

1.3 MATHEMATICS (121 and 122)

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

SECTION 1 (50 marks)

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

1 Without using a calculator, evaluate;

$$\frac{2\frac{1}{5} + \frac{2}{3} \text{ of } 3\frac{3}{4} - 4\frac{1}{6}}{1\frac{1}{4} - 2\frac{2}{5} \div 1\frac{1}{3} + 3\frac{3}{4}}$$

(3 marks)

2 The diagonal of a rectangular garden measures $11\frac{1}{4}$ m while its width measures $6\frac{3}{4}$ m. Calculate the perimeter of the garden.

(2 marks)

3 A motorist took 2 hours to travel from one town to another town and 1 hour 40 minutes to travel back. Calculate the percentage change in the speed of the motorist.

(3 marks)

4 A square room is covered by a number of whole rectangular slabs of sides 60 cm by 42 cm. Calculate the least possible area of the room in square metres.

(3 marks)

5 Given that $\sin(x + 60)^\circ = \cos(2x)^\circ$, find $\tan(x + 60)^\circ$.

(3 marks)

6 Simplify the expression:

$$\frac{4x - 9x^3}{3x^2 - 4x - 4}$$

(3 marks)

7 The external length, width and height of an open rectangular container are 41 cm, 21 cm and 15.5 cm respectively. The thickness of the material making the container is 5 mm. If the container has 8 litres of water, calculate the internal height above the water level.

(4 marks)

8 Factorise $2x^2y^2 - 5xy - 12$

(2 marks)

9 Using a ruler and a pair of compasses only:

(a) construct a parallelogram PQRS in which PQ = 6 cm, QR = 4 cm and angle SPQ = 75° ;

(3 marks)

(b) determine the perpendicular distance between PQ and SR.

(1 mark)

10 The masses of people during a clinic session were recorded as shown in the table below.

Mass (kg)	40-44	45-49	50-54	55-59	60-64	65-69	70-74
No. of people	1	2	12	10	2	2	1

Calculate the mean mass.

(3 marks)

- 11 A customer paid Ksh 5 880 for a suit after she was allowed a discount of 2% on the selling price. If the discount had not been allowed, the shopkeeper would have made a profit of 20% on the sale of the suit. Calculate the price at which the shopkeeper bought the suit. (3 marks)

Three vertices of a parallelogram PQRS are P(-1, 2), Q(8, -5) and R (5,0).

- (a) On the grid provided below draw the parallelogram PQRS. (1 mark)
- (b) Determine the length of the diagonal QS. (2 marks)
- 13 In January, Mambo donated $\frac{1}{6}$ th of his salary to a children's home while Simba donated $\frac{1}{5}$ th of his salary to the same children's home. Their total donation for January was Ksh 14 820. In February, Mambo donated $\frac{1}{8}$ th of his salary to the children's home while Simba donated $\frac{1}{12}$ th of his salary to the children's home. Their total donation for February was Ksh 8 675. Calculate Mambo's monthly salary. (4 marks)
- 14 (a) Express 10500 in terms of its prime factors. (1 mark)
- (b) Determine the smallest positive number P such that 10500P is a perfect cube. (2 marks)
- 15 Three police posts X, Y and Z are such that Y is 50 km on a bearing of 060° from X while Z is 70 km from Y and on a bearing of 300° from X.
- (a) Using a suitable scale, draw a diagram to represent the above situation. (3 marks)
- (b) Determine the distance, in km, of Z from X. (1 mark)
- 16 A small cone of height 8 cm is cut off from a bigger cone to leave a frustum of height 16 cm. If the volume of the smaller cone is 160 cm^3 , find the volume of the frustum. (3 marks)

SECTION II (50 marks)

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

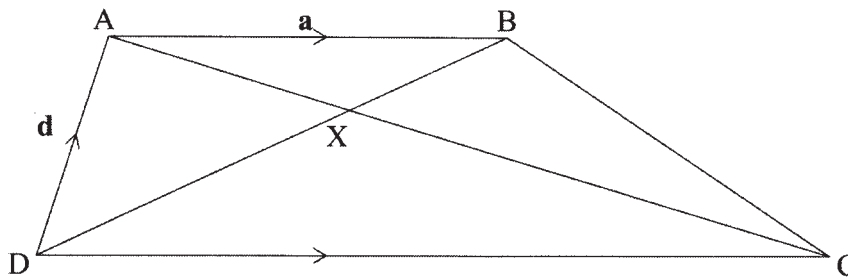
- 17 A solid consists of a cone and a hemisphere. The common diameter of the cone and the hemisphere is 12 cm and the slanting height of the cone is 10 cm.
- (a) Calculate correct to two decimal places:
- (i) the surface area of the solid; (3 marks)
- (ii) the volume of the solid. (4 marks)
- (b) If the density of the material used to make the solid is 1.3 g/cm^3 , calculate its mass in kilograms. (3 marks)

