3.2 MATHEMATICS ALT B (122)

In the year 2012 Mathematics Alt B was tested in two papers. **Paper 1 (122/1)** and **Paper 2 (122/2)**. Each paper consisted of two sections: Section 1 (50 marks) short answer questions of not more than four marks each and Section II (50 marks), a choice of eight questions of 10 marks each where candidates answer any five. Paper 1 (122/1) tested mainly Forms 1 and 2 work while Paper 2 (121/2) tested mainly forms 3 and 4 work of the syllabus.

This report is based on an analysis of performance of candidates who sat the year 2012 KCSE Mathematics Alt B.

3.2.1 CANDIDATES' GENERAL PERFORMANCE

Table 9: Candidates' Performance in Mathematics Alternative B in the years 2010 - 2012

Year	Paper	Candidature	Maximum score	Mean Score	Standard Deviation
2010	1 2	**1221**	100 100	20.40 17.96	16.85 15.91
2011	1 2 **Overall**	**1247**	100 100 **200**	12.11 14.65 **26.64**	12.75 15.43 **26.89**
2012	1 2 **Overall**	**1281**	100 100 **200**	9.27 9.77 **18.99**	12.48 13.48 **25.19**

From the table the following observations can be made:

(i) The subject registered a decline in performance when compared to the previous year's performance.

(ii) The mean score of the papers was quite low.

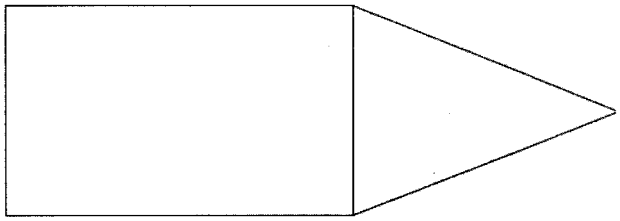
INDIVIDUAL QUESTION ANALYSIS

Mathematics Alt B has continued to have a dismal performance since its inception in 2010. With this kind of performance, most questions were poorly performed. The questions discussed below are those considered to be dismally performed.

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

Question 9

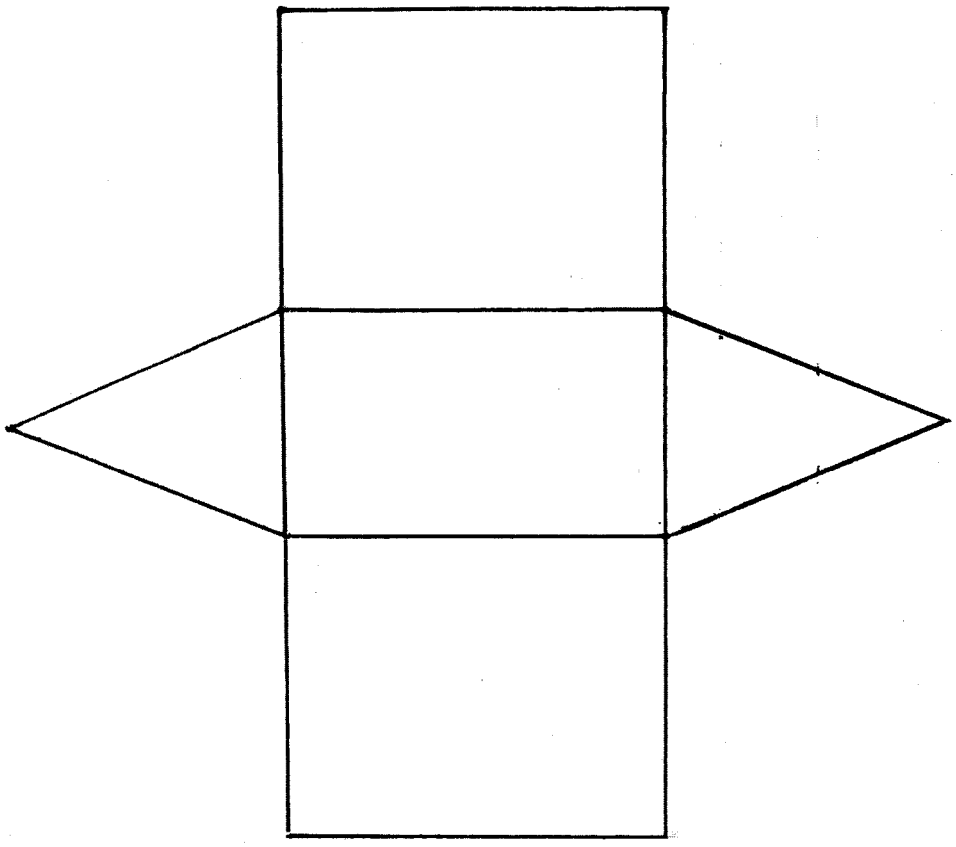
The figure below is part of a net of a triangular prism. Complete the net. (3 marks)



Weaknesses

Most candidates could not draw the net accurately. Some drew the nets of a rectangular pyramid

Expected response

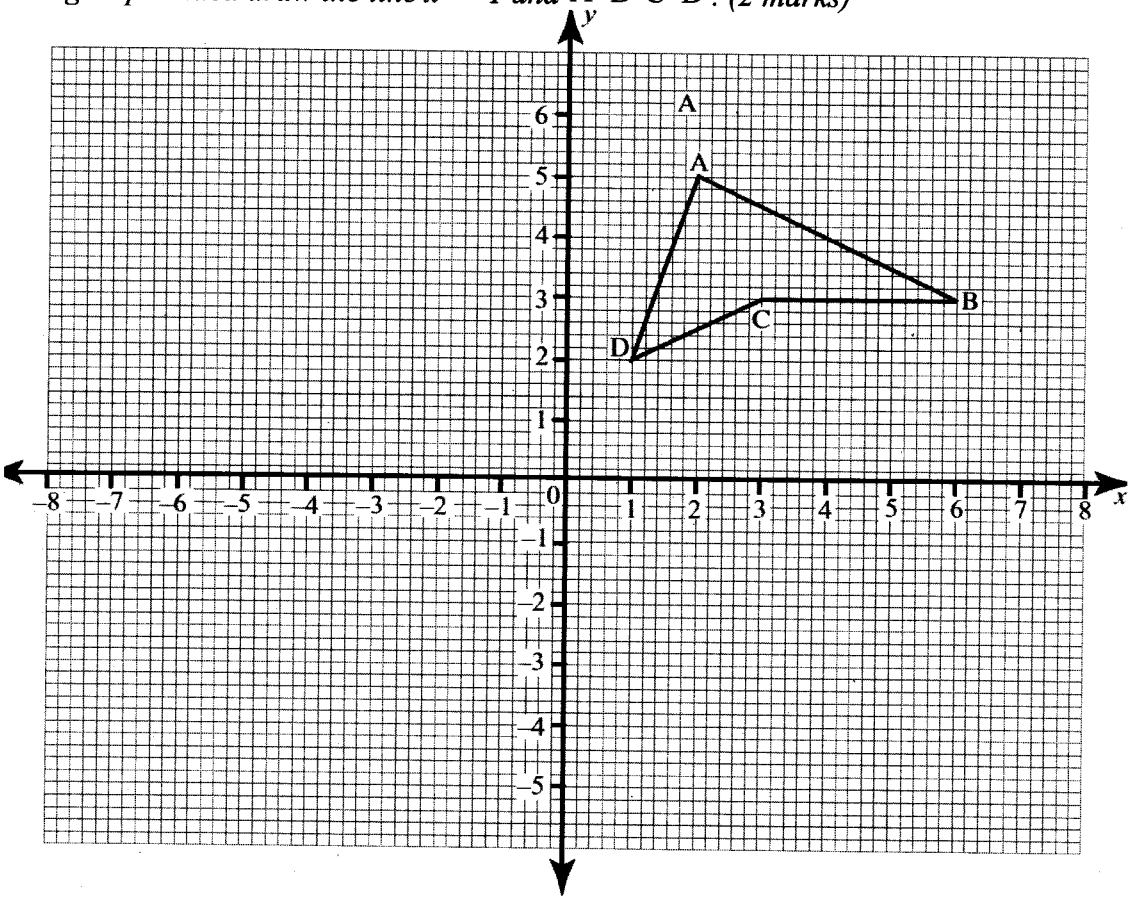


Advice to teachers

Teach different types of solids and their corresponding nets.

Question 11

Quadrilateral ABCD shown below, whose vertices are A (2, 5), B (6, 3), C (3, 3) and D (1, 2) is mapped onto A′ B′ C′ D′ *by a reflection in the line x = -1.*
(a) On the grid provided draw the line x = -1 and A′ B′ C′ D′. *(2 marks)*

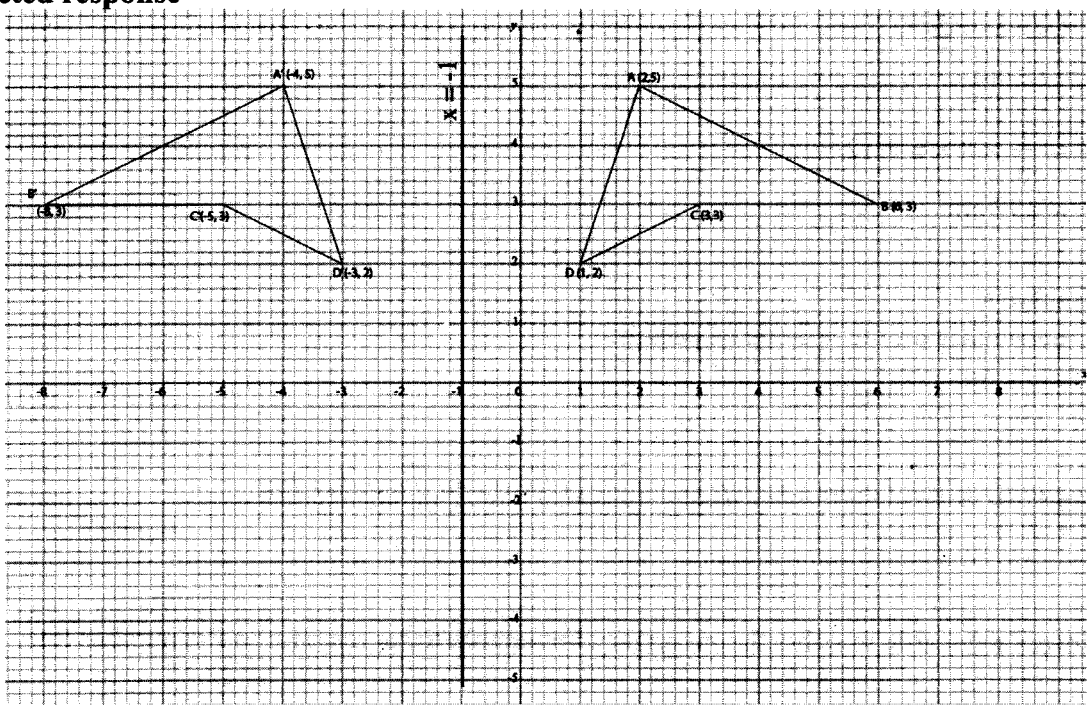


(b) State the type of congruence between quadrilateral ABCD and A′ B′ C′ D′. *(1 mark)*

Weaknesses

Many candidates could not draw the line x = -1 and instead drew y = -1. Majority also didn't know the type of congruence.

Expected response

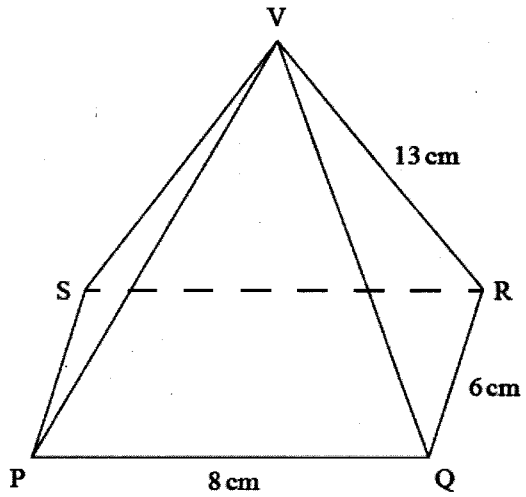


Advice to teachers

Give more exercises and help students differentiate between the lines x = a and y = b.

Question 14

The figure below represents a rectangular based pyramid VPQRS. PQ =8 cm, QR = 6 cm and VP= VQ = VR = VS = 13 cm.



Calculate:
(a) the vertical height of the pyramid; *(2 marks)*
(b) the volume of the pyramid. *(2 marks)*

Weaknesses

Candidates were unable to use the Pythagoras theorem to obtain the height of the pyramid, hence could not find the volume.

