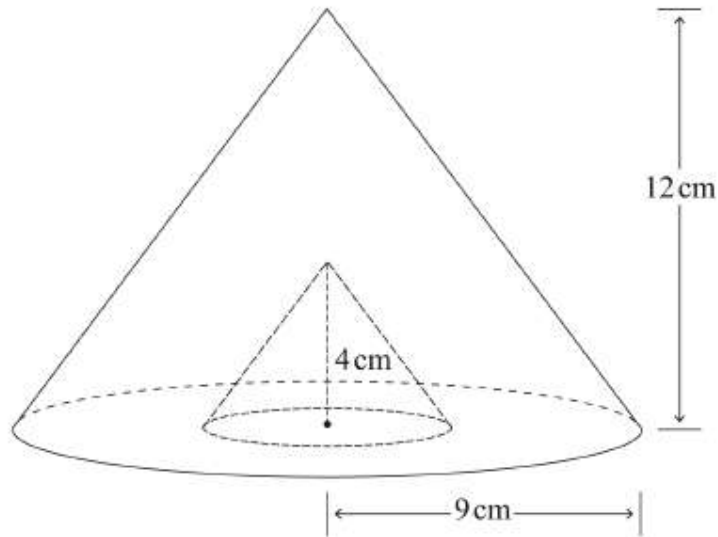
- (a) Given that $\mathbf{OA} = \mathbf{p}$ and $\mathbf{AB} = \mathbf{q}$, express in terms of \mathbf{p} and \mathbf{q} :
- (i) \mathbf{OB} ; (1 mark)
- (ii) \mathbf{AD} ; (2 marks)
- (iii) \mathbf{CB} . (2 marks)
- (b) Lines OB and AD intersect at point X such that $\mathbf{AX} = k\mathbf{AD}$ and $\mathbf{OX} = r\mathbf{OB}$, where k and r are scalars. Determine the values of k and r . (5 marks)

- 23 (a) On the grid provided, draw the square whose vertices are A (6, -2), B (7, -2), C (7, -1) and D (6, -1). (1 mark)



- (b) On the same grid, draw:
- (i) $A'B'C'D'$, the image of ABCD, under an enlargement scale factor 3, centre (9, -4); (3 marks)
 - (ii) $A''B''C''D''$, the image of $A'B'C'D'$ under a reflection in the line $x = 0$; (2 marks)
 - (iii) $A'''B'''C'''D'''$, the image of $A''B''C''D''$ under a rotation of $+90^\circ$ about (0,0). (2 marks)
- (c) Describe a single transformation that maps $A'B'C'D'$ onto $A'''B'''C'''D'''$. (2 marks)

- 24 The figure below represents a cone of height 12 cm and base radius of 9 cm from which a similar smaller cone is removed, leaving a conical hole of height 4 cm.



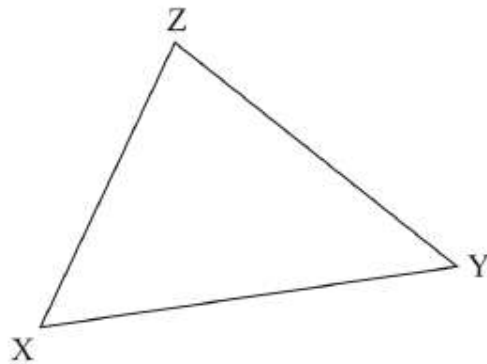
- (a) Calculate:
- (i) the base radius of the conical hole; (2 marks)
 - (ii) the volume, in terms of π , of the smaller cone that was removed. (2 marks)
- (b) (i) Determine the slant height of the original cone. (1 mark)
- (ii) Calculate, in terms of π , the surface area of the remaining solid after the smaller cone is removed. (5 marks)

3.3.2 Mathematics Alt. A Paper 2 (121/2)

SECTION I (50 marks)

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

- 1 The sum of n terms of the sequence; 3, 9, 15, 21, ... is 7500. Determine the value of n . (3 marks)
- 2 A quadratic curve passes through the points $(-2, 0)$ and $(1, 0)$. Find the equation of the curve in the form $y = ax^2 + bx + c$, where a , b and c are constants. (2 marks)
- 3 Make d the subject of the formula,
- $$P = \frac{1}{2}mn^2 - \frac{qd^2}{n}$$
- (3 marks)
- 4 Solve the equation
- $$2 \log x - \log (x - 2) = 2 \log 3.$$
- (3 marks)
- 5 (a) Using a pair of compasses and ruler only, construct an escribed circle to touch side XZ of triangle XYZ drawn below. (3 marks)



- (b) Measure the radius of the circle. (1 mark)
- 6 The equation of a circle is given by $x^2 + 4x + y^2 - 2y - 4 = 0$. Determine the centre and radius of the circle. (3 marks)
- 7 (a) Expand $(1 - x)^5$. (1 mark)
- (b) Use the expansion in (a) up to the term in x^3 to approximate the value of $(0.98)^5$. (2 marks)
- 8 The position vectors of points F, G and H are \mathbf{f} , \mathbf{g} and \mathbf{h} respectively. Point H divides FG in the ratio 4:–1. Express \mathbf{h} in terms of \mathbf{f} and \mathbf{g} . (2 marks)