- 18 Makau made a journey of 700 km partly by train and partly by bus. He started his journey at 8.00 a.m. by train which travelled at 50 km/h. After alighting from the train, he took a lunch break of 30 minutes. He then continued his journey by bus which travelled at 75 km/h. The whole journey took $11\frac{1}{2}$ hours.
- (a) Determine:
- the distance travelled by bus; (4 marks)
 - the time Makau started travelling by bus. (3 marks)
- (b) The bus developed a puncture after travelling $187\frac{1}{2}$ km. It took 15 minutes to replace the wheel.
Find the time taken to complete the remaining part of the journey. (3 marks)
- 19 (a) The product of the matrices $\begin{pmatrix} 0 & 1 \\ 2 & p \end{pmatrix}$ and $\begin{pmatrix} -1.5 & -0.5 \\ p & p-2 \end{pmatrix}$ is a singular matrix.
Find the value of p . (3 marks)
- (b) A saleswoman earned a fixed salary of Ksh x and a commission of Ksh y for each item sold. In a certain month she sold 30 items and earned a total of Ksh 50 000. The following month she sold 40 items and earned a total of Ksh 56 000.
- Form two equations in x and y . (2 marks)
 - Solve the equations in (i) above using matrix method. (3 marks)
 - In the third month she earned Ksh 68 000. Find the number of items sold. (2 marks)
- 20 In a triangle ABC, $BC = 8$ cm, $AC = 12$ cm and angle $ABC = 120^\circ$.
- (a) Calculate the length of AB, correct to one decimal place. (4 marks)
- (b) If BC is the base of the triangle, calculate, correct to one decimal place:
- the perpendicular height of the triangle; (2 marks)
 - the area of the triangle; (2 marks)
 - the size of angle ACB. (2 marks)
- 21 (a) Using the trapezium rule with seven ordinates, estimate the area of the region bounded by the curve $y = -x^2 + 6x + 1$, the lines $x = 0$, $y = 0$ and $x = 6$. (5 marks)
- (b) Calculate:
- the area of the region in (a) above by integration; (3 marks)
 - the percentage error of the estimated area to the actual area of the region, correct to two decimal places. (2 marks)

- 22 The displacement, s metres, of a moving particle after t seconds is given by,
 $s = 2t^3 - 5t^2 + 4t + 2$.

Determine:

- (a) the velocity of the particle when $t = 3$ seconds; (3 marks)
 (b) the value of t when the particle is momentarily at rest; (3 marks)
 (c) the displacement when the particle is momentarily at rest; (2 marks)
 (d) the acceleration of the particle when $t = 3$ seconds. (2 marks)
- 23 In the figure below, ABCD is a trapezium. AB is parallel to DC, diagonals AC and DB intersect at X and $DC = 2 AB$. $\mathbf{AB} = \mathbf{a}$, $\mathbf{DA} = \mathbf{d}$, $\mathbf{AX} = k \mathbf{AC}$ and $\mathbf{DX} = h \mathbf{DB}$, where h and k are constants.



- (a) Find in terms of \mathbf{a} and \mathbf{d} :
- (i) \mathbf{BC} ; (2 marks)
 (ii) \mathbf{AX} ; (2 marks)
 (iii) \mathbf{DX} . (1 mark)
- (b) Determine the values of h and k . (5 marks)
- 24 The frequency table below shows the daily wages paid to casual workers by a certain company.

Wages in shillings	100-150	150-200	200-300	300-400	400-600
No. of workers	160	120	380	240	100

- (a) Draw a histogram to represent the above information. (5 marks)
- (b) (i) State the class in which the median wage lies. (1 mark)
 (ii) Draw a vertical line, in the histogram, showing where the median wage lies. (1 mark)
- (c) Using the histogram, determine the number of workers who earn sh 450 or less per day. (3 marks)

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

SECTION I (50 marks)

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

- 1 Use logarithms, correct to 4 decimal places, to evaluate

$$\sqrt[3]{\frac{83.46 \times 0.0054}{1.56^2}} \quad (4 \text{ marks})$$

- 2 Three grades A, B, and C of rice were mixed in the ratio 3:4:5. The cost per kg of each of the grades A, B and C were Ksh 120, Ksh 90 and Ksh 60 respectively.

Calculate:

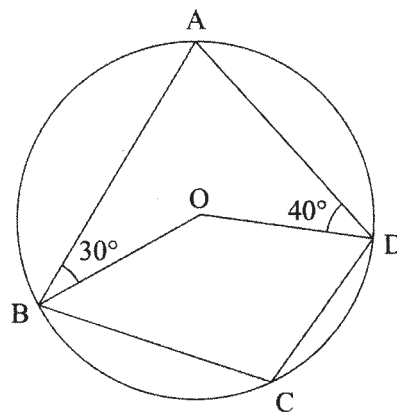
- (a) the cost of one kg of the mixture; (2 marks)
(b) the selling price of 5 kg of the mixture given that the mixture was sold at 8% profit. (2 marks)

- 3 Make s the subject of the formula.

$$w = \sqrt[3]{\frac{s+t}{s}} \quad (3 \text{ marks})$$

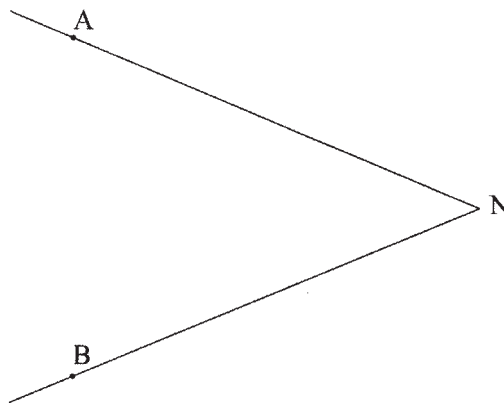
- 4 (a) Solve the inequalities $2x - 5 > -11$ and $3 + 2x \leq 13$, giving the answer as a combined inequality. (3 marks)
(b) List the integral values of x that satisfy the combined inequality in (a) above. (1 mark)

- 5 In the figure below, ABCD is a cyclic quadrilateral. Point O is the centre of the circle. Angle ABO = 30° and angle ADO = 40° .