Expected response

(a) height $= \sqrt{13^2 - 5^2}$

$= 12$ cm

(b) volume $= \frac{1}{3} \times 8 \times 6 \times 12$

$= 192$ cm^3

Advice to teachers

Teach more thoroughly on the volume of prisms.

Question 15

Solve the inequality given below and represent the solution on a number line.

$-5x - 3 > 2x + 4$ *(2 marks)*

Weaknesses

Many candidates were able to solve the inequality but unable to represent it in the number line.

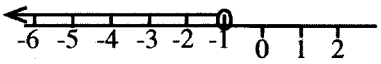
Expected response

$-5x - 3 > 2x + 4$

$-5x - 2x - 3 > 4$

$-7x > 7$

$x < -1$

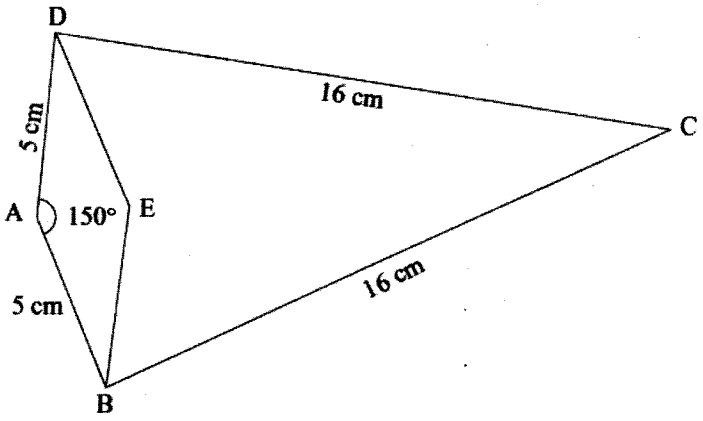


Advice to teachers

Teach more on the representation of the inequalities on the number line.

Question 18

The figure below shows a kite ABCD and a rhombus ABED. AB =AD = 5 cm, BC = DC = 16 cm and angle DAB = 150°.



Calculate:

(a) the area of the rhombus ABED; *(2 marks)*

(b) (i) the length of diagonal BD, correct to one decimal place; *(2 marks)*

(ii) the area of triangle BCD. *(3 marks)*

(c) the area of the kite ABCD. *(3 marks)*

Weaknesses

Calculation of the length BD was a challenge to most candidates

Expected response

a) $2 \times \frac{1}{2} \times 5 \times 5 \operatorname{Sin} 150^{\circ}$

$= 12.5 \text{ cm}^2$

b) (i) $\frac{\frac{1}{2}BD}{5} = \operatorname{Sin} 75^{\circ}$

$BD = 9.7$

(ii) Area of Δ BCD

$S = \frac{1}{2}(9.7 + 16 + 16) = 20.85$

$A = \sqrt{20.85(20.85 - 9.7)(20.85 - 16)^2}$

$= \sqrt{20.85 \times 11.15 \times (4.85)^2}$

$= 73.95$

c) Area of kite ABCD

$\frac{1}{2} \times 12.5 + 73.95$

$= 80.2 \text{ cm}^2$

Advice to teachers

Give more questions on application to trigonometry

Question 24

A room measuring 4x metres by (2x + 2) metres is to be carpeted leaving a uniform margin all around the walls. The dimensions of the carpet are (3x + 1) metres by 2x metres.

(a) Write an expression for the area of the carpet. *(1 mark)*

(b) If the area of the margin is 36 square metres, find:

(i) the value of x; *(3 marks)*

(ii) the area of the carpet. *(2 marks)*

(c) The carpet costs Ksh 1600 per square metre. The cost of transport and labour is 2.5% of the cost of the carpet. Calculate the total cost of carpeting the room. *(4 marks)*

Weaknesses

Candidates were unable to interpret the question to come up with the required quadratic equations

Expected response

a) $(3x + 1)2x = 6x^2 + 2x$

b) (i) $(2x + 2)4x = 6x^2 + 2x + 36$

$2x^2 + 6x - 36 = 0$

$(2x + 12)(x - 3) = 0$

$x = 3$

(ii) area of carpet

$= 3(3) + 1 + 2(3)$

$= 10 \times 6 = 60m^2$

c) Cost of carpet

$= 60 \times 1600$

$= 96000$

Cost of labour

$= 96000 \times 0.025$

$= 2400$

Total cost

$= 96000 + 2400$

$= 98400$

Advice to teachers

Give more questions on application to quadratic equations

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

Question 1

Round off each of the numbers in the expression $169.2 + \frac{92.4 \times 4.9}{14.7}$ *correct to one significant figure. Hence find the approximate value of the expression.* *(3 marks)*

Weaknesses

Candidates confused significant figures with decimal place.

Expected response

$$200 + \frac{90 \times 5}{10}$$

$$= 245$$

Advice to teachers

Distinguish clearly between significant figures and decimal places when teaching.

Question 13

An agent was paid a commission of Ksh 50 000 per annum. The commission was increased by 10% annually. Calculate the total amount of money the agent was paid in 3 years. (3 marks)

Weaknesses

Most candidates could not recognize it is a G.P

Expected response

$a = 50\,000; r = 1.1$

$$s_n = 50\,000 \times \frac{(1.1)^3 - 1}{1.1 - 1}$$

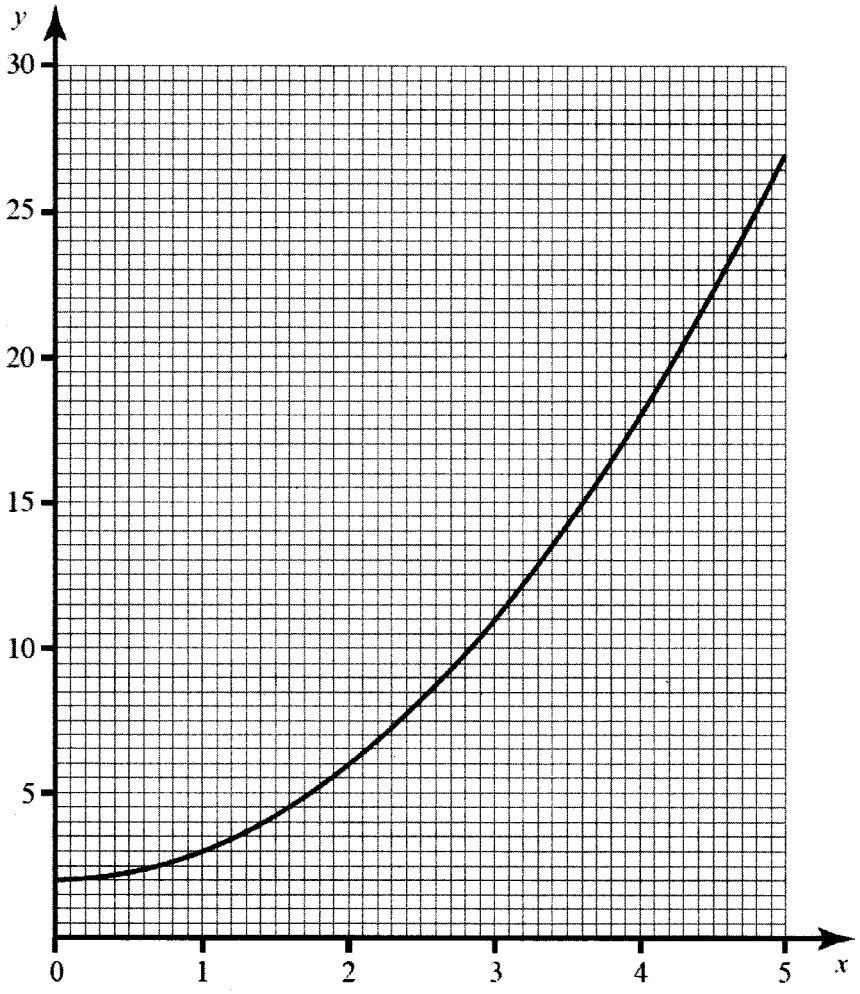
$$= 165\,500$$

Advice to teachers

Give more examples on application of G.P

Question 16

The graph below represents a curve of an equation.



Use the trapezium rule with 5 strips of equal width to estimate the area, in cm², bounded by the curve, the x -axis, x =0 and x = 5. *(3 marks)*

Weaknesses

Identifying the ordinates and use of the trapezium rule was a big challenge to the candidates.

Expected response

x	0	1	2	3	4	5
.	2	3	6	11	18	27

$y = x^2 + 2$

$Area = \frac{1}{2}\{(2+27)+2(3+6+11+18)\}cm^2$

$\frac{1}{2}\{29+2\times 38\}$

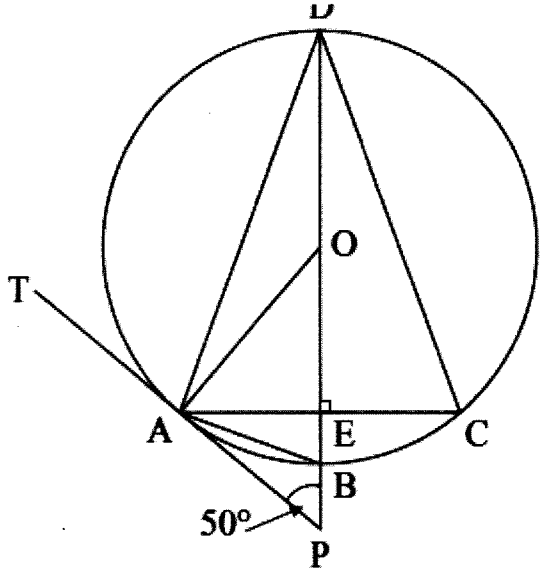
$= 52.5cm^2$

Advice to teachers

Give more practice ro students on finding the area under a curve.

Question 20

In the figure below, O is the centre of the circle of radius 2.5 cm. DOBP is a straight line and is perpendicular to the chord AC at E. Line TP is a tangent to the circle at A and angle APD = 50°.



(a) Calculate, correct to 2 decimal places, the length of:

(i) OP; *(2 marks)*

(ii) AP; *(2 marks)*

(iii) AC. *(2 marks)*

(b) Determine the size of:

(i) angle ADC; *(2 marks)*

(ii) angle ACD. *(2 marks)*

Weaknesses

Applying trigonometric ratios to find the lengths was a challenge to the candidates

Expected response

(a) (i)

$$OP = \frac{2.5}{\sin 50^\circ}$$

$$= 3.26 \text{ cm}$$

(ii)

$$AP = \frac{2.5 \sin 40^\circ}{\sin 50}$$

$$= 2.10$$

(iii)

$$AC = 2\,AE$$
$$= 2 \times 2.5 \sin 40^\circ$$

$$= 3.21$$

(b) (i)

$\angle PAC = 40^\circ$
(sum of $\angle$s in Δ AEP)

$\angle ADC = 40^\circ$
(angle in alt. segment)

(ii)

$$\angle ACD = \tfrac{1}{2}(180^\circ - 40^\circ)$$
$$= 70^\circ$$

Advice to teachers

Give students more practice on angle properties of a circle and use of trigonometric ratios

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

SECTION I (50 marks)

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

1 Simplify the expression

$$\frac{a^2 - b^2}{a^2 + ab - a - b}$$

(3 marks)

2 Three partners Auma, Barua and Chiku contributed Ksh 200 000, Ksh 300 000 and Ksh 500 000 respectively for a business enterprise. They realised a profit which they shared in the ratio of their contributions. If Auma and Chiku together received Ksh 105 000, calculate the total profit realised from the business. (3 marks)

3 Given that $3^{2y} = 6561$, determine the value of y. (3 marks)

4 Given $\tan \theta = \frac{5}{7}$, find the value of $\sin \theta$. (2 marks)

5 A solid whose volume is 64 cm□ has a mass of 30 g. Calculate its density in kg/m□ (3 marks)

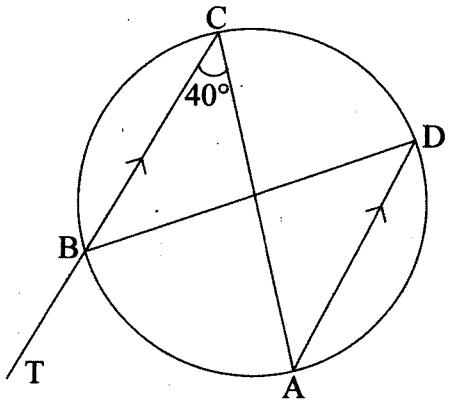
6 A carpenter had three pieces of timber of lengths 40 cm, 56 cm, and 64 cm. He cut the timber into smaller pieces of equal length. Calculate:

(a) the greatest possible length of each piece that the carpenter cut; (2 marks)

(b) the total number of pieces of timber obtained. (2 marks)

7 The circumference of a circle is 31.24 cm. A minor arc of the circle subtends an angle of 81° at the centre. Find the length of the major arc of the circle. (3 marks)

8 In the figure below, ABCD is a cyclic quadrilateral. Line TBC is parallel to line AD and angle ACB = 40°.

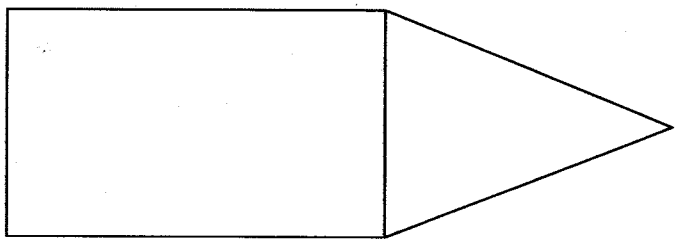


Find the size of:

(a) angle CAD; (1 mark)

(b) angle TBD. (2 marks)

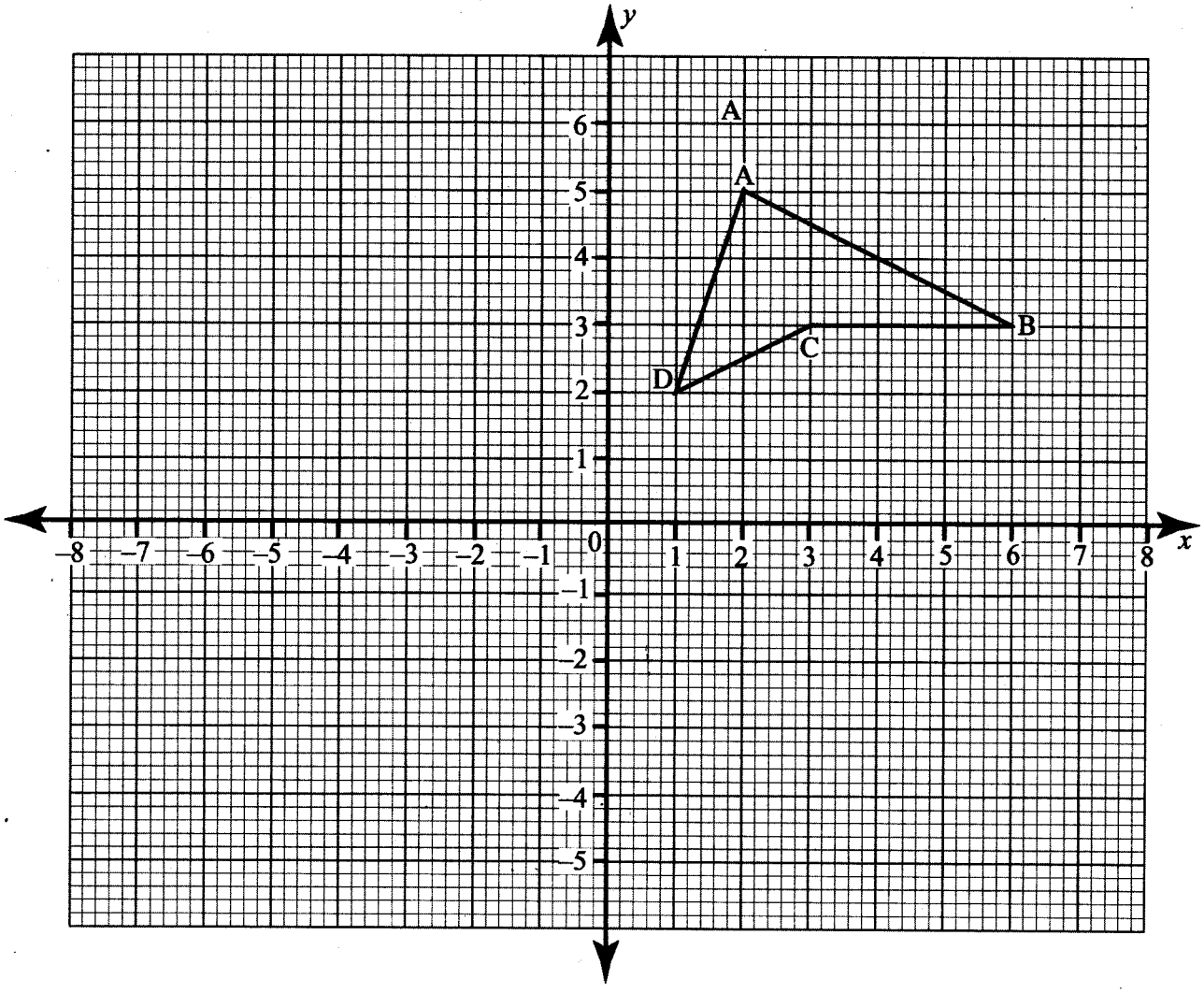
9 The figure below is part of a net of a triangular prism. Complete the net. (3 marks)



10 Express 0.1333... as a fraction in its simplest form. (3 marks)

11 Quadrilateral ABCD shown below, whose vertices are A(2, 5), B(6, 3), C(3, 3) and D(1, 2) is mapped onto A′ B′ C′ D′ by a reflection in the line x = -1.

(a) On the grid provided draw the line x = -1 and A′ B′ C′ D′ (2 marks)



(b) State the type of congruence between quadrilateral ABCD and A′ B′ C′ D′ (1 mark)

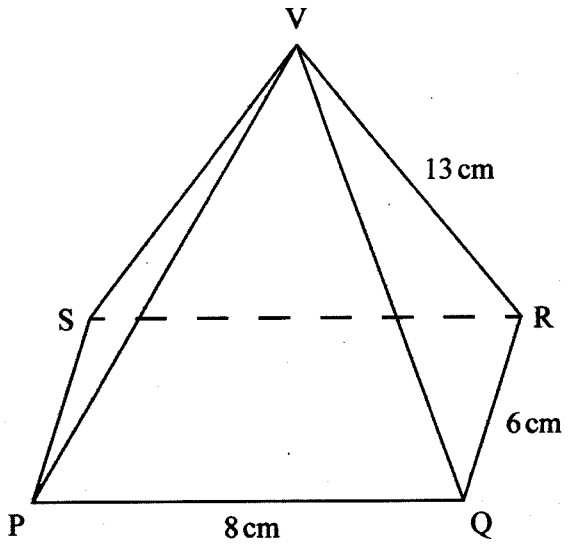
12 The radius of a solid cone is 3.5 cm and its slant height is 9 cm. Calculate the total surface area of the cone. (3 marks)

13 A tower B is 60 km from a tower A on a bearing of 045°. Tower C is 100 km from tower B on a bearing of 150°. Using scale drawing:

(a) show the positions of the towers; (2 marks)

(b) determine the distance, in kilometres, from tower A to tower C. (2 marks)

14 The figure below represents a rectangular based pyramid VPQRS. PQ = 8 cm, QR = 6 cm and VP = VQ = VR = VS = 13 cm.



Calculate:

(a) the vertical height of the pyramid; (2 marks)

(b) the volume of the pyramid. (2 marks)

15 Solve the inequality given below and represent the solution on a number line. (2 marks)
$-5x - 3 > 2x + 4$

16 Makau started his journey from village A at 8.00 am. After walking for 12 km at a speed of 4 km/h he arrived at village B. He stayed at village B for 30 minutes. He then took a minibus which travelled at a speed of 72 km/h and arrived at village C at 11.45 am. Calculate the distance between A and C via B. (4 marks)

SECTION II (50 marks)

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

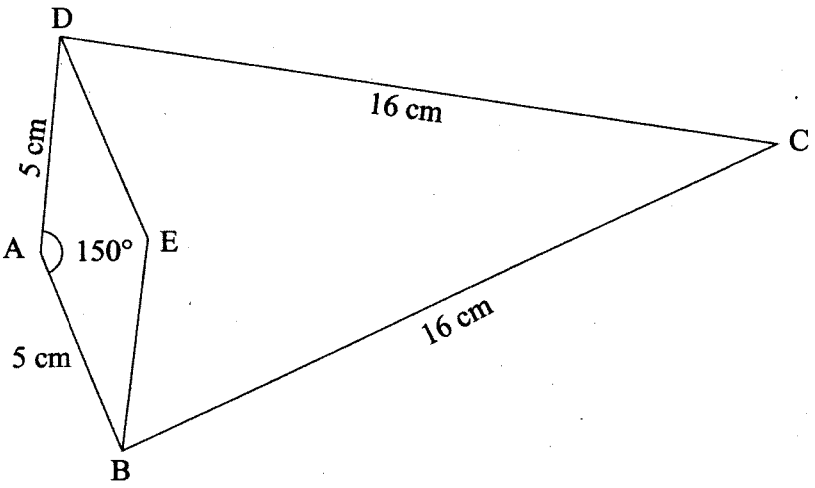
17 The inside of a rectangular hall measures 15 m long, 9 m wide and 3 m high. There are three doors each measuring 2 m by 2.2 m and six windows each measuring 1.5 m by 1.5 m.

(a) Calculate the total area of the walls to be painted. (4 marks)

(b) To paint an area of 2.5 m^2 requires one litre of paint. If the paint is sold in 4 litre tins, determine the number of tins of paint that should be bought. (3 marks)

(c) The cost of a 4 litre tin of paint is Ksh 1700. The painter is paid a fixed charge of Ksh 2 000 and Ksh 30 per square metre of the wall painted. Calculate the total cost of painting the walls. (3 marks)

18 The figure below shows a kite ABCD and a rhombus ABED. AB = AD = 5 cm, BC = DC = 16 cm and angle DAB = 150°.



Calculate:

(a) the area of the rhombus ABED; (2 marks)

(b) (i) the length of diagonal BD, correct to one decimal place; (2 marks)
(ii) the area of triangle BCD. (3 marks)

(c) the area of the kite ABCD. (3 marks)

19 (a) The sum of four consecutive odd numbers is 120. If x represents the smallest of the odd numbers, determine the four odd numbers. (4 marks)

(b) (i) In a certain shop, the cost of 3 spades and 2 hammers is Ksh 1180 and the cost of 2 spades and one hammer Ksh 680. Find the total cost of one spade and one hammer. (4 marks)

(ii) In another shop, the cost of a spade is 10% higher while the cost of a hammer is 5% lower. Find the total cost of one spade and one hammer in the shop. (2 marks)

20 (a) A wall of a building is 8 m high. In a photograph of the building, the height of the wall is 10 cm.

(i) Find the height of a door in the photograph if its actual height is 2.4 m. (3 marks)

(ii) The area of a window on the photograph is 1.4 cm□ Calculate the actual area of the window. (3 marks)

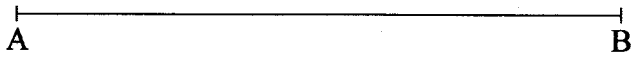
(b) The surface areas of two similar cuboids are 16 cm□ and 49 cm□

(i) Find the volume scale factor of the cuboids. (2 marks)

(ii) If the volume of the smaller cuboid is 128 cm^3, determine the volume of the bigger cuboid. (2 marks)

21 Line AB shown below is one side of a triangle ABC in which AC = 7 cm and angle BAC =120°. Using a pair of compasses and ruler only:

(a) Complete triangle ABC. (2 marks)



(b) On the same diagram as in (a) above,

(i) construct a circle that touches the sides of triangle ABC. Measure the radius of the circle. (3 marks)

(ii) Construct a perpendicular from C to meet BA produced at N. Measure the length of CN. (2 marks)

(c) Find the area of the region in the triangle ABC that lies outside the circle. (3 marks)

22 On a certain day, an exchange bureau bought and sold foreign currencies as shown in the table below.

Currency	Buying (Ksh)	Selling (Ksh)
1 US Dollar	80.89	81.06
1 Sterling Pound	128.23	128.55
1 South African Rand	11.60	11.73
1 UAE Dirham	22.02	22.07
1 Euro	107.65	107.93

(a) A Kenyan businessman intending to travel abroad required 3600 UAE Dirham and 4500 Euros. Calculate the amount of money in Kenya Shillings, that he needed for the exchange. (3 marks)

(b) Another businessman arrived in Kenya in possession of 2000 US dollars and 5000 South African Rands.