- 9 Two machines, M and N produce 60% and 40% respectively of the total number of items manufactured in a factory. It is observed that 5% of the items produced by machine M are defective while 3% of the items produced by machine N are defective. If an item is selected at random from the factory, find the probability that it is defective. (3 marks)
- 10 Two taps A and B can each fill an empty tank in 3 hours and 2 hours respectively. A drainage tap R can empty the full tank in 6 hours. Taps A and R are opened for 5 hours then closed.
- (a) Determine the fraction of the tank that is still empty. (2 marks)
- (b) Find how long it would take to fill the remaining fraction of the tank if all the three taps are opened. (2 marks)
- 11 Simplify the expression $\frac{\sqrt{48}}{\sqrt{5} + \sqrt{3}}$, leaving the answer in the form $a\sqrt{b} + c$ where a, b and c are integers. (3 marks)
- 12 A point P moves inside a sector of a circle, centre O, and chord AB such that $2\text{ cm} < OP \leq 3\text{ cm}$ and angle APB = 65° . Draw the locus of P. (4 marks)
- 13 The table below shows income tax rates in a certain year.

Monthly income in Kenya shillings	Tax rate in each shilling
Up to 9 680	10%
from 9 681 to 18 800	15%
from 18 801 to 27 920	20%
from 27 921 to 37 040	25%
over 37 040	30%

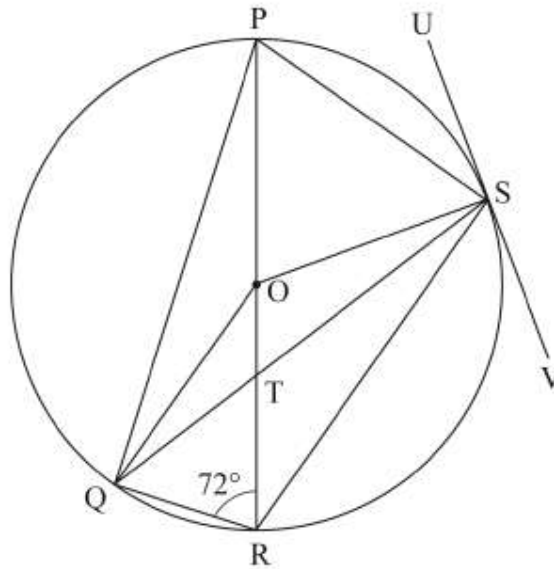
- In that year, a monthly personal tax relief of Ksh 1 056 was allowed. Calculate the monthly income tax paid by an employee who earned a monthly salary of Ksh 32 500. (4 marks)
- 14 Solve the equation $6 \cos^2 x + 7 \sin x - 8 = 0$ for $0^\circ \leq x \leq 90^\circ$. (4 marks)
- 15 The positions of two towns are ($2^\circ\text{S}, 30^\circ\text{E}$) and ($2^\circ\text{S}, 37.4^\circ\text{E}$). Calculate, to the nearest km, the shortest distance between the two towns. (Take the radius of the earth to be 6 370 km) (2 marks)
- 16 The vertices of a triangle T are A(1, 2), B(4, 2) and C(3, 4). The vertices of triangle T', the image of T are $A'(\frac{1}{2}, 1)$, $B'(2, 1)$ and $C'(\frac{3}{2}, 2)$. Determine the transformation matrix $M = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ that maps T onto T'. (3 marks)

SECTION II (50 marks)

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

- 17** The Hire Purchase (H.P.) price of a public address system was Ksh 276 000. A deposit of Ksh 60 000 was paid followed by 18 equal monthly instalments. The cash price of the public address system was 10% less than the H.P. price.
- (a) Calculate:
- (i) the monthly instalment; (2 marks)
- (ii) the cash price. (2 marks)
- (b) A customer decided to buy the system in cash and was allowed a 5% discount on the cash price. He took a bank loan to buy the system in cash. The bank charged compound interest on the loan at the rate of 20% p.a. The loan was repaid in 2 years. Calculate the amount repaid to the bank by the end of the second year. (3 marks)
- (c) Express as a percentage of the Hire Purchase price, the difference between the amount repaid to the bank and the Hire Purchase price. (3 marks)

- 18** In the figure below, PR is a diameter of the circle centre O. Points P, Q, R and S are on the circumference of the circle. Angle PRQ = 72°, QS = QP and line USV is a tangent to the circle at S.



Giving reasons, calculate the size of:

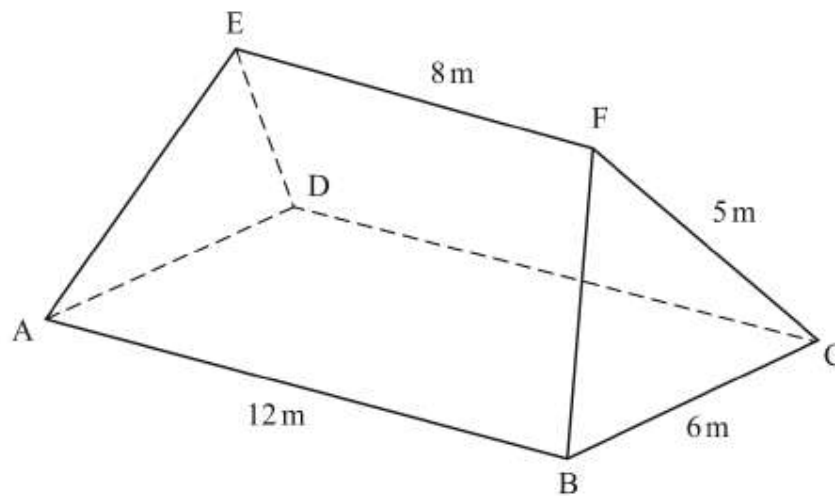
- (a) $\angle QPR$; (2 marks)
- (b) $\angle PQS$; (2 marks)
- (c) $\angle OQS$; (2 marks)
- (d) $\angle RTS$; (2 marks)
- (e) $\angle RSV$. (2 marks)