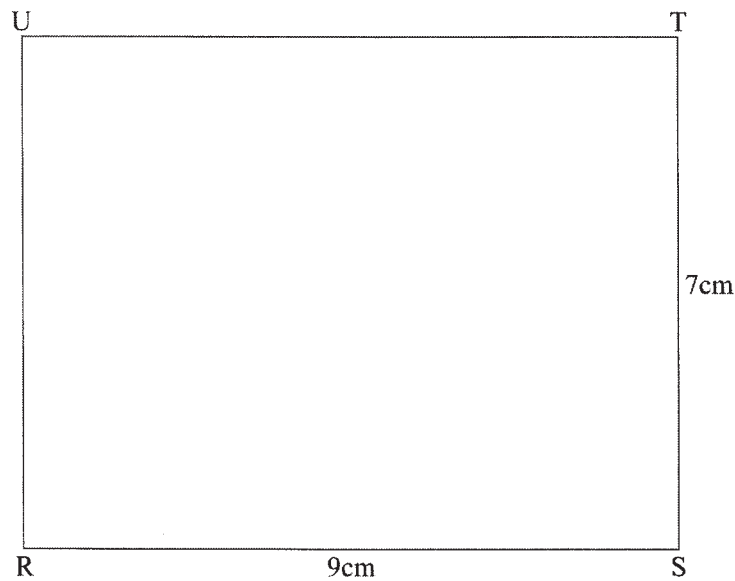
Calculate the size of angle BCD. (2 marks)

- 6 The ages in years of five boys are 7, 8, 9, 10 and 11 while those of five girls are 4, 5, 6, 7 and 8. A boy and a girl are picked at random and the sum of their ages is recorded.
- (a) Draw a probability space to show all the possible outcomes. (1 mark)
- (b) Find the probability that the sum of their ages is at least 17 years. (1 mark)
- 7 The vertices of a triangle are A(1,2), B(3,5) and C(4,1). The coordinates of C' the image of C under a translation vector T, are (6,-2).
- (a) Determine the translation vector T. (1 mark)
- (b) Find the coordinates of A' and B' under translation vector T. (2 marks)
- 8 Write $\sin 45^\circ$ in the form $\frac{1}{\sqrt{a}}$ where a is a positive integer. Hence simplify $\frac{\sqrt{8}}{1 + \sin 45^\circ}$, leaving the answer in surd form. (3 marks)
- 9 The radius of a spherical ball is measured as 7 cm, correct to the nearest centimetre. Determine, to 2 decimal places, the percentage error in calculating the surface area of the ball. (4 marks)
- 10 (a) In the figure below, lines NA and NB represent tangents to a circle at points A and B. Use a pair of compasses and ruler only to construct the circle. (2 marks)



- (b) Measure the radius of the circle. (1 mark)
- 11 Expand and simplify the expression.
- $$\left(a + \frac{1}{2}\right)^4 + \left(a - \frac{1}{2}\right)^4$$
- (3 marks)

- 12 The figure below represents a scale drawing of a rectangular piece of land, RSTU. RS = 9 cm and ST = 7 cm.



- An electric post P, is to be erected inside the piece of land. On the scale drawing, shade the possible region in which P would lie such that $PU > PT$ and $PS \leq 7$ cm. (3 marks)
- 13 Vector $\mathbf{OP} = 6\mathbf{i} + \mathbf{j}$ and $\mathbf{OQ} = -2\mathbf{i} + 5\mathbf{j}$. A point N divides PQ internally in the ratio 3:1. Find PN in terms of \mathbf{i} and \mathbf{j} . (3 marks)
- 14 A point M (60°N , 18°E) is on the surface of the earth. Another point N is situated at a distance of 630 nautical miles east of M. Find:
- (a) the longitude difference between M and N; (2 marks)
- (b) the position of N. (1 mark)
- 15 The equation of a circle centre (a,b) is $x^2 + y^2 - 6x - 10y + 30 = 0$. Find the values of a and b. (3 marks)
- 16 The table below shows values of x and y for the function $y = 2 \sin 3x^\circ$ in the range $0^\circ \leq x \leq 150^\circ$.

x°	0	15	30	45	60	75	90	105	120	135	150
y	0	1.4	2	1.4	0	-1.4	-2	-1.4	0	1.4	2

- (a) On the grid provided, draw the graph of $y = 2 \sin 3x$. (2 marks)

- (b) From the graph determine the period. (1 mark)