(i) Calculate the amount of money, in Kenya Shillings, that he obtained after exchanging the foreign currencies. (3 marks)

(ii) The businessman used 65% of the money to buy goods in Kenya. He changed the balance of the money into sterling pounds. Calculate the amount of money, to the nearest pound, he obtained. (4 marks)

23 (a) The equation of a line L_1 is $y = 2x + 3$. Find:

(i) the value of x when $y = 0$; (1 mark)

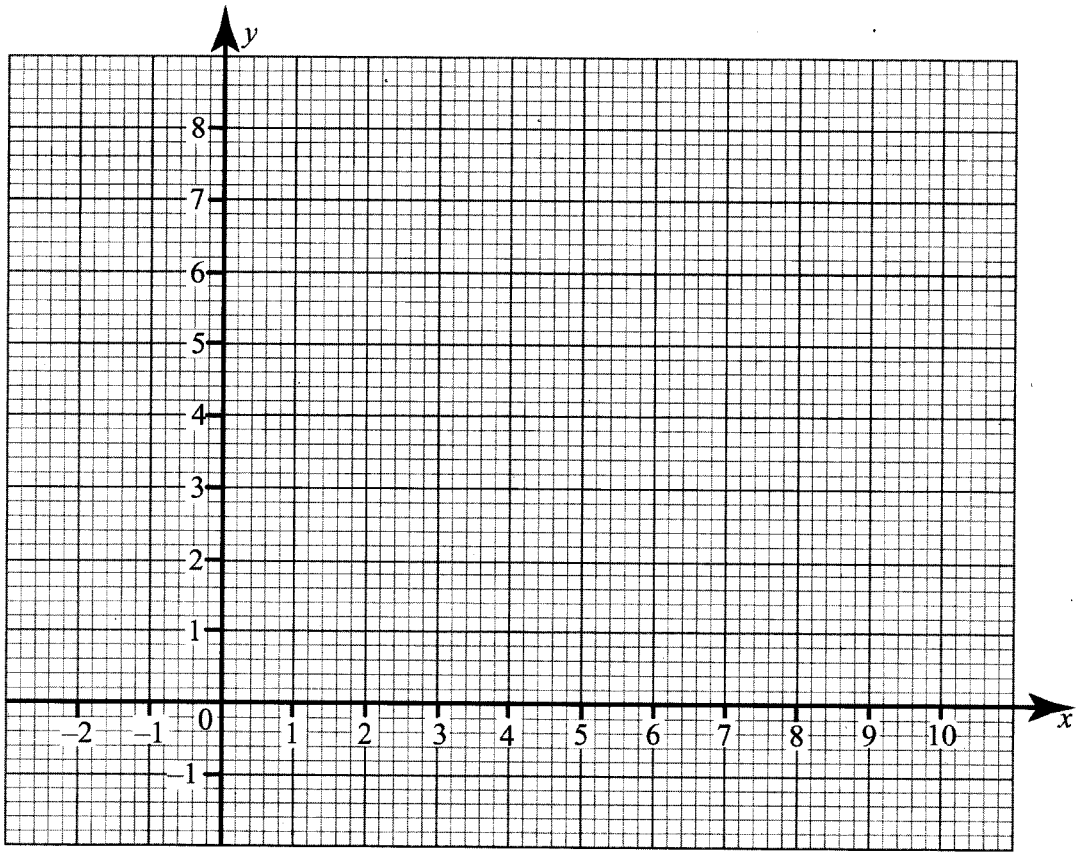
(ii) the value of y when $x = 0$. (1 mark)

(b) The equation of another line L_2 is $y = -\frac{1}{2}x + 5$. Find:

(i) the value of x when $y = 4$. (1 mark)

(ii) the value of y when $x = -2$. (1 mark)

(c) (i) On the grid provided, draw L_1 and L_2. (2 marks)



(ii) From the graph determine the values of x and y where L_1 and L_2 intersects. (1 mark)

(iii) Determine the area, in cm□ of the region enclosed by the x-axis, L_1 and L_2. (3 marks)

24 A room measuring $4x$ metres by $(2x + 2)$ metres is to be carpeted leaving a uniform margin all around the walls. The dimensions of the carpet are $(3x + 1)$ metres by $2x$ metres.

(a) Write an expression for the area of the carpet. (1 mark)

(b) If the area of the margin is 36 square metres, find:

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

(ii) the area of the carpet. (2 marks)

(c) The carpet costs Ksh 1600 per square metre. The cost of transport and labour is 2.5% of the cost of the carpet. Calculate the total cost of carpeting the room. (4 marks)

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 $169.2 + \frac{92.4 \times 4.9}{14.7}$ correct to one significant figure. Hence find the approximate value of the expression. (3 marks)

2 Make n the subject of the formula

$$P = \frac{mn}{m^2 - n}$$

(3 marks)

3 The width of a rectangular garden is 3m shorter than its length. The area of the garden is $108m^2$. Find the length of the garden. (3 marks)

4 The marks scored by 36 students in a mathematics test are:

46	45	17	35	30	25	16	23	46	36	35	30
45	15	8	44	25	11	9	30	18	42	32	35
31	25	23	19	20	30	47	35	15	10	30	33

Using equal class intervals and starting with the class 1 - 10:

(a) represent the above data in a frequency distribution table; (2 marks)

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

5 Ndegeborrowed Ksh 120 000 from a financial institution which charged a simple interest rate per annum. He repaid a total of Ksh 195 600 after 3½ years. Find the rate of interest charged. (3 marks)

6 Using a ruler and a pair of compasses only:

(a) Construct triangle ABC such that AB = 7cm, angle CAB = 30° and angle ABC = 45°. (2 marks)

(b) Construct a circle that passes through the vertices of triangle ABC in (a) above. (2 marks)

7 Solve the simultaneous equations

$2x + y = 5$

$11x + 4y = 17$

(3 marks)

8 Two points A and B are such that $\mathbf{OA} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$ and $\mathbf{AB} = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$. Point M is the midpoint of **OB.**

Determine the coordinates of M. (3 marks)

9 Three machines A, B and C can complete some work in 10 hours, 15 hours and 18 hours respectively. If all the machines work together for 4 hours, find the fraction of work done. (2 marks)

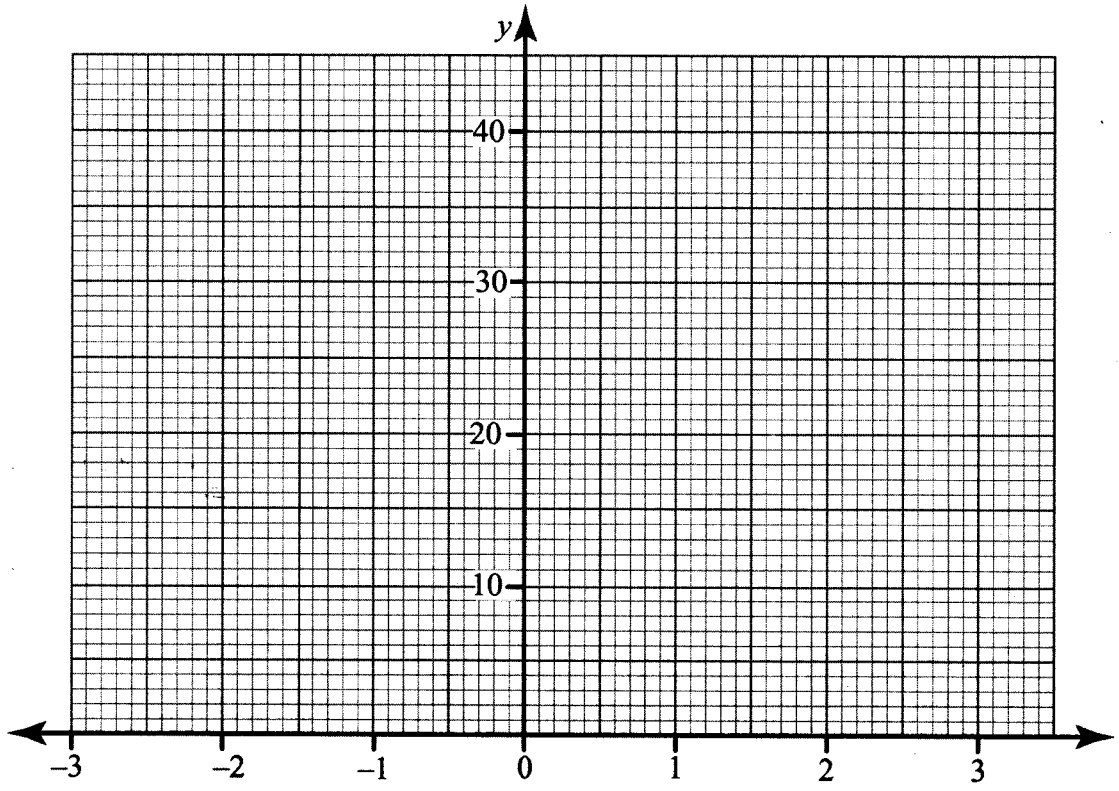
10 A triangle ABC is such that AB = 8cm, BC = 6cm and angle ABC = 120°. Calculate the length of AC correct to 2 decimal places. (3 marks)

11 The equation of a curve is given by $y = 3x^2 + 8$

(a) Complete the table below for values of y. (1 mark)

x	- 3	- 2	- 1	0	1	2	3
y	35		11			20	

(b) On the grid provided, draw the graph of $y = 3x^2 + 8$ for $-3 \leq x \leq 3$ (2 marks)



12 In a certain year, Income Tax Rates were as shown in the table below:

Monthly Income (Ksh)	Tax Rate in each shilling
Upto 9680	10%
from 9681 to 18 800	15%
from 18 801 to 27 920	20%
from 27 921 to 37 040	25%
from 37 041 and above	30%

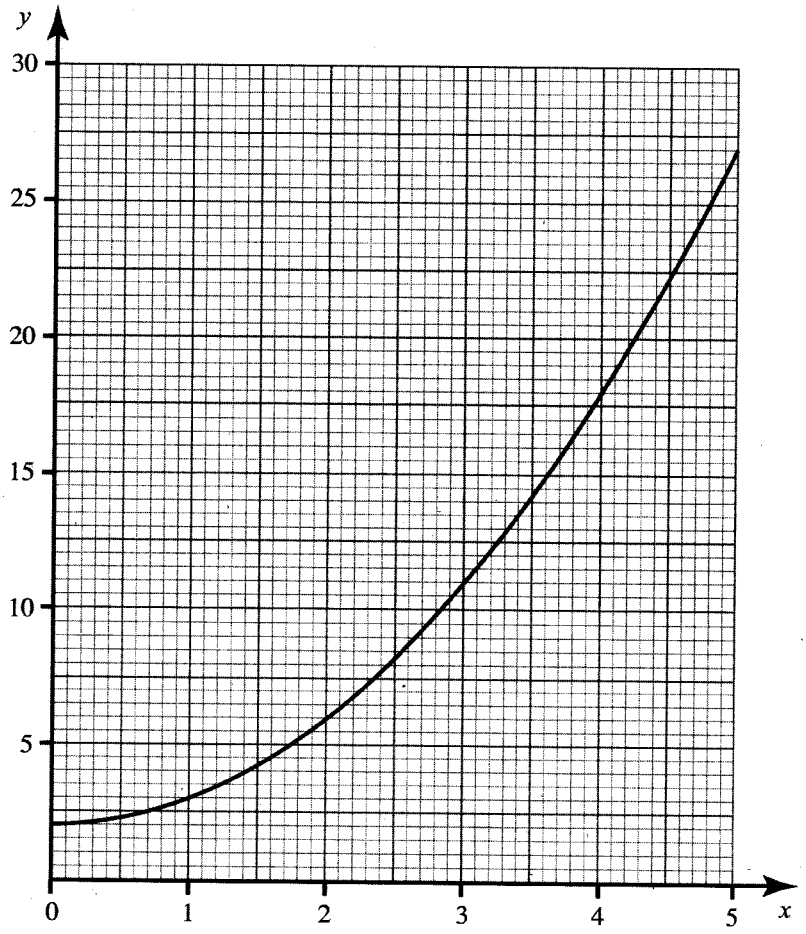
In July that year, Fatuma earned a salary of Ksh 16 420. She was allowed a personal relief of Ksh 1056 per month. Calculate Fatuma's net tax for that month. (4 marks)

13 An agent was paid a commission of Ksh 50 000 per annum. The commission was increased by 10% annually. Calculate the total amount of money the agent was paid in 3 years. (3 marks)

14 A point R is on longitude 6° E while a point S is on longitude 15° W. If the local time at S is 8.30pm, determine the local time at R. (3 marks)

15 The vertices of a triangle are P (–3, 1) , Q (1, 3) and R (4, –2). The vertices of its image under a transformation are P′ (6, –2), Q′ (–2, –6) and R′ (–8, 4). Determine the transformation matrix that maps PQR onto P′Q′R′. (4 marks)

16 The graph below represents a curve of an equation.



Use the trapezium rule with 5 strips of equal width to estimate the area, in cm^2, bounded by the curve, the x - axis, $x = 0$ and $x = 5$. (3 marks)

SECTION II (50 marks)

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

17 A coffee agent has two types of coffee, type X and type Y. Type X costs Ksh 150 per Kg and type Y cost Ksh 240 per Kg.