- 19 (a) Complete the table below for $y = x^3 + 4x^2 - 5x - 5$. (2 marks)

x	-5	-4	-3	-2	-1	0	1	2
$y = x^3 + 4x^2 - 5x - 5$			19			-5		

- (b) On the grid provided, draw the graph of $y = x^3 + 4x^2 - 5x - 5$ for $-5 \leq x \leq 2$. (3 marks)
- (c) (i) Use the graph to solve the equation $x^3 + 4x^2 - 5x - 5 = 0$. (2 marks)
- (ii) By drawing a suitable straight line on the graph, solve the equation $x^3 + 4x^2 - 5x - 5 = -4x - 1$. (3 marks)

- 20 The figure ABCDEF below represents a roof of a house. $AB = DC = 12$ m, $BC = AD = 6$ m, $AE = BF = CF = DE = 5$ m and $EF = 8$ m.



- (a) Calculate, correct to 2 decimal places, the perpendicular distance of EF from the plane ABCD. (3 marks)
- (b) Calculate the angle between:
- (i) the planes ADE and ABCD; (2 marks)
- (ii) the line AE and the plane ABCD, correct to 1 decimal place; (2 marks)
- (iii) the planes ABFE and DCFE, correct to 1 decimal place. (3 marks)

- 21 (a) Complete the table below, giving the values correct to 1 decimal place. (2 marks)

x°	0	40	80	120	160	200	240
$2 \sin (x + 20)^\circ$	0.7		2.0		0.0		- 2.0
$\sqrt{3} \cos x$	1.7	1.3		- 0.9		- 1.6	

- (b) On the grid provided, using the same scale and axes, draw the graphs of $y = 2 \sin (x + 20)^\circ$ and $y = \sqrt{3} \cos x$ for $0^\circ \leq x \leq 240^\circ$. (5 marks)
- (c) Use the graphs drawn in (b) above to determine:
- (i) the values of x for which $2 \sin (x + 20) = \sqrt{3} \cos x$; (2 marks)
- (ii) the difference in the amplitudes of $y = 2 \sin (x + 20)$ and $y = \sqrt{3} \cos x$. (1 mark)

- 22 Three quantities R, S and T are such that R varies directly as S and inversely as the square of T.

- (a) Given that $R = 480$ when $S = 150$ and $T = 5$, write an equation connecting R, S and T. (4 marks)
- (b) (i) Find the value of R when $S = 360$ and $T = 1.5$. (2 marks)
- (ii) Find the percentage change in R if S increases by 5% and T decreases by 20%. (4 marks)

- 23 The equation of a curve is given by $y = 5x - \frac{1}{2}x^2$.

- (a) On the grid provided, draw the curve of $y = 5x - \frac{1}{2}x^2$ for $0 \leq x \leq 6$. (3 marks)
- (b) By integration, find the area bounded by the curve, the line $x = 6$ and the x-axis. (3 marks)
- (c) (i) On the same grid as in (a), draw the line $y = 2x$. (1 mark)
- (ii) Determine the area bounded by the curve and the line $y = 2x$. (3 marks)

24 The table below shows marks scored by 42 students in a test.

35	49	69	57	58	75	48
40	46	86	47	81	67	63
56	80	36	62	49	46	26
41	58	68	73	65	59	72
64	70	64	54	74	33	51
73	25	41	61	56	57	28

- (a) Starting with the mark of 25 and using equal class intervals of 10, make a frequency distribution table. (2 marks)
- (b) On the grid provided, draw the ogive for the data. (4 marks)
- (c) Using the graph in (b) above, estimate:
- (i) the median mark; (2 marks)
 - (ii) the upper quartile mark. (2 marks)

3.3.3 Mathematics Alt. B Paper 1 (122/1)

SECTION I (50 marks)

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

1 Without using a calculator, evaluate:

$$-3(-5 - +7) \div +2(-3 + -6). \quad (3 \text{ marks})$$

2 The first four prime numbers are written in descending order to form a number.

(a) Write down the number. (1 mark)

(b) Find the total value of the hundreds digit in the number. (1 mark)

3 Without using a calculator evaluate:

$$\frac{\frac{2}{3} \text{ of } 5\frac{2}{5} - 2\frac{3}{10}}{\frac{3}{5} \div 4\frac{1}{2} + 1\frac{3}{5}} \quad (3 \text{ marks})$$

4 Tito owned Ksh 600 to Nekesa, Ksh 750 to Mwitwa and Ksh 650 to Auma. He had Ksh 1200 to repay to the three people in proportion to what he owed them. Calculate the amount of money Mwitwa received more than Nekesa. (3 marks)

5 Given that $r = 2$ and $h = 3r - 1$, evaluate $\frac{7r^2 + 2rh}{\sqrt{4h - 2r}}$. (3 marks)

6 The surface area of a cube is 1176 cm^2 . Determine the length of one of its sides. (3 marks)

7 By construction, divide the line PQ below into six equal parts. (3 marks)



8 Given that $\tan x = \frac{3}{4}$ and x is an acute angle, without using mathematical tables or a calculator, find the value of $2 \sin x - \cos x$. (3 marks)

9 A box contains five shillings coins and ten shillings coins. The number of ten shillings coins are 6 times as many as the five shillings coins. The total value of all the coins in the box is Ksh 2600. Determine the total number of coins in the box. (4 marks)