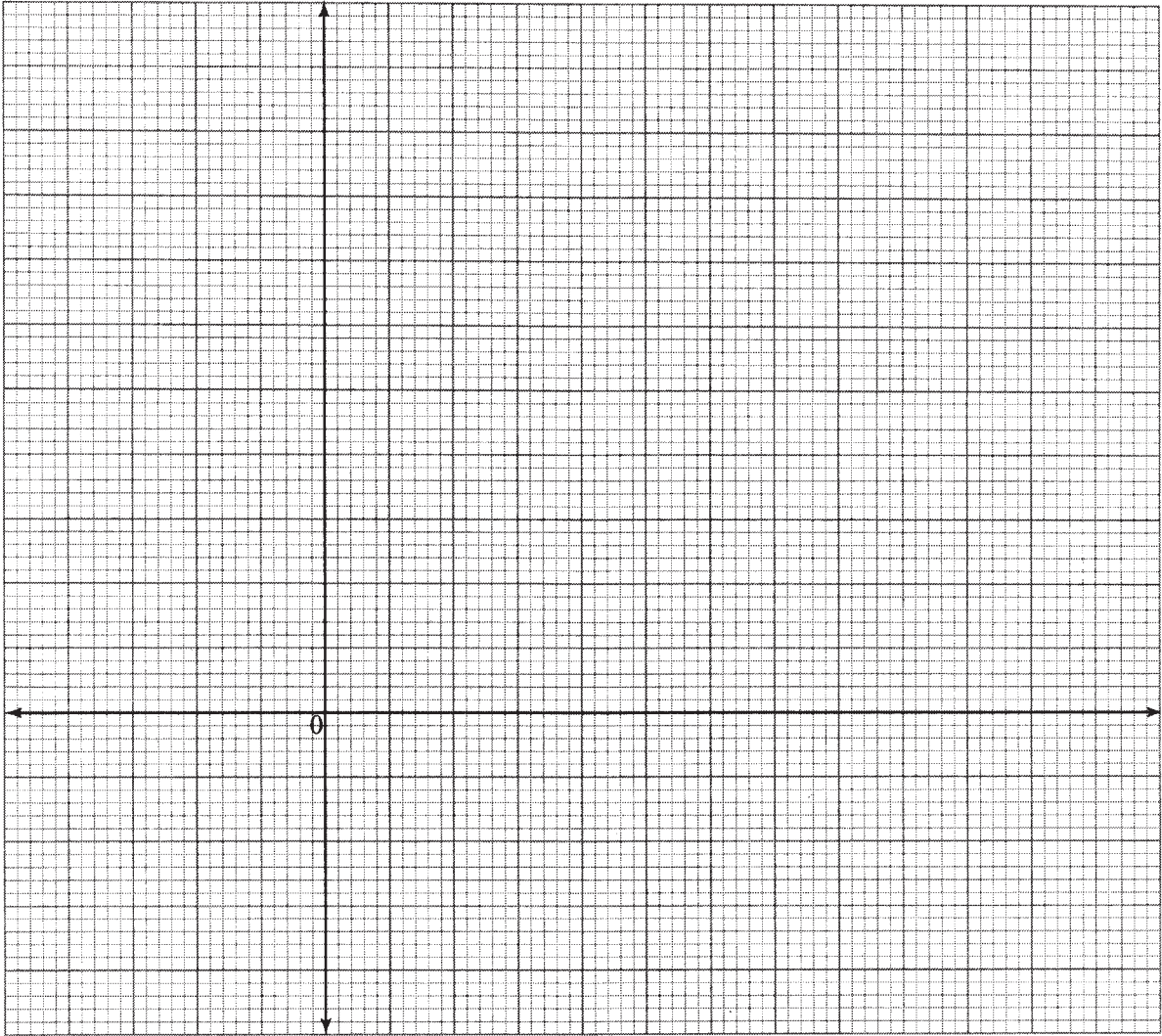
SECTION II (50 marks)

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

- 17 The cash price of a laptop was Ksh 60 000. On hire purchase terms, a deposit of Ksh 7 500 was paid followed by 11 monthly installments of Ksh 6 000 each.
- (a) Calculate:
- (i) the cost of a laptop on hire purchase terms; (2 marks)
- (ii) the percentage increase of hire purchase price compared to the cash price. (2 marks)
- (b) An institution was offered a 5% discount when purchasing 25 such laptops on cash terms. Calculate the amount of money paid by the institution. (2 marks)
- (c) Two other institutions, X and Y, bought 25 such laptops each. Institutions X bought the laptops on hire purchase terms. Institution Y bought the laptops on cash terms with no discount by securing a loan from a bank. The bank charged 12% p.a. compound interest for two years. Calculate how much more money institution Y paid than institution X. (4 marks)
- 18 The first, fifth and seventh terms of an Arithmetic Progression (AP) correspond to the first three consecutive terms of a decreasing Geometric Progression (G.P). The first term of each progression is 64, the common difference of the AP is d and the common ratio of the G.P is r .
- (a) (i) Write two equations involving d and r . (2 marks)
- (ii) Find the values of d and r . (4 marks)
- (b) Find the sum of the first 10 terms of:
- (i) the Arithmetic Progression (A.P); (2 marks)
- (ii) the Geometric Progression (G.P). (2 marks)