(a) The agent mixed type X and type Y in the ratio 7:3 to make a 20Kg mixture.

(i) Calculate the mass of each type in the mixture. (2 marks)
(ii) The agent sold the mixture at a profit of 25%. Find the selling price of the mixture. (3 marks)

(b) The agent later mixed type X and type Y in the ratio a:b. The cost of the mixture was Ksh 186 per Kg.

Determine:

(i) the ratio a:b; (3 marks)
(ii) the mass of type X coffee needed to prepare a 500g packet of the mixture. (2 marks)

18 (a) Given that matrix $\mathbf{R} = \begin{pmatrix} x & 3 \\ 2x & 3x \end{pmatrix}$ is a singular matrix, find the value of x. (3 marks)

(b) Matrices **A**, **B** and **P** are such that $\mathbf{A} = \begin{pmatrix} 3 & 1 \\ 2 & 4 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 2 & -1 \\ 0 & 1 \end{pmatrix}$ and $\mathbf{P} = \mathbf{BA} - 3\mathbf{B}$.

Determine:

(i) **BA**; (1 mark)
(ii) 3**B**; (1 mark)
(iii) **P**; (2 marks)
(iv) inverse of **P**. (3 marks)

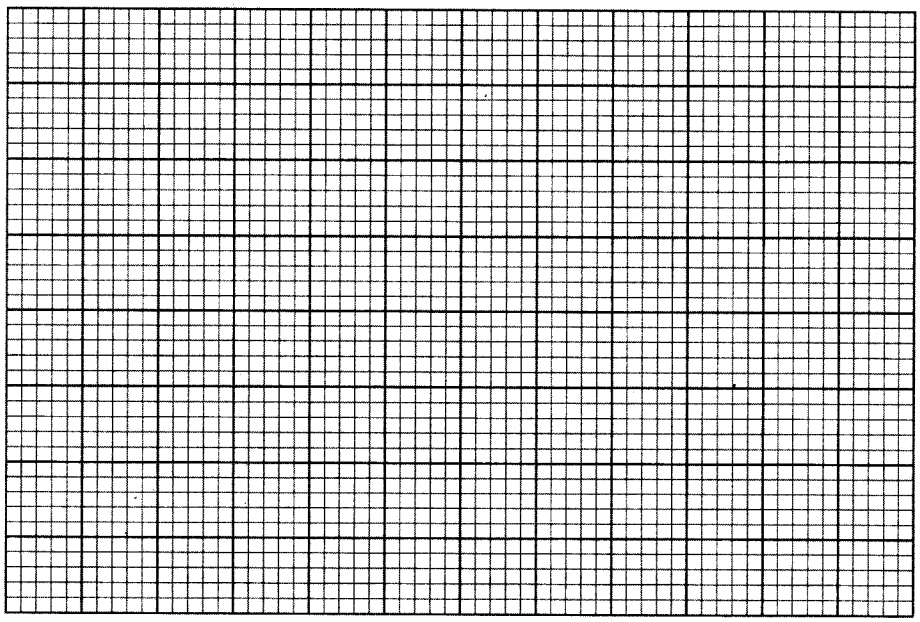
19 A curve is represented by the equation $y = \sin x^o$.

(a) Complete the table below for, $y = \sin x^o$ giving your answer correct to 2 decimal places. (2 marks)

x^o	0	30	60	90	120	150	180	210	240	270
$y = \sin x^o$	0		0.87	1		0.50	0			

(b) On the grid provided below, draw the graph of $y = \sin x^o$ for $0^o \leq x \leq 270^o$

(4 marks)

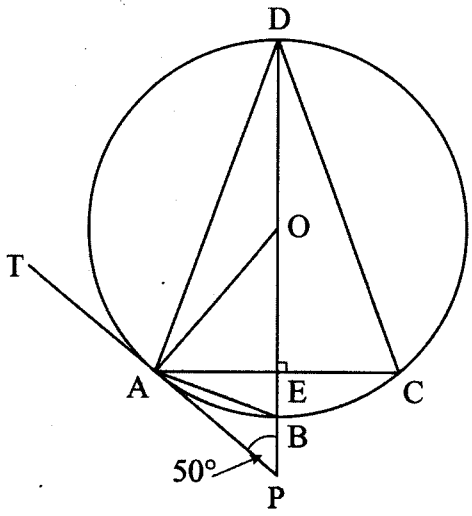


(c) Use the graph in (b) above to:

(i) determine the value of x^o when y = 0.7; (2 marks)

(ii) solve the equation, $5\sin x^0 = -2$. (2 marks)

20 In the figure below, O is the centre of the circle of radius 2.5cm. DOBP is a straight line and is perpendicular to the chord AC at E. Line TP is a tangent to the circle at A and angle APD = 50^0.



(a) Calculate, correct to 2 decimal places, the length of:

(i) OP; (2 marks)
(ii) AP; (2 marks)
(iii) AC. (2 marks)

(b) Determine the size of:

(i) angle ADC; (2 marks)
(ii) angle ACD. (2 marks)

21 Mutuku bought a car for Ksh 500 000. The value of the car depreciated at the rate of 10% p.a for 3 years.

(a) Determine the value of the car at the end of the 3 years. (3 marks)

(b) Mutuku sold the car at the value calculated in (a) above and used the money to buy a piece of land. The value of the land appreciated at the rate of 15% p.a. for the first year.

(i) Calculate the value of the land at the end of the first year. (2 marks)
(ii) The value of the land then appreciated at the rate of 12% p.a. in the next two years. Calculate the value of the land, to the nearest shilling, at the end of the two years. (2 marks)

(c) Determine, to 3 significant figures, the percentage gain in Mutuku's land investment at the end of the 3 years. (3 marks)

22 A box contains 3 red balls, 3 blue balls and 2 green balls. All the balls are identical except for the colour. Two balls are picked at random from the box one at a time without replacement.

(a) Using a tree diagram, show all the possible outcomes. (2 marks)

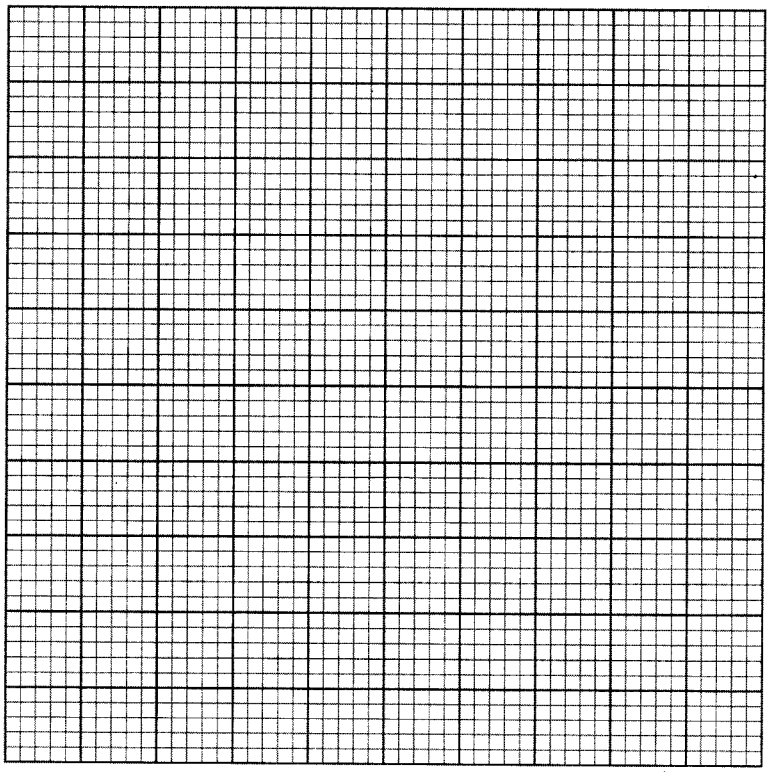
(b) Use the tree diagram to calculate the probability that:

(i) both balls are red; (2 marks)
(ii) one ball is red and the other is green; (3 marks)
(iii) both balls are of different colours. (3 marks)

23 The table below shows masses, to the nearest Kg, of patients who visited a health centre on a certain day.

Mass (Kg)	30 – 39	40 – 49	50 – 59	60 – 69	70 – 79	80 – 89	90 – 99
Frequency (f)	2	5	25	60	27	12	5

(a) On the grid provided below draw a cumulative frequency curve for the data. (6 marks)



(b) Use the graph to estimate:

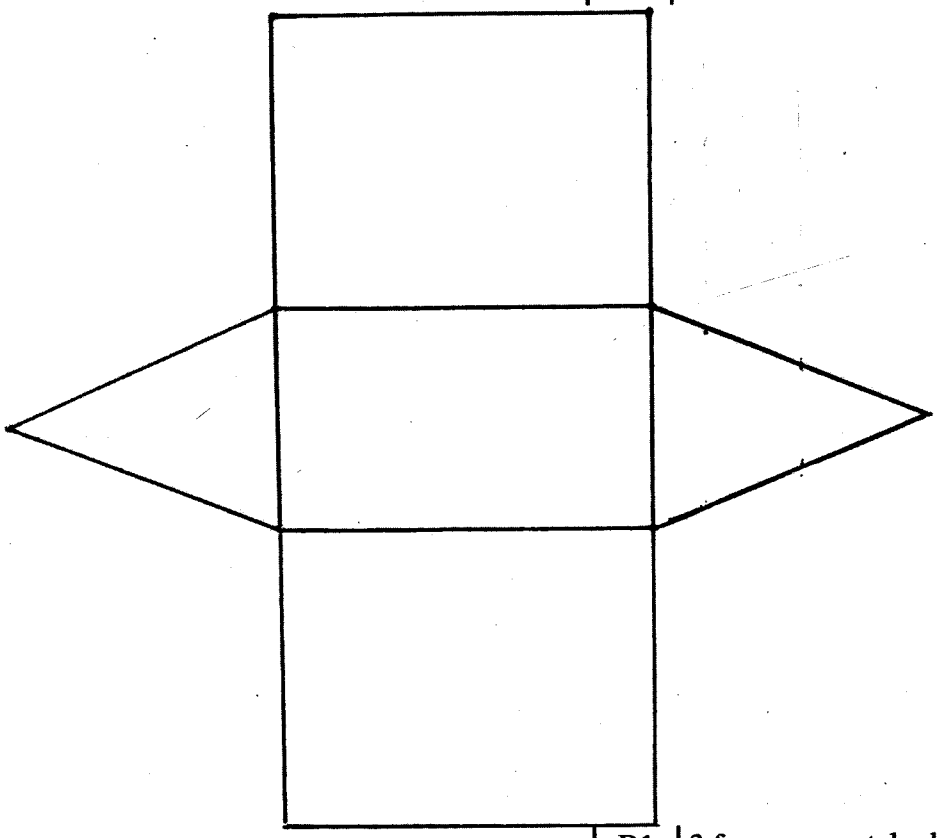
(i) the median mass; (2 marks)
(ii) the number of patients whose mass was less than or equal to 50.5Kg. (2 marks)