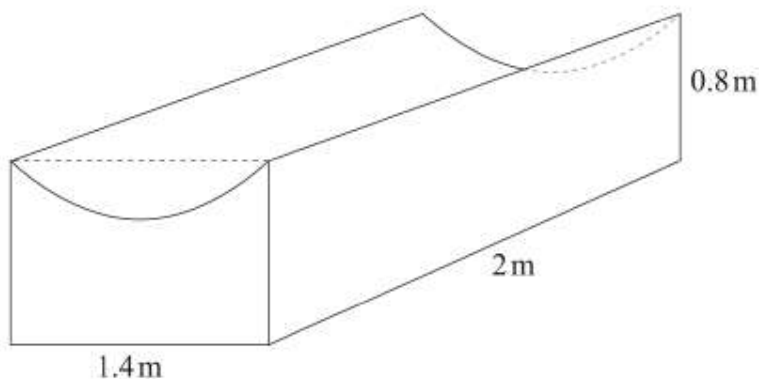
10 Simplify $\frac{3^{-2} \times 81^{\frac{3}{2}}}{4^{-3} \div 8^{\frac{1}{3}}}$, leaving your answer in index form. Hence evaluate the expression. (4 marks)

- 11 A retailer bought a mobile phone for Ksh 5750. The marked price at the retailer's shop was 12% higher than the buying price. After allowing a certain discount, the retailer sold the mobile phone for Ksh 6118. Calculate the percentage discount. (3 marks)
- 12 Factorise $9a^2 - \frac{16}{b^2c^2}$ (2 marks)
- 13 Three types of books A, B and C were each piled on a table to attain the same height. The thickness of the books were 12 mm, 28 mm and 54 mm for types A, B and C respectively. Find:
- (a) the least height attained; (3 marks)
- (b) the number of type A books piled. (1 mark)
- 14 The sum of the interior angles of a regular polygon is 1260° . Find the size of each interior angle. (3 marks)
- 15 The corresponding lengths of two similar triangles are 5 cm and 7.5 cm. If the area of the larger triangle is 22.5 cm^2 , calculate the area of the smaller triangle. (3 marks)
- 16 The area of a sector of a circle is 77 cm^2 . The arc of the sector subtends an angle of 45° at the centre of the circle. Find the circumference of the circle. (Take $\pi = \frac{22}{7}$). (4 marks)

SECTION II (50 marks)

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

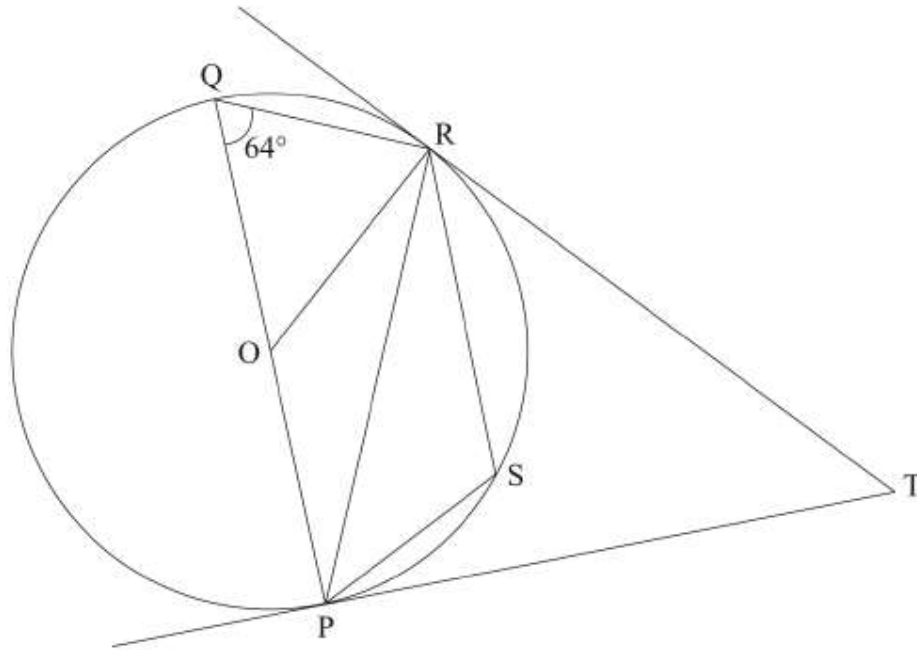
- 17 The figure below represents a solid prism with a semi-circular groove. The dimensions are as shown.



- (a) Calculate:
- (i) the volume of the prism; (4 marks)
- (ii) the total surface area of the prism. (4 marks)
- (b) All the rectangular faces are painted. Calculate the percentage of the surface of the prism that is painted correct to 1 decimal place. (2 marks)