19 The vertices of a rectangle are $A(-1,-1)$, $B(-4,-1)$, $C(-4,-3)$ and $D(-1,-3)$.

- (a) On the grid provided, draw the rectangle and its image $A' B' C' D'$ under a transformation whose matrix is $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$. (4 marks)



(b) $A'' B'' C'' D''$ is the image of $A' B' C' D'$ under a transformation matrix,

$$P = \begin{pmatrix} \frac{1}{2} & 1 \\ 1 & \frac{1}{2} \end{pmatrix}.$$

- (i) Determine the coordinates of A'' , B'' , C'' and D'' . (2 marks)
- (ii) On the same grid draw the quadrilateral $A'' B'' C'' D''$. (1 mark)
- (c) Find the area of $A'' B'' C'' D''$. (3 marks)

20 A parent has two children whose age difference is 5 years. Twice the sum of the ages of the two children is equal to the age of the parent.

- (a) Taking x to be the age of the elder child, write an expression for:
- (i) the age of the younger child; (1 mark)
 - (ii) the age of the parent. (1 mark)
- (b) In twenty years time, the product of the children's ages will be 15 times the age of their parent.
- (i) Form an equation in x and hence determine the present possible ages of the elder child. (4 marks)
 - (ii) Find the present possible ages of the parent. (2 marks)
 - (iii) Determine the possible ages of the younger child in 20 years time. (2 marks)

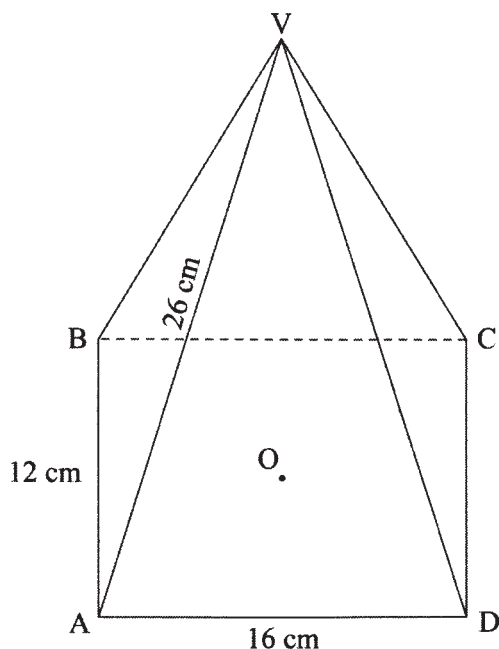
21 The table below shows values of x and some values of y for the curve $y = x^3 + 2x^2 - 3x - 4$ for $-3 \leq x \leq 2$.

x	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
y	-4.0	-0.4		1.6	0		-4.0	-4.9			6

- (a) Complete the table by filling in the missing values of y , correct to 1 decimal place. (2 marks)
- (b) On the grid provided, draw the graph of $y = x^3 + 2x^2 - 3x - 4$.
Use the scale: 1 cm represents 0.5 units on x -axis.
1 cm represents 1 unit on y -axis. (3 marks)

- (c) Use the graph to:
- (i) solve the equation $x^3 + 2x^2 - 3x - 4 = 0$; (3 marks)
- (ii) estimate the coordinates of the turning points of the curve. (2 marks)

- 22 The figure below represents a rectangular based pyramid VABCD. AB = 12 cm and AD = 16 cm. Point O is vertically below V and VA = 26 cm.



Calculate:

- (a) the height, VO, of the pyramid; (4 marks)
- (b) the angle between the edge VA and the plane ABCD; (3 marks)
- (c) the angle between the planes VAB and ABCD. (3 marks)
- 23 The cost C, of producing n items varies partly as n and partly as the inverse of n. To produce two items it costs Ksh 135 and to produce three items it costs Ksh 140. Find:
- (a) the constants of proportionality and hence write the equation connecting C and n; (5 marks)
- (b) the cost of producing 10 items; (2 marks)

- (c) the number of items produced at a cost of Ksh 756. (3 marks)

24 A building contractor has two lorries, P and Q, used to transport at least 42 tonnes of sand to a building site. Lorry P carries 4 tonnes of sand per trip while lorry Q carries 6 tonnes of sand per trip. Lorry P uses 2 litres of fuel per trip while lorry Q uses 4 litres of fuel per trip. The two lorries are to use less than 32 litres of fuel. The number of trips made by lorry P should be less than 3 times the number of trips made by lorry Q. Lorry P should make more than 4 trips.