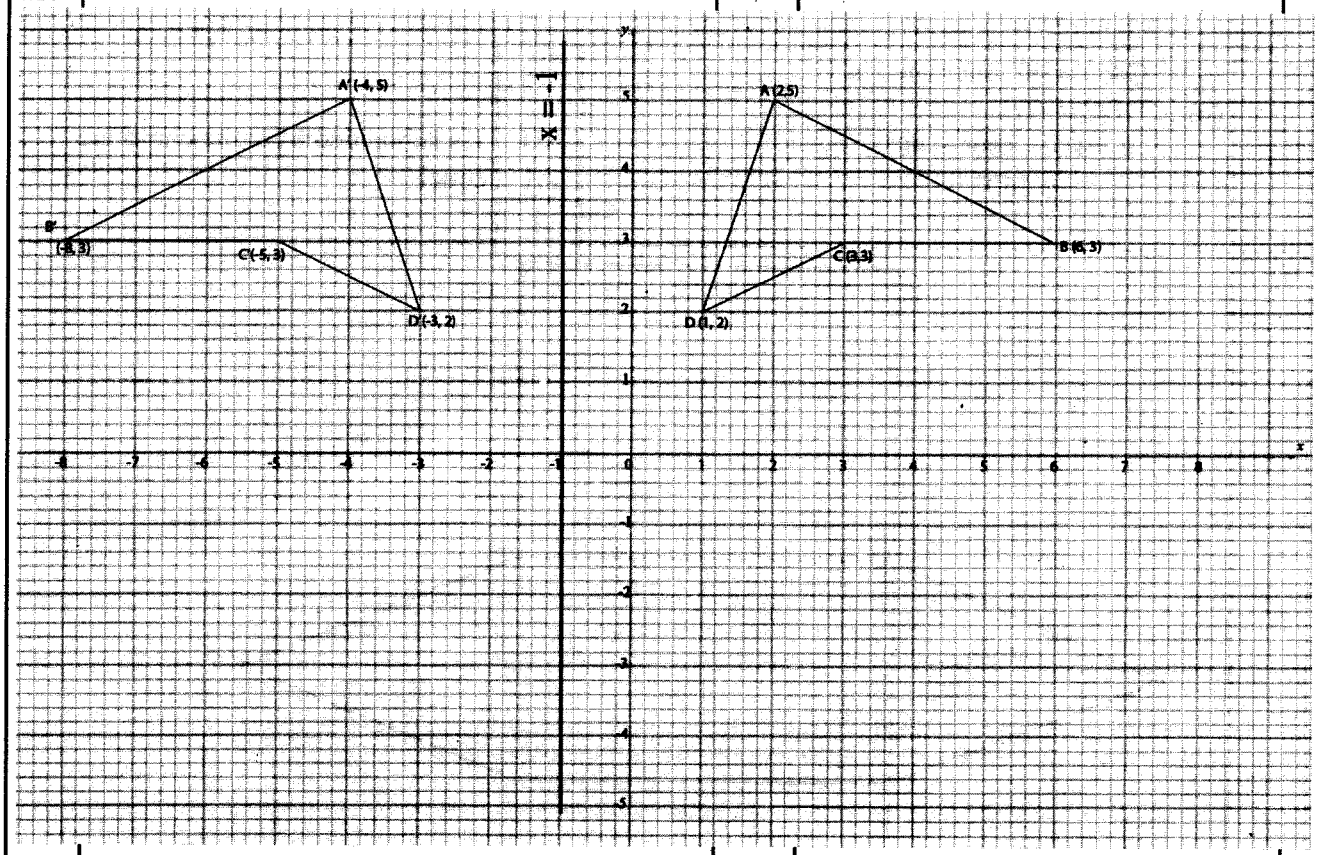
24 Three variables S, T and R are such that S varies directly as T and inversely as R. When S = 18, T = 9 and R = 4.

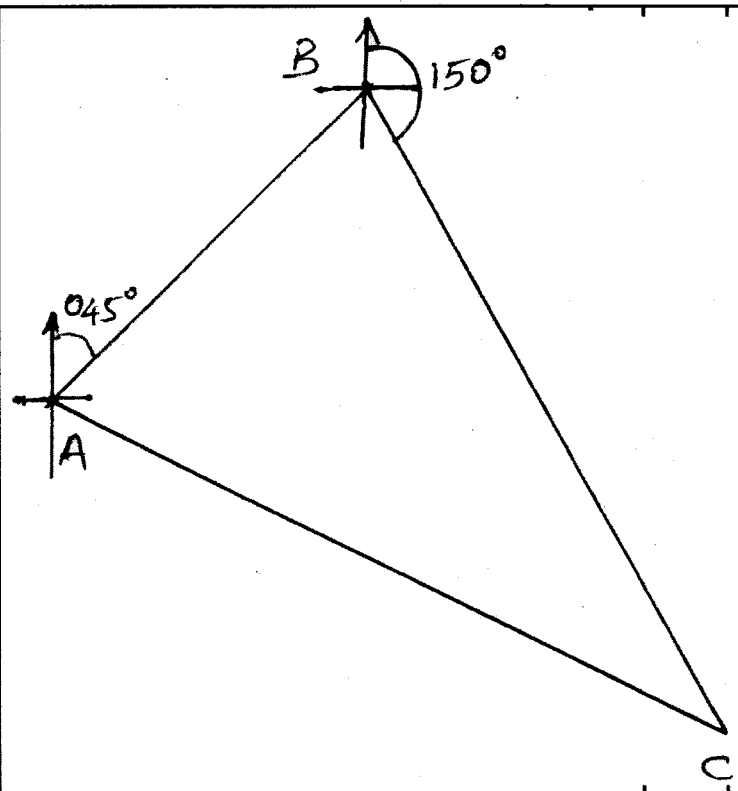
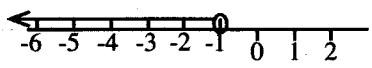
(a) (i) Determine the constant of proportionality. (3 marks)
(ii) Express S in terms of T and R. (1 mark)
(iii) Find the value of T when S = 108 and R = 6. (3 marks)

(b) Determine the percentage change in S if R is increased by 20%. (3 marks)

1.	$\frac{a^2-b^2}{a^2+ab-a-b}=\frac{(a+b)(a-b)}{a(a+b)-1(a+b)}$ $=\frac{(a+b)(a-b)}{(a-1)(a+b)}$ $=\frac{a-b}{a-1}$	M1 M1 A1 3	
2.	Auma: Barua: Chiku = 2:3:5 Total profit $=\frac{105000}{7}\times 10$ $= 150000$	B1 M1 A1 3	
3.	$6561 = 3^8$ $3^{2y} = 3^8$ $2y = 8$ $y = 4$	B1 M1 A1 3	
4.	Hypotenuse $=\sqrt{7^2+5^2}$ $=\sqrt{74}$ $\text{Sin}\,\theta=\frac{5}{\sqrt{74}}$ or $= 0.5812$	M1 A1 2	or Alternative
5.	Density in g/cm^3 $=\frac{30}{64}$ Density in km/m^3 $=\frac{\frac{30}{1000}}{\frac{64}{100}}$ $= 468.75$ kg/m^3	M1 M1 A1 3	
6.	(a) $40 = 2^3\times 5$; $56 = 2^3\times 7$; $64 = 2^6$ Greatest length of pieces $= 2^3 = 8$ (b) $(40\div 8)+(56\div 8)+(64\div 8)$ $= 20$	M1 A1 M1 A1 4	
7.	Length of minor arc $=\frac{81}{360}\times 31.24$ $= 7.029$ Length of major arc $= 31.24 - 7.029$ $= 24.211$	M1 M1 A1 3	ALTERNATIVE Angle of major sector $= 360^\circ - 81^\circ$ $= 279^\circ$ Length of major arc $=\frac{279^\circ}{360^\circ}\times 31.24$ $= 24.211$

8.	(a) $\angle CAD = 40°$ alternate $\angle s$ (b) $\angle DBC = 40°$ $\therefore \angle TBD = 180° - 40°$ $= 140°$	B1 M1 A1 3	$\angle s$ subtended by same chord are equal
9.		B1 B1 B1 3	3 faces accurately drawn
10.	$100x = 13.333...$ $10x = 1.333...$ $90x = 12$ $x = \frac{12}{90} = \frac{2}{15}$	M1 M1 A1 3	

11.			
	$x = -1$ √ drawn image A′ B′ C′ D′ √ drawn A′ B′ C′ D′ is oppositely congruent to ABCD	B1 B1 B1 3	
12.	Total surface area $= \frac{22}{7} \times 3.5^2 + \frac{22}{7} \times 3.5 \times 9$ $= \frac{22}{7} \times 3.5(3.5 + 9)$ $= 137.5$ cm	M1 M1 A1 3	

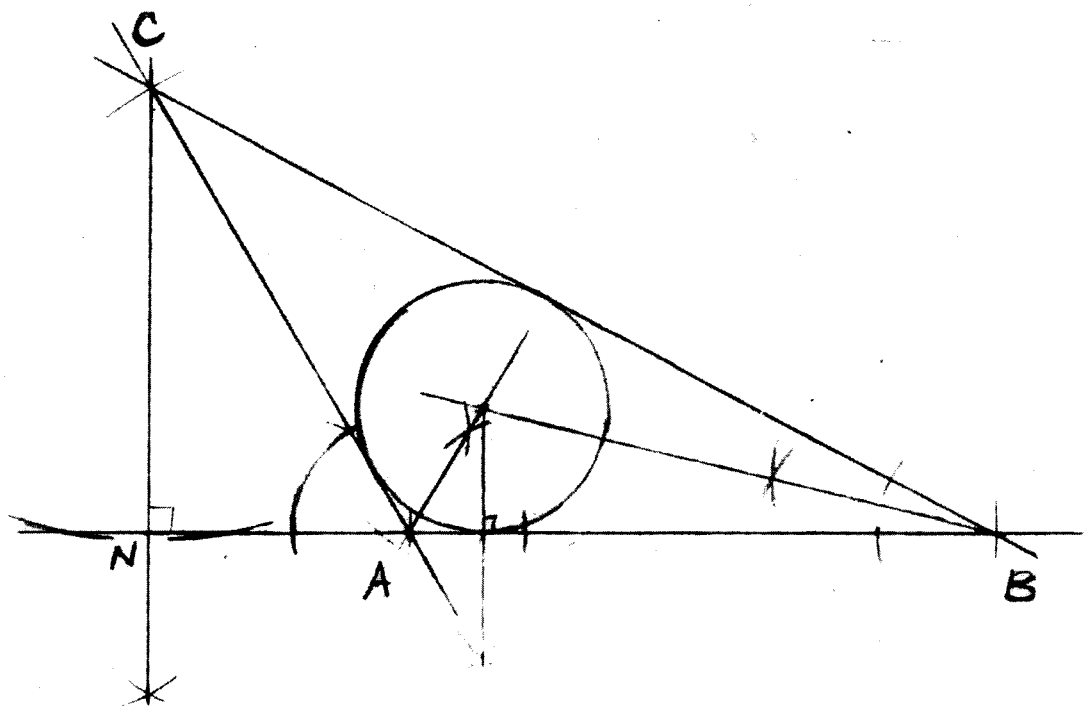
13.	 (a) AB accurately drawn BC accurately drawn (b) distance from A to C = 10.2 x 10 = 102 km	B1 B1 M1 A1 4	AC = 10.2 ± 0.1 cm
14.	(a) height $= \sqrt{13^2 - 5^2}$ $= 12$ cm (b) volume $= \frac{1}{3} \times 8 \times 6 \times 12$ $= 192\ cm^3$	M1 A1 M1 A1 4	
15.	$-5x - 3 > 2x + 4$ $-5x - 2x - 3 > 4$ $-7x > 7$ $x < -1$ 	 B1 B1 2	

16.	Time at stop B $8.00 + \frac{12}{4}h = 11.00$ Time taken to C from B 11.45 - 11.30 = 15 minutes Distance $= 12 + \frac{15}{60} \times 72$ $= 30$ km	B1 B1 M1 A1 4	
17.	a) Area to be painted $2(15 \times 3 + 9 \times 3) - (2 \times 2.2 \times 3 + 1.5 \times 1.5 \times 6)$ $= 117.3\ m^2$ b) No. of tins required $= \frac{117.3}{4 \times 2.5}$ $= 11.73$ $\simeq 12$ tins c) Total cost: $12 \times 1700 + (2000 + 30 \times 117.3)$ = Sh 25919	 M1 M1 M1 A1 M1 A1 B1 M1 M1 A1 10	 area of walls area of doors and windows difference cost of paint sum of cost of paint, standing charge and labour

18.	a) $2 \times \frac{1}{2} \times 5 \times 5 \sin 150^\circ$ $= 12.5 \text{ cm}^2$ b) (i) $\frac{\frac{1}{2}BD}{5} = \sin 75^\circ$ $BD = 9.7$ (ii) Area of Δ BCD $S = \frac{1}{2}(9.7 + 16 + 16) = 20.85$ $A = \sqrt{20.85(20.85 - 9.7)(20.85 - 16)^2}$ $= \sqrt{20.85 \times 11.15 \times (4.85)^2}$ $= 73.95$ c) Area of kite ABCD $\frac{1}{2} \times 12.5 + 73.95$ $= 80.2 \text{ cm}^2$	M1 A1 M1 A1 B1 M1 A1 M1 M1 A1 10	
19.	a) odd numbers after x $x + 2, x + 4, x + 6$ $x + (x + 2) + (x + 4) + (x + 6) = 120$ $4x = 120 - 12$ $x = 27$ $\therefore$ odd numbers: 27, 29, 31, 33 b) (i) $3p + 2m = 1180$ $2p + m = 680$ $3p + 2m = 1180$ ..... (i) $2p + m = 680$ ..... (ii) $3p + 2m = 1180$ ..... (i) $4p + 2m = 1360$ ..... (iii) $p = 180$ substitute p = 180 in (ii) $2 \times 180 + m = 680$ $m = 320$ $p + m = 180 + 320 = 500$ (ii) $180 \times 1.1 + 320 \times 0.95$ $198 + 304 = 502$	B1 M1 A1 B1 B1 M1 A1 B1 M1 A1 10	for $3p + 2m = 1180$ or $2p + m = 680$ or equivalent for p = 180 and m = 320