- 18** (a) Three vertices of a parallelogram ABCD are A(-7, 3), B(1, -1) and C(5, 1). On the grid provided, draw the parallelogram ABCD. (2 marks)
- (b) Determine:
- (i) the gradient of the line AB; (2 marks)
- (ii) the equation of line AB in the form $y = mx + c$, where m and c are constants. (2 marks)
- (c) Another line L is perpendicular to CD and passes through point (1, 3). Determine:
- (i) the equation of L in the form $ax + by = c$ where a , b and c are constants; (3 marks)
- (ii) the coordinates of the y-intercept of line L. (1 mark)
- 19** (a) The roots of a quadratic equation are $\frac{1}{2}$ and -1 . Write down the quadratic equation in the form $ax^2 + bx + c = 0$, where a , b and c are integers. (3 marks)
- (b) (i) Barasa bought $(2y + 1)$ mangoes at y shillings each. The total cost of the mangoes was Ksh 55. Find the cost of each mango. (4 marks)
- (ii) Karau spent Ksh 95 more than Barasa to buy the same type of mangoes. For every 6 mangoes he bought, he was given one extra mango. Calculate the total number of mangoes Karau got. (3 marks)
- 20** The angle of elevation of the top T, of a vertical mast from a point P, 100 m away from the foot F, of the mast is 14° .
- (a) Using a scale of 1 cm to represent 10 m, make a scale drawing to represent the above information. (3 marks)
- (b) Using the scale drawing, determine the height of the mast. (2 marks)
- (c) A support cable, 27 m long, is fixed tightly at a point D on the mast 5 m below T and at a point C on the ground. Points P, F and C lie on a straight line with P and C on opposite sides of F. On the scale drawing, show the position of the cable. (2 marks)
- (d) Use the scale drawing to determine:
- (i) the angle of depression of C from D; (1 mark)
- (ii) the distance of C from P. (2 marks)

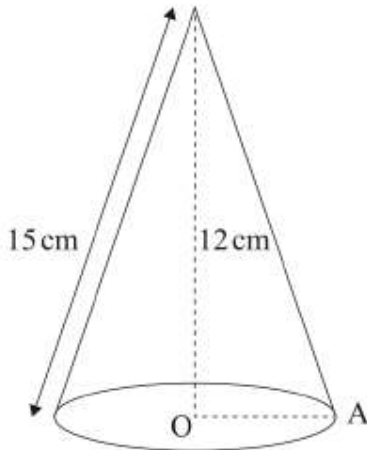
- 21 In the figure below, P, Q, R and S are points on the circumference of the circle centre O. TP and TR are tangents to the circle at P and R respectively. POQ is a diameter of the circle and angle PQR = 64° .



Giving reasons in each case, find the size of:

- | | |
|--------------------|-----------|
| (a) $\angle ROP$; | (2 marks) |
| (b) $\angle PSR$; | (2 marks) |
| (c) $\angle ORP$; | (2 marks) |
| (d) $\angle TRP$; | (2 marks) |
| (e) $\angle RTP$. | (2 marks) |

- 22 The figure below represents a cone whose vertical height is 12 cm and slant height is 15 cm.



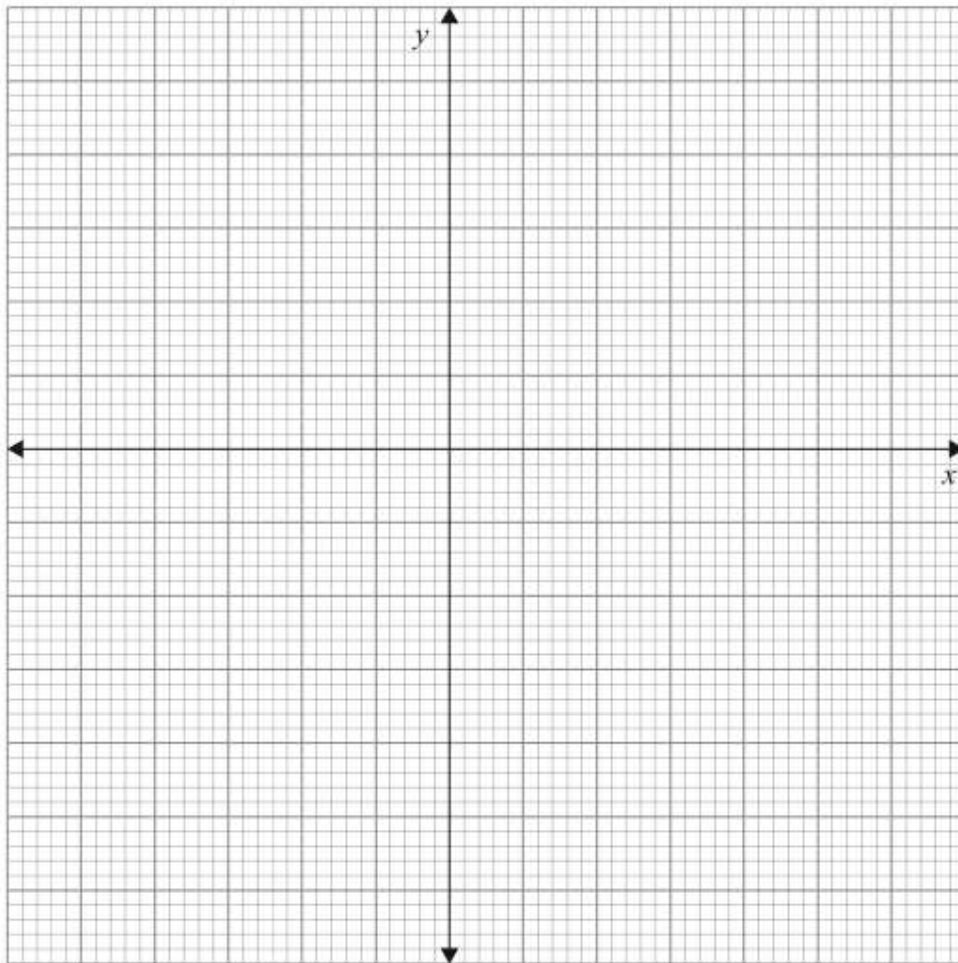
- (a) Calculate:
- (i) the radius, OA , of the cone; (2 marks)
 - (ii) the volume of the cone. (2 marks)
- (b) A smaller cone of radius 6 cm is cut off from the cone above to leave a frustum. Calculate:
- (i) the height of the smaller cone; (2 marks)
 - (ii) the volume of the smaller cone; (2 marks)
 - (iii) the volume of the frustum. (2 marks)