- (a) Taking x to represent the number of trips made by lorry P and y to represent the number of trips made by lorry Q, write the inequalities that represent the above information. (4 marks)
- (b) On the grid provided, draw the inequalities and shade the unwanted regions. (4 marks)
- (c) Use the graph drawn in (b) above to determine the number of trips made by lorry P and by lorry Q to deliver the greatest amount of sand. (2 marks)

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

SECTION I (50 marks)

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

- 1 Evaluate $\frac{-3 \times +6 + -2}{-4 + +5 - -3}$ (3 marks)
- 2 Find the common prime factors of 1890 and 1008. (2 marks)
- 3 On a certain day a journalist started travelling at 0850 hours to attend a meeting. He travelled for $6\frac{1}{2}$ hours and then rested for 1 hour 45 minutes. He attended the meeting for $3\frac{3}{4}$ hours and travelled for 35 minutes to a hotel.
Determine the time, in 12-hour clock system, the journalist arrived at the hotel. (3 marks)
- 4 Use cube tables to calculate, to 4 significant figures, the volume of a cube whose side is 0.4321 m. (3 marks)
- 5 A cylindrical container of height 45 cm has a capacity of 25 litres. Find the radius of the container to the nearest millimetre. (3 marks)
- 6 Find the integral values of x which satisfy the inequality $3x \leq 2x + 3 < 4x + 5$ (3 marks)
- 7 Three metal rods of lengths 234 cm, 270 cm and 324 cm were cut into shorter pieces, all of the same length, to make window grills.
Calculate the length of the longest piece that can be cut from each of the rods and hence the total number of pieces that can be obtained from the rods. (4 marks)
- 8 Simplify $\frac{1\frac{1}{5} - \frac{3}{8} \div \frac{2}{3}}{\frac{6}{7} \text{ of } 1\frac{1}{2} - \frac{3}{8}}$ (3 marks)
- 9 A support cable of length 6.5 m is fixed on a vertical pole at a distance of 0.9 m from the top. The cable is anchored on the ground at a distance of 2.5 m from the foot of the pole.
Determine the height of the pole. (3 marks)
- 10 Use logarithm tables to evaluate (3 marks)
- $$\sqrt{\frac{2.5 \times 0.064}{8.1}}$$
- 11 Using a ruler and a pair of compasses only, construct triangle ABC such that AB = 4.5 cm, BC = 8.1 cm and angle CBA = 60° .
Measure angle CAB. (3 marks)
- 12 The areas of the lids of two similar cylinders are 16 cm^2 and 25 cm^2 . If the volume of the bigger cylinder is 800 cm^3 , find the volume of the smaller cylinder. (4 marks)
- 13 Use factorisation to solve the equation: (3 marks)
- $$\frac{1}{8}x^2 + x = 48$$

14 The sum of interior angles of a regular polygon is 1620° . Calculate the number of sides of the polygon. (2 marks)

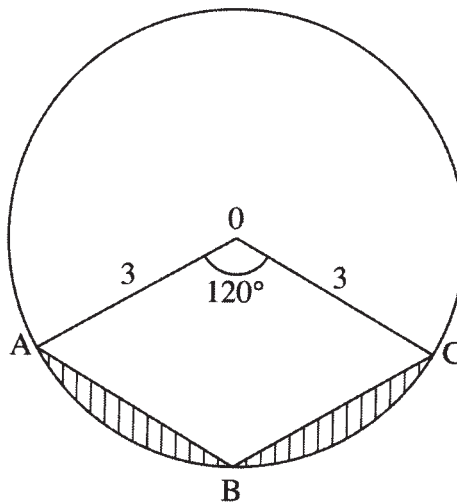
15 Solve the simultaneous equations:

$$p - q = 3$$

$$p^2 - q^2 = 21$$

(4 marks)

16 In the figure below, OABC is a rhombus drawn in a circle, centre O, of radius 3 cm. Angle $AOC = 120^\circ$



Determine the total area of the shaded regions to 2 decimal places.

(4 marks)

SECTION II (50 marks)

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

17 A salesman was paid a basic salary of Ksh 48 000 per month plus a commission of 3% for sales of goods worth above Ksh 500 000.

- In January he sold goods worth Ksh 800 000, calculate his total earnings that month. (3 marks)
- In February his total earnings were Ksh 78 000. Find the value of goods sold that month. (4 marks)
- In the month of March, his original rate of commission was reduced by 60%. If he sold goods worth Ksh 2 500 000, calculate his total earnings that month. (3 marks)

18 Three straight lines L_1 , L_2 and L_3 are such that:

L_1 cuts the y -axis at $y = 5$ and has a gradient of 2;

L_2 is perpendicular to L_1 at the point where L_1 cuts the x -axis;

L_3 is parallel to L_2 and passes through point $(1, 2)$.

(a) Find the equations, in the form $y = mx + c$, of:

(i) L_1 ; (2 marks)

(ii) L_2 ; (3 marks)

(iii) L_3 . (2 marks)

(b) Determine the coordinates of the point at which L_3 is perpendicular to L_1 . (3 marks)

19 Three partners, Amani, Furaha and Nehema, contributed a total capital of Ksh 750 000 to start a business. Amani contributed $\frac{1}{3}$ of the money, Furaha contributed $\frac{2}{5}$ of the money and Nehema contributed the rest.

After some time the business realised a profit of 36% of the capital. The profit was taxed at the rate of 5%.

After taxation, each of the partners received Ksh 20 000 of the profit. The remainder of the profit was shared among the three partners in the ratio of their contributions.