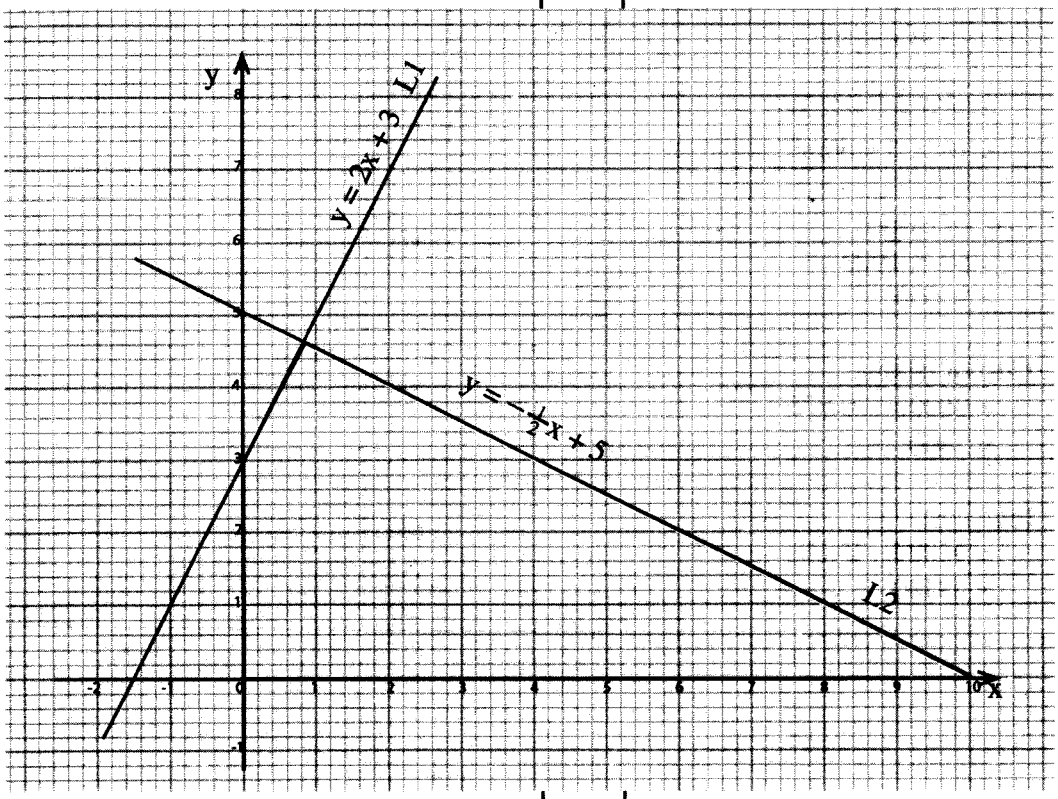
20.	a) (i) 10:800 1:80 height of door on photograph: $= \frac{240}{80}$ = 3 cm (ii) L.S.F = 1:80 A.S.F = 1:6400 ∴ Actual area of the window $= \frac{1.4 \times 6400}{10\,000}$ $= 0.896\ m^2$ b) (i) Volume scale factor $= (\sqrt{16})^3 : (\sqrt{49})^3$ = 64 : 343 (ii) Volume of bigger cuboid $= \frac{128}{64} \times 343$ $= 686\ cm^3$	B1 M1 A1 B1 M1 A1 M1 A1 M1 A1	or equivalent
		10	

21



a) construction of 120°	B1	
completion of △	B1	
b) (i) identifying centre of circle	B1	at least 2 mediators drawn
⊥ from centre to at least one side	B1	at least 1 perpendicular drawn
completing circle radius 1.7 ± 0.1	B1	
(ii) ⊥ from C to N	B1	
CN = 6.1 ± 0.1	B1	
c) area of △ ABC = $\frac{1}{2} \times 8 \times 6.1$	M1	
area of circle = 3.142×1.7^2	M1	
area of △ outside the circle		
= $\frac{1}{2} \times 8 \times 6.1 - 3.142 \times 1.7^2$		
= 24.4 - 9.079202769		
= 15.32079723		
= 15.32	A1	
	10	

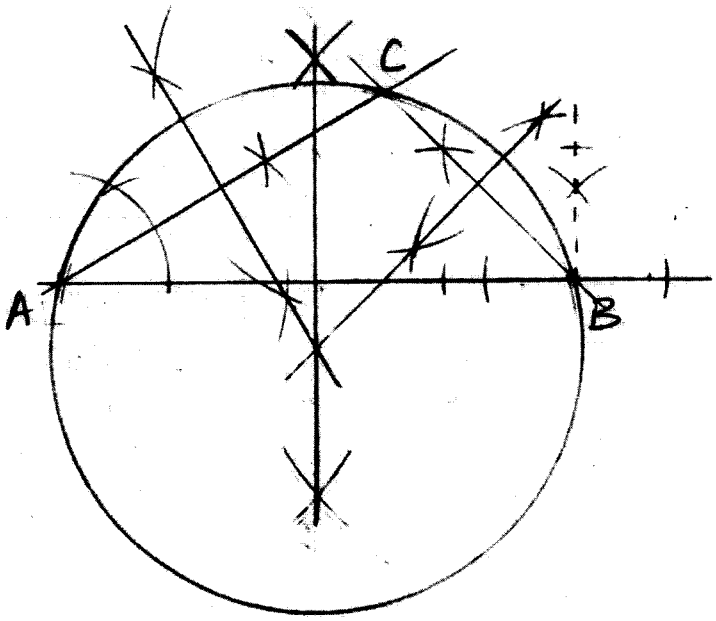
22.	a) $3600 \times 22.07 + 4500 \times 107.93$ $= 565137$ b) (i) $2000 \times 80.89 + 5000 \times 11.60$ $= 219780$ (ii) $219780 \times \frac{65}{100}$ $= 142857$ Balance: $219780 - 142857$ $= 76923$ Exchange: $= \frac{76923}{128.55}$ $\simeq 598$	M1 M1 A1 M1 M1 A1 M1 M1 M1 A1 10	√ conversions sum √ conversions sum or equivalent e.g. 35% used correctly

23.	a) (i) L_1: when $y = 0, x = \frac{-3}{2}$	B1	
	(ii) L_1: when $x = 0, y = 3$	B1	
	b) (i) L_2: when $y = 4, x = 2$	B1	
	L_2: when $x = -2, y = 6$	B1	
	c) (i) 		
	Line L_1 drawn	B1	
	Line L_2 drawn	B1	
	(ii) value of x and y when $L_1 = L_2$ $x = 0.8, y = 4.6$	B1	
	(iii) area of region bounded by L_1, L_2, and x - axis		
	Area $= \frac{1}{2} \times 11.5 \times 4.6$	M1	for 11.5 and 4.6
	$= 26.45$	M1 A1	
		10	

24.	a) $(3x + 1)2x = 6x^2 + 2x$	B1	
	b) (i) $(2x + 2)4x = 6x^2 + 2x + 36$	M1	
	$2x^2 + 6x - 36 = 0$	M1	
	$(2x + 12)(x - 3) = 0$	A1	
	$x = 3$		
	(ii) area of carpet		
	$= 3(3) + 1 + 2(3)$	M1	
	$= 10 \times 6 = 60m^2$	A1	
	c) Cost of carpet		
	$= 60 \times 1600$	M1	
	$= 96000$		
	Cost of labour		
	$= 96000 \times 0.025$	M1	
	$= 2400$		
	Total cost		
	$= 96000 + 2400$	M1	
	$= 98400$	A1	
		10	

5.1.4 Mathematics Alternative B Paper 2 (122/2)

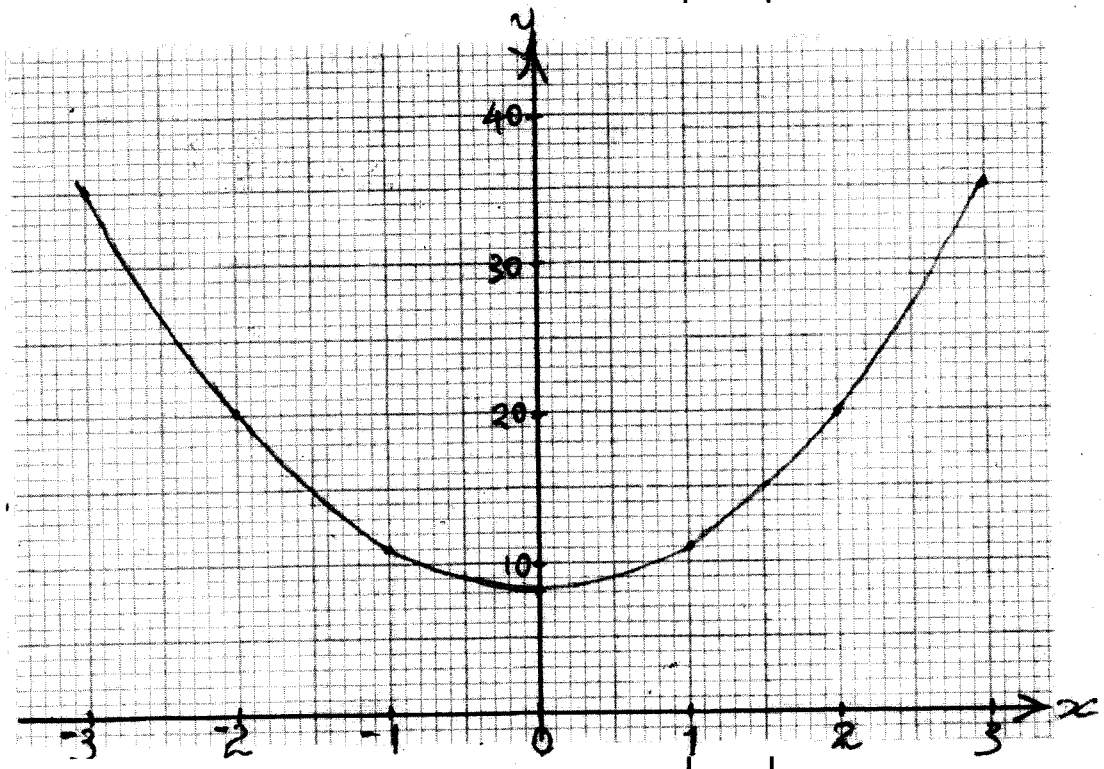
1.	$200 + \frac{90 \times 5}{10}$ $= 245$	B1 M1 A1 3	√ rounding off √ operations
2.	$mn = pm^2 - pn$ $mn + pn = pm^2$ $n(m + p) = pm^2$ $n = \frac{pm^2}{m + p}$	M1 M1 A1 3	
3.	$x(x - 3) = 108$ $x^2 - 3x - 108 = 0$ $(x - 12)(x + 9) = 0$ $x = 12$ *or* $x = -9$ $\therefore$ *length* $= 12m$	B1 M1 A1 3	or equivalent expression
4. (a)	CLASS | 1-10 | 11-20 | 21-30 | 31-40 | 41-50 FREQUENCY | 3 | 8 | 10 | 8 | 7	B1 B1	classes frequencies
(b)	modal class $= 21 - 30$	B1 3	
5.	Interest $= 195\,600 - 120\,000$ $= 75\,600$ Rate: $120\,000 \times R \times \frac{7}{2} = 75\,600$ $\Longrightarrow R = \frac{75\,600 \times 2}{120\,000 \times 7} \times 100$ $= 18\%$	B1 M1 A1 3	

6.		B1 B1 B1 B1 4	30° *and* 45° constructed completion of △. Perpendicular bisector at least 2 sides of △. Drawing circle.
7.	$2x + y = 5 \ldots (i)$ $11x + 4y = 17 \ldots (ii)$ $8x + 4y = 20$ $11x + 4y = 17$ $x = -1$ *Subst.* $x = -1$ *in* (i): $2(-1) + y = 5$ $y = 7$ $x = -1, y = 7$	M1 M1 A1 3	
8.	$\underset{\sim}{QB} = \begin{pmatrix} 2 \\ 5 \end{pmatrix} + \begin{pmatrix} 4 \\ 5 \end{pmatrix}$ $= \begin{pmatrix} 6 \\ 10 \end{pmatrix}$ $OM = \frac{1}{2}\begin{pmatrix} 6 \\ 10 \end{pmatrix}$ $= \begin{pmatrix} 3 \\ 5 \end{pmatrix}$ **M is (3, 5)**	M1 M1 A1 3	