23 The vertices of a trapezium ABCD are A(2, 0), B(4, 0), C(6, 2) and D(2, 2).

(a) On the grid provided below, draw:

(i) the trapezium ABCD;

(1 mark)



(ii) $A'B'C'D'$ the image of ABCD under a reflection in the line $y = -x$; (2 marks)

(iii) $A''B''C''D''$ the image of $A'B'C'D'$ under a rotation of -90° , centre $(0, 0)$. (2 marks)

(b) Describe a transformation that maps $A''B''C''D''$ onto ABCD. (2 marks)

(c) State pairs of trapezia that are directly congruent and those that are oppositely congruent. (3 marks)

- 24** A racing motorcycle started from rest and moved with a constant acceleration of 1 m/s^2 for 15 seconds. It then accelerated at 3.5 m/s^2 for the next 10 seconds and maintained a constant speed for the next 10 seconds. It decelerated constantly and came to rest after 25 seconds.
- (a) On the grid provided, draw the velocity–time graph for the motorcycle. (4 marks)
- (b) Use the graph to determine:
- (i) the deceleration of the motorcycle; (2 marks)
 - (ii) the total distance travelled; (2 marks)
 - (iii) the average speed for the motorcycle, correct to 3 significant figures. (2 marks)

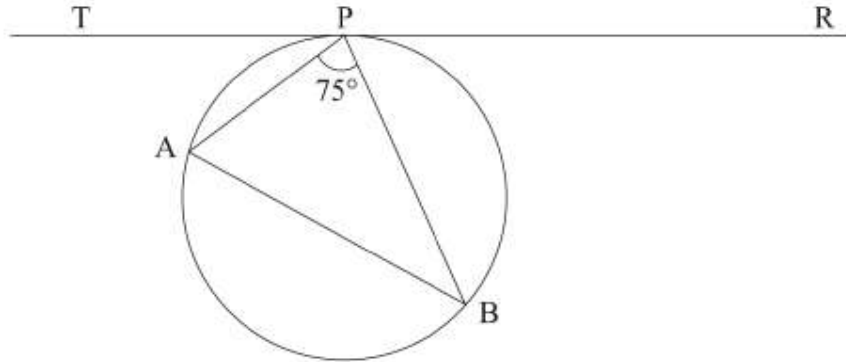
3.3.4 Mathematics Alt. B Paper 2 (122/2)

SECTION I (50 marks)

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

- 1 Round off each of the numbers in the expression $\frac{4.957}{0.2628 - 0.0149}$ to 3 significant figures, hence evaluate the expression. (2 marks)
- 2 Given the matrices $\mathbf{A} = \begin{pmatrix} 2 & 4 \\ 3 & 0 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 2 & 3 \\ 1 & 1 \end{pmatrix}$, find $\mathbf{AB} - 5\mathbf{B}$. (3 marks)
- 3 Three types of coffee, A, B and C are mixed such that $A:B = 4:3$ and $B:C = 1:2$. Determine the mass of type C in a mixture of 52 kg. (3 marks)
- 4 In a Geometric Progression (G.P), the 4th term is 24, and the 6th term is 96. Determine:
- (a) the common ratio of the G.P; (2 marks)
- (b) the first term of the G.P. (2 marks)
- 5 Two fair dice are rolled together and the sum of the numbers showing on the top faces noted.
- (a) Represent all the possible outcomes in a probability space. (2 marks)
- (b) Determine the probability that the sum is greater than 6 but less than 10. (1 mark)
- 6 Two points A and B are such that $\mathbf{OA} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$ and $\mathbf{AB} = \begin{pmatrix} 4 \\ 4 \end{pmatrix}$. M is a point on \mathbf{AB} such that $\mathbf{AM} : \mathbf{MB} = 3:1$.
- Determine:
- (a) \mathbf{OB} ; (2 marks)
- (b) the coordinates of M. (2 marks)

- 7 In the figure below, TPR is a tangent to the circle at P. Angle $APB = 75^\circ$ and angle BPR is twice angle APT.



Determine the size of angle BAP. (2 marks)

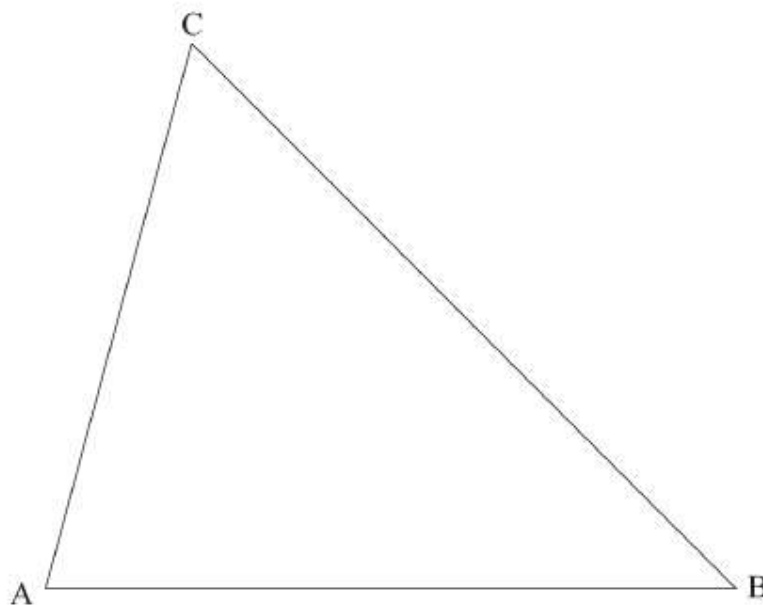
- 8 Given that $2 \cos(x - 30)^\circ = -0.9$, determine the value of x for $0^\circ \leq x \leq 180^\circ$ correct to 2 decimal places. (3 marks)