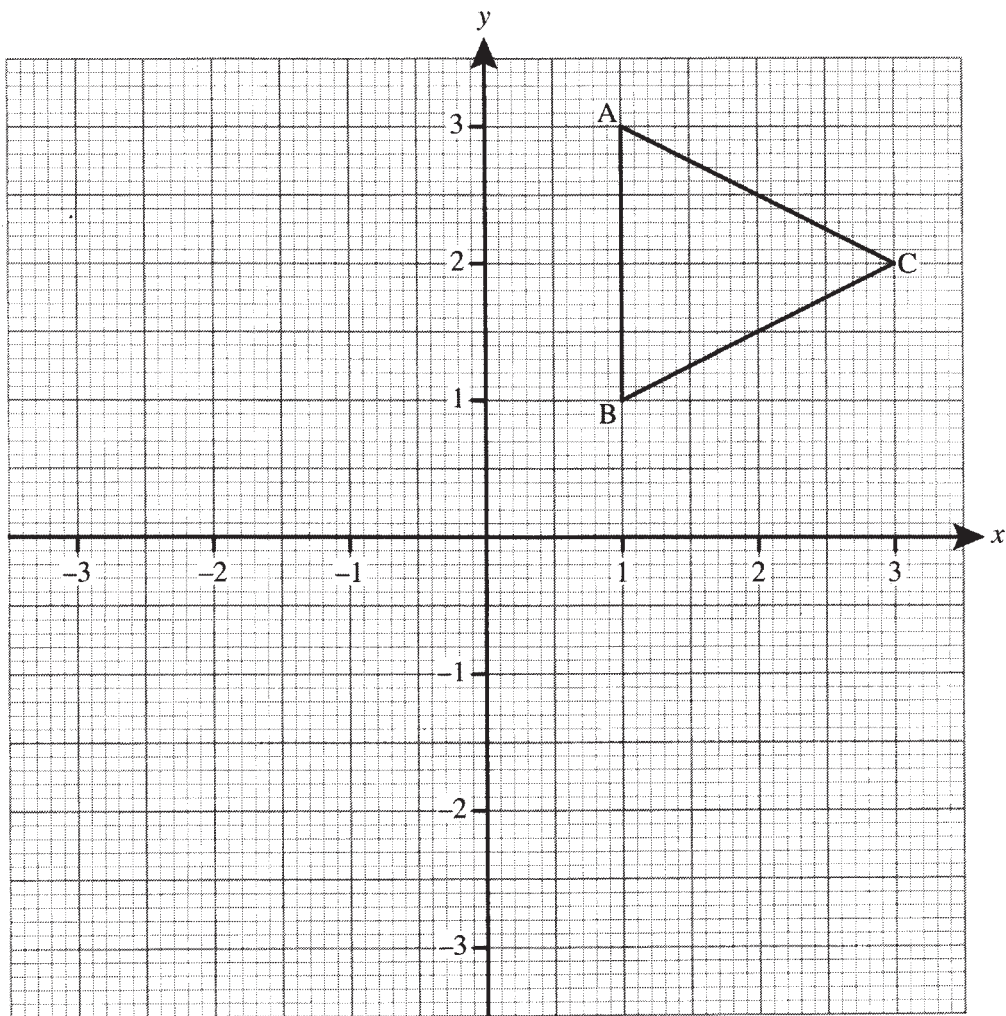
Calculate:

(a) the amount of money contributed by Nehema; (3 marks)

(b) the profit realised after taxation; (3 marks)

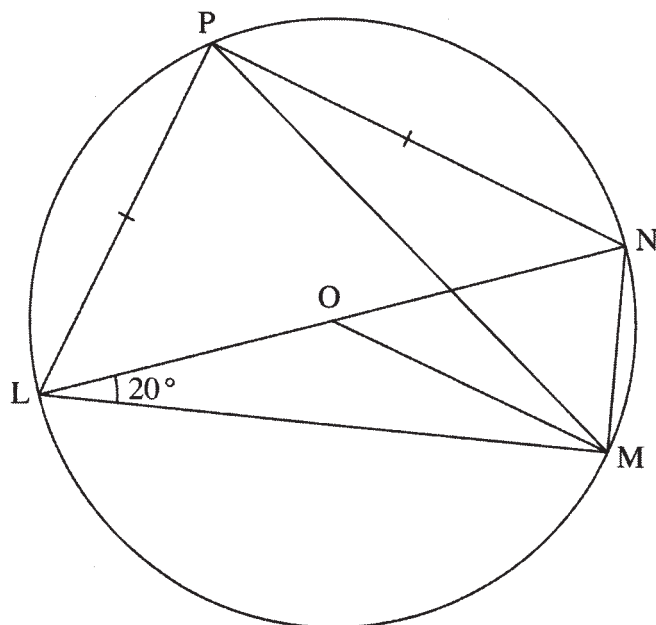
(c) the amount of money Furaha got more than Nehema. (4 marks)

- 20 The figure below shows triangle ABC with co-ordinates A (1, 3), B (1, 1) and C (3, 2).