9.	Function of work done in 4 hours. $= 4\left(\frac{1}{10}+\frac{1}{15}+\frac{1}{18}\right)$ $\frac{8}{9}$	M1 A1 2	
10.	$AC^2 = 8^2 + 6^2 - 2\times 8\times 6\cos 120°$ $= 64 + 36 - 96\times -0.5$ $AC = \sqrt{148} = 12.17$	M1 M1 A1 3	
11. (a)		B1	

x	-3	-2	-1	0	1	2	3
$y = 3x^2 + 8$	**(35)**	20	**(11)**	8	11	**(20)**	35

(b)



P1
C1
3

12.	1^{st} *bracket*: $9680 \times \frac{10}{100}$ $= 968$ 2^{nd} *bracket*: $(16420 - 9680) \times \frac{15}{100}$ $= 1011$ *Net tax*: $(968 + 1011) - 1056$ $= 923$	M1 M1 M1 A1 4	
13.	$a = 50\,000; r = 1.1$ $s_n = 50\,000 \times \frac{(1.1)^3 - 1}{1.1 - 1}$ $= 165\,500$	B1 M1 A1 3	
14.	*Longitude difference* $= 15° + 6 = 21°$ *Time diference* $= 21 \times 4 = 84$ min *local time at* $R = 8.30 + 1h\ 24$ min $= 9.54$ *pm*	B1 B1 B1 3	
15.	$\begin{matrix} & P & Q & R & & P' & Q' & R' \end{matrix}$ $\begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} -3 & 1 & 4 \\ 1 & 3 & -2 \end{pmatrix} = \begin{pmatrix} 6 & -2 & -8 \\ -2 & -6 & 4 \end{pmatrix}$ $-3a + b = 6 \qquad c + 3d = -6$ $a + 3b = -2 \qquad 4c - 2d = 4$ $a = -2 \qquad c = 0$ $b = 0 \qquad d = -2$ *Matrix* $= \begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$	M1 M1 A1 B1 4	

16.	<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td></td><td>2</td><td>3</td><td>6</td><td>11</td><td>18</td><td>27</td></tr></table> $y = x^2 + 2$ $Area = \frac{1}{2}\{(2+27)+2(3+6+11+18)\}cm^2$ $\frac{1}{2}\{29+2\times 38\}$ $= 52.5cm^2$	B1 M1 A1 3	√ ordinates (may be implied from working)
17.	(a) (i) *Mass of type x*: $\frac{7}{10}\times 20 = 14kg$ *Mass of type y*: $\frac{3}{10}\times 20 = 6kg$ (ii) *Cost Price* $= 14\times 150 + 6\times 240$ $= Sh\ 3\,540$ *Selling Price* $= Sh\ \frac{125}{100}\times 3540$ $= Sh\ 4\,425$ (b) (i) $\frac{150a+240b}{a+b} = 186$ $150a + 240b = 186a + 186b$ $36a = 54b$ $a:b = 3:2$ (ii) $\frac{3}{5}\times 500g$ $= 300g$	B1 B1 M1 M1 A1 M1 A1 M1 M1 A1 10	

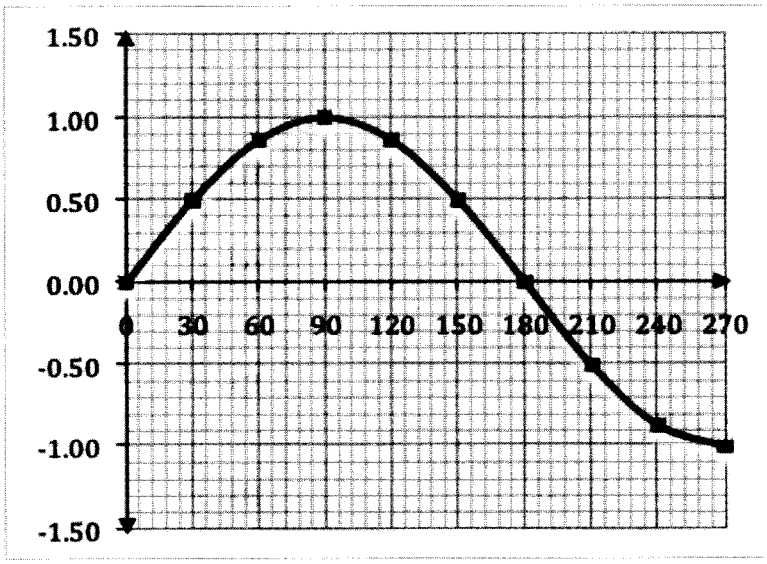
18.	(a) $R = \begin{pmatrix} x & 3 \\ 2x & 3x \end{pmatrix}$		
	$\therefore 3x^2 - 6x = 0$	M1	
	$3x(x-2) = 0$	M1	
	$x = 0$ *or* $x = 2$	A1	
	(b) (i) $\boldsymbol{BA} = \begin{pmatrix} 2 & -1 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} 3 & 1 \\ 2 & 4 \end{pmatrix}$	B1	
	$= \begin{pmatrix} 4 & -2 \\ 2 & 4 \end{pmatrix}$		
	(ii) $3\boldsymbol{B} = 3\begin{pmatrix} 2 & -1 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 6 & -3 \\ 0 & 3 \end{pmatrix}$	B1	
	(iii) $\boldsymbol{P} = \begin{pmatrix} 4 & -2 \\ 2 & 4 \end{pmatrix} - \begin{pmatrix} 6 & -3 \\ 0 & 3 \end{pmatrix}$	M1	
	$= \begin{pmatrix} -2 & 1 \\ 2 & 1 \end{pmatrix}$	A1	
	(iv) $\lvert\mathbf{P}\rvert = -2 \times 1 - 2 \times 1$		
	$= -4$	B1	
	Inverse of $\mathbf{P} = -\frac{1}{4}\begin{pmatrix} 1 & -1 \\ -2 & -2 \end{pmatrix}$	M1	
	$= \begin{pmatrix} -\frac{1}{4} & \frac{1}{4} \\ \frac{1}{2} & \frac{1}{2} \end{pmatrix}$	A1	
		10	

19. (a)

x	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°
Sin x		0.5			0.87			-0.5	-0.87	-1

B2 — Allow B1 for 3 or 4 values correct.

(b)



S1 — √ use of scale
P2 — P1 for at least 7 √
C1 — curve

(c) x when y = 0.7

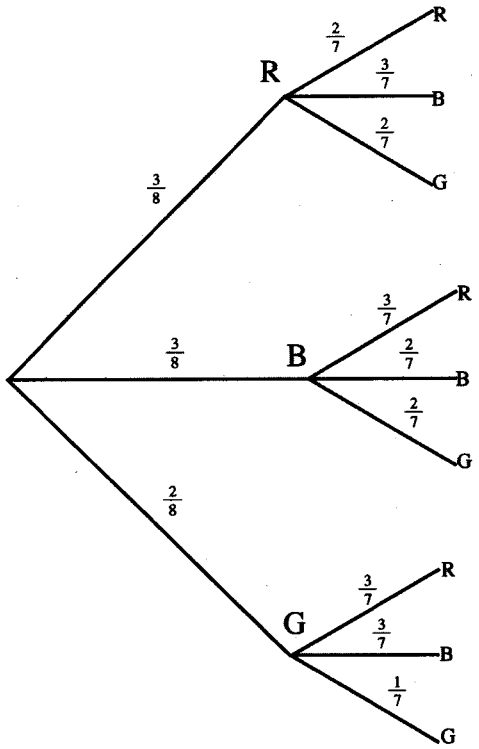
x = 45° — B1
= 135° — B1

(d) sin x = - 0.4

x = 204° — B1
B1

10

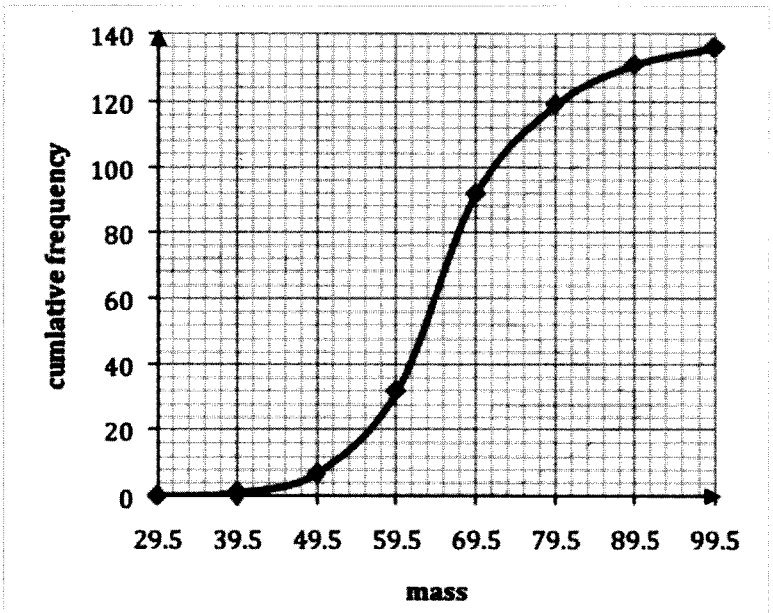
20.	(a) (i) $OP = \frac{2.5}{\sin 50°}$	M1	
	$= 3.26$ cm	A1	
	(ii) $AP = \frac{2.5 \sin 40°}{\sin 50}$	M1	
	$= 2.10$	A1	
	(iii) $AC = 2\,AE$		
	$= 2 \times 2.5 \sin 40°$	M1	
	$= 3.21$	A1	
	(b) (i) $\angle PAC = 40°$ (sum of $\angle$s in Δ AEP)	B1	
	$\angle ADC = 40°$ (angle in alt. segment)	B1	
	(ii) $\angle ACD = \frac{1}{2}(180° - 40°)$	M1	
	$= 70°$	A1	
		10	
21.	(a) Value of car after 3 years		
	$(100 - 10)\% = 90\%$	M1	
	500000×0.9^3	M1	
	$= 364\,500$	A1	
	(b) (i) 364500×1.15	M1	
	$= 419\,175$	A1	
	(ii) 419175×1.12^2	M1	
	$= 525\,813$	A1	
	(c) % gain from investment		
	$= \frac{(525813 - 364500)}{364500} \times 100$	M1 M1	
	$= 44.3\%$	A1	
		10	

22.	(a) 	B1 B1	1st set branches 2nd set branches
	(b) (i) P (both balls red) $= \frac{3}{8} \times \frac{2}{7}$ $= \frac{3}{28}$	M1 A1	
	(ii) P (one ball red and one ball green) $= \frac{3}{8} \times \frac{2}{7} + \frac{2}{8} \times \frac{3}{7}$ $= \frac{6}{56} + \frac{6}{56} = \frac{3}{14}$	M1 M1 A1	
	(iii) P (different colours) $= 1 - \left[\left(\frac{3}{8} \times \frac{2}{7}\right) + \left(\frac{3}{8} \times \frac{2}{7}\right) + \left(\frac{2}{8} \times \frac{1}{7}\right)\right]$ $= 1 - \frac{14}{56} = \frac{3}{4}$	M1 M1 A1	P (same colours) 1 - P (same colours)
		10	

23.

Mass kg	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Frequency	2	5	25	60	27	12	5
Upper class unit	39.5	49.5	59.5	69.5	79.5	89.5	99.5
Cumulative frequency	1	7	32	92	119	131	136

B1	for upper class limit
B1	for c.f.



S1	√ scale
P2	√ plotting allow B1 for 4-6 points
C1	

(b) (i) identifying 68 patients — B1
reading 65.5 ± 1 kg — B1

(ii) identifying 50.5 kg — B1
reading 8 patients — B1

10

24.	(a) (i) $S = \frac{kT}{R}$	B1	
	$\Rightarrow 18 = \frac{k \times 9}{4}$		
	$k = \frac{18 \times 4}{9}$	M1	
	$= 8$	A1	
	(ii) $S = \frac{8T}{R}$	B1	
	(iii) value of T when S = 108 and R =6		
	$T = \frac{S \times R}{8}$	M1	making T the subject
	$= \frac{108 \times 6}{8}$	M1	√ substitution
	$= 81$	A1	
	(b) % change of S		
	New $S = \frac{8 \times T}{1.2R}$	M1	
	Old $S = \frac{8T}{R}$		
	change $= \frac{8T}{1.2R} - \frac{8T}{R}$	M1	
	$\% = \left(\frac{1}{1.2} - 1\right) \times 100$		
	$= -16\frac{2}{3}\%$	A1	
		10	