- 9 The vertices of a triangle RST are $R(1, 3)$, $S(1, 7)$ and $T(-1, 4)$. Triangle RST is mapped onto triangle $R'S'T'$ by transformation matrices $\mathbf{P} = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ followed by $\mathbf{Q} = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$.

Find the coordinates of $R'S'T'$. (3 marks)

- 10 Using the method of completing the square, solve the equation $2x^2 + 8x = 15$, correct to one decimal place. (3 marks)

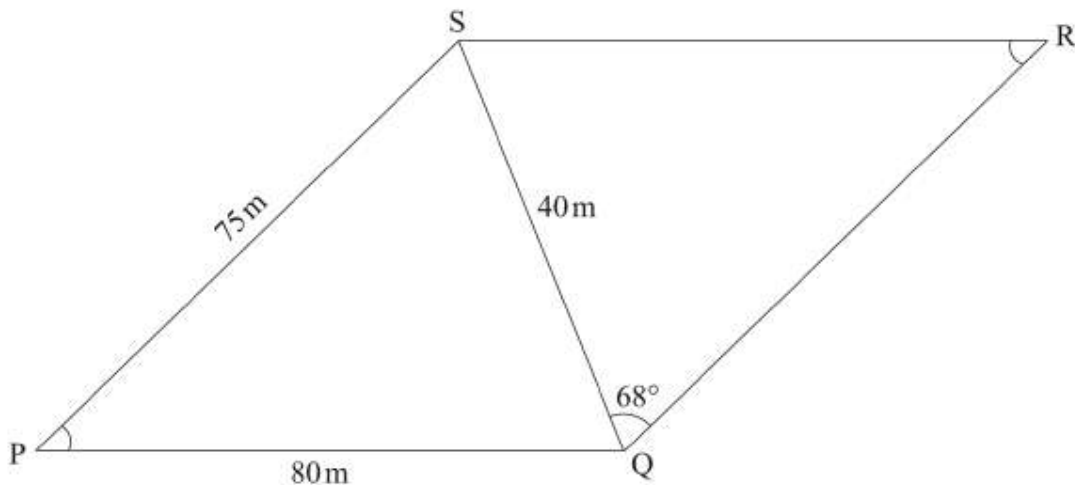
- 11 (a) Using a ruler and a pair of compasses only, construct an inscribed circle in triangle ABC given below. (2 marks)



- (b) Measure the radius of the circle. (1 mark)

- 12 In a camp, there was enough food to feed 2000 people on equal rations for 90 days. After 20 days 500 more people joined the camp. Calculate the number of days that the remaining food would be used to feed the people. (4 marks)

- 13 Figure PQRS below represents a garden in which, $PQ = 80\text{ m}$, $PS = 75\text{ m}$, $SQ = 40\text{ m}$, $\angle SQR = 68^\circ$ and $\angle SPQ = \angle SRQ$.



Calculate, to 2 significant figures, the length of SR. (3 marks)

- 14 The table below shows part of income tax rates in a certain year.

Monthly Income in Ksh	Tax Rate in each Shilling
Up to 10 164	10%
From 10 165 to 19 740	15%
From 19 741 to 29 316	20%

In a certain month of that year, Abdala's income was Ksh 21 820. He was entitled to a monthly personal tax relief of Ksh 1162. Calculate the income tax paid by Abdala that month. (4 marks)

- 15 Ali and Kinjo bought the same type of pencils and rubbers from the same shop. Ali bought 2 pencils and 3 rubbers for Ksh 66, Kinjo bought 7 pencils and 2 rubbers for Ksh 129. Find the cost of a pencil. (3 marks)

- 16 The table below shows marks scored by students in a mathematics test.

Marks	20 – 29	30 – 39	40 – 49	50 – 59	60 – 69	70 – 79	80 – 89	90 – 99
Number of students	4	6	8	10	9	7	4	2

On the grid provided below, draw an ogive to represent the data. (3 marks)

SECTION II (50 marks)

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

- 17** Kurao borrowed Ksh 300 000 from a financial institution. The institution charged compound interest at the rate of 18% per annum on the outstanding balance at the end of each year. At the end of the first and second years, he made equal repayments of Ksh 134 000. He repaid the remaining amount of money plus interest at the end of the third year.

Calculate:

- (a) the interest charged at the end of the first year; (2 marks)
- (b) the principal at the beginning of:
 - (i) the second year; (2 marks)
 - (ii) the third year. (2 marks)
- (c) the amount of money Kurao paid at the end of the third year. (2 marks)
- (d) the total interest charged on the loan. (2 marks)

- 18** (a) The n th term of a sequence is given by $U_n = n^2 - n + 3$

Determine:

- (i) the 10th term of the sequence; (2 marks)
 - (ii) the difference between the 30th and the 20th terms of the sequence; (2 marks)
 - (iii) the value of n given that $U_n = 243$. (3 marks)
- (b) In a research, it was found that the number of bacteria tripled every hour. Given that the number of bacteria at the start of a certain hour was 180:
- (i) write an expression for the number of bacteria after t hours; (1 mark)
 - (ii) determine the number of bacteria, to the nearest million, after 12 hours. (2 marks)

- 19** The time in minutes each student in a group took to solve a certain mathematics question is shown in the table below.

Time in Minutes	0 – 1	1 – 2	2 – 3	3 – 4	4 – 5	5 – 6	6 – 7	7 – 8
Number of students	2	4	3	5	8	6	5	3

- (a) State the modal class. (1 mark)
- (b) The above data was represented in a pie-chart, determine the angle that represented the number of students who answered the question in 4 – 5 minutes. (2 marks)

- (c) Calculate the mean time taken to solve the question. (4 marks)
- (d) On the grid provided, draw a bar graph to represent the data. (3 marks)

20 A curve is represented by the equation $y = -2x^2 + 7x - 3$.

- (a) Make a table of the values of x for: $-1 \leq x \leq 4$ and the corresponding values of y for the curve. (2 marks)
- (b) On the grid provided, draw the graph of $y = -2x^2 + 7x - 3$ for $-1 \leq x \leq 4$. (3 marks)
- (c) Use the graph to determine:
- (i) the roots of the equation $-2x^2 + 7x - 3 = 0$; (2 marks)
- (ii) the instantaneous rate of change of the curve at $x = 1$. (3 marks)

21 Four vectors are such that $\mathbf{OA} = -2\mathbf{i} + \mathbf{j}$, $\mathbf{OB} = 3\mathbf{i} + 5\mathbf{j}$, $\mathbf{OC} = -8\mathbf{i} - 12\mathbf{j}$ and $\mathbf{OD} = 2\mathbf{i} - 4\mathbf{j}$.

- (a) Express in terms of \mathbf{i} and \mathbf{j} , the vectors:
- (i) \mathbf{AB} ; (2 marks)
- (ii) \mathbf{CD} . (2 marks)
- (b) Determine the co-ordinates of the mid-point of \mathbf{AD} . (3 marks)
- (c) Calculate to 3 significant figures, the magnitude of \mathbf{BC} . (3 marks)

22 Two points P and Q lie on the equator. The position of P is (0° , 12° E) and that of Q is (0° , 60° W).
(Take the radius of the earth to be 6370 km and $\pi = \frac{22}{7}$).

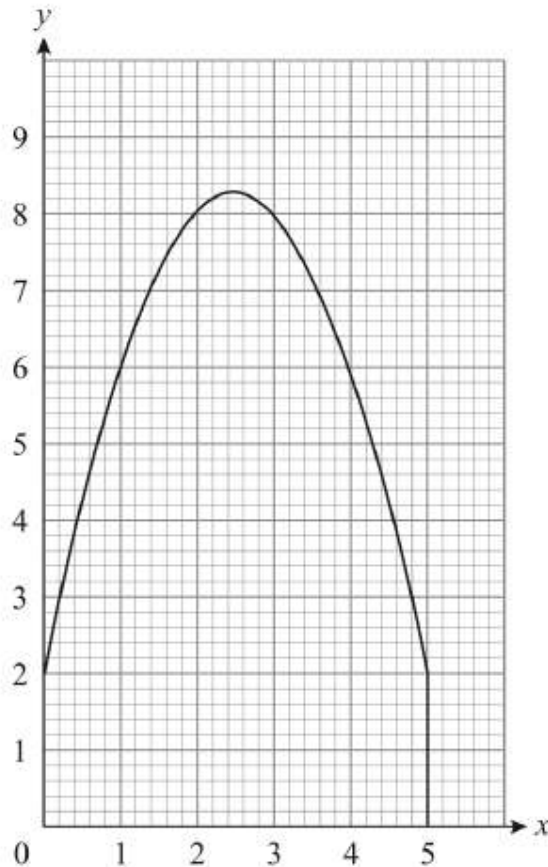
- (a) (i) Calculate the distance from P to Q in kilometres. (3 marks)
- (ii) Determine the local time at Q when the time is 9.00 pm at P. (3 marks)
- (b) A point T is due North of Q. An aeroplane flying from Q at 1001 km/h takes 2 h to reach T. Determine the position of T. (4 marks)

23 A relation connecting three variables R, C and T is such that R varies directly as the square of C and inversely as T. When $R = 30$, $C = 6$ and $T = 2.4$.

- (a) Find:
- (i) the constant of proportionality; (3 marks)
- (ii) the equation connecting R, C and T. (1 mark)

- (b) Given that $R = 40$ and $C = 8$, determine:
- (i) the value of T ; (2 marks)
 - (ii) the percentage change in R when C decreases by 10% and T increases by 8%. (4 marks)

- 24 In the figure below the area bounded by the curve, the y -axis, the x -axis and the line $x = 5$ represents a map of a piece of land.



- (a) Estimate the area of the map in cm^2 by:
- (i) the counting technique; (2 marks)
 - (ii) using the trapezium rule with 5 strips of equal width. (3 marks)
- (b) Given that the actual area of the map is $30\frac{5}{6} \text{ cm}^2$, calculate:
- (i) the percentage error, correct to 2 significant figures, when the trapezium rule is used to estimate the area of the map; (2 marks)
 - (ii) the actual area in hectares of the piece of land if the scale used was 1:12000. (3 marks)