- (a) Draw triangle A'B'C', the image of ΔABC under reflection in the y -axis. (2 marks)
- (b) (i) Draw line $y = x$. (1 mark)
- (ii) Draw triangle A''B''C'', the image of $\Delta A'B'C'$ under reflection in the line $y = x$. (2 marks)
- (c) Determine the matrix of transformation that maps ΔABC onto $\Delta A''B''C''$. (3 marks)
- (d) Describe fully a single transformation that maps ΔABC onto $\Delta A''B''C''$. (2 marks)

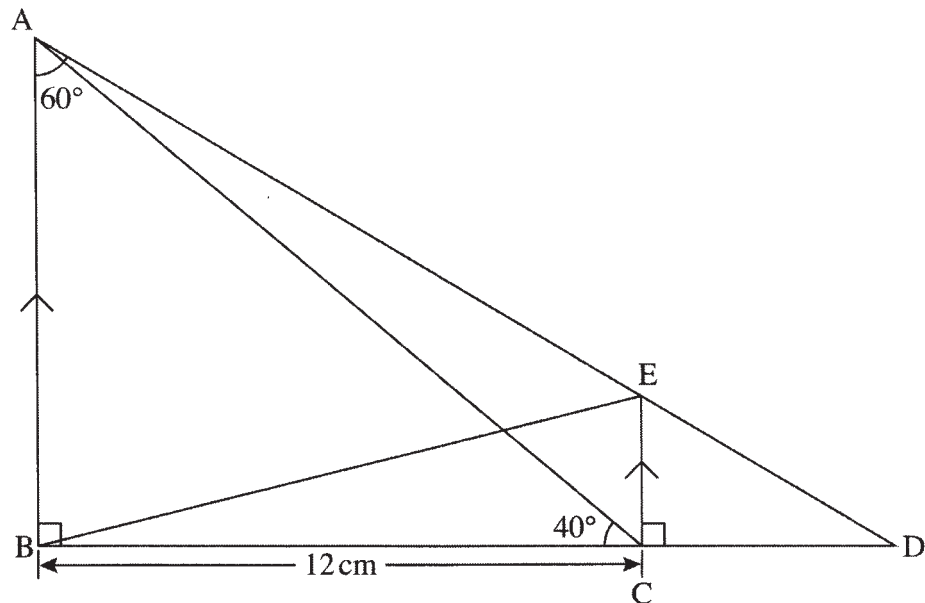
- 21 In the figure below, points L, M, N and P are on the circumference of a circle centre O. Line LON is a diameter of the circle. $PL = PN$ and angle $NLM = 20^\circ$.



Find, giving a reason in each case, the size of each of the following angles.

- | | | |
|-----|----------------|-----------|
| (a) | $\angle MPN$; | (2 marks) |
| (b) | $\angle PLN$; | (2 marks) |
| (c) | $\angle LPM$; | (2 marks) |
| (d) | $\angle MNP$; | (2 marks) |
| (e) | $\angle PMO$. | (2 marks) |

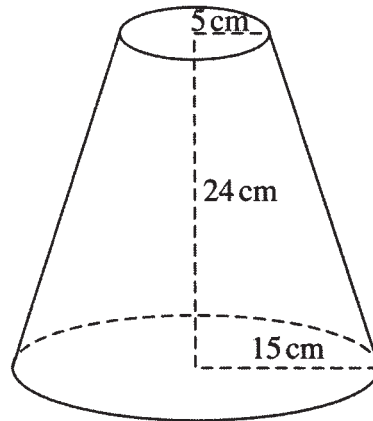
- 22 In the figure below, $BC = 12$ cm, $\angle ACB = 40^\circ$, $\angle BAD = 60^\circ$, BCD is a straight line and CE is parallel to BA .



Calculate:

- (a) the length of:
- (i) AB ; (2 marks)
- (ii) CD . (4 marks)
- (b) the size of angle CBE . (4 marks)
- 23 A piece of land is in the shape of a quadrilateral $ABCD$. Point B is 450 m east of A . Point D is 500 m from A on a bearing of 310° . Point C is 700 m from D on a bearing of 080° .
- (a) Using 1 cm to represent 100 m, make a scale drawing of the piece of land. (4 marks)
- (b) Find:
- (i) the perimeter of the piece of land; (3 marks)
- (ii) the length of AC ; (1 mark)
- (iii) the bearing of A from C . (2 marks)

- 24 The figure below represents a frustum of a cone with dimensions as shown.



Taking $\pi = 3.142$, calculate:

- (a) the area of the circular surfaces, correct to 4 significant figures; (3 marks)
- (b) the height of the small cone that was cut off to make the frustum; (2 marks)
- (c) the area of the curved surface of the frustum, correct to 4 significant figures. (5 marks)

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

SECTION I (50 marks)

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

1 Given that $m = \frac{3}{0.089^2}$ and $n = \frac{1}{\sqrt{82.49}}$,

use a calculator to find:

(a) the value of m and the value of n ; (2 marks)

(b) the value of $m + n$ to 4 significant figures. (1 mark)

2 Given that $\mathbf{a} = 2\mathbf{i} - 4\mathbf{j}$ and $\mathbf{b} = \mathbf{i} - 3\mathbf{j}$, find $3\mathbf{a} - 5\mathbf{b}$. (3 marks)

3 The mass of an object is 0.36 kg and its density is 2.5g/cm³. Calculate the volume of the object in cm³. (2 marks)

4 Make T the subject of the formula, (3 marks)

$$P = \sqrt{\frac{S(T - R)}{A}}$$

5 A trader mixes two types of fruit juices A and B in the ratio 2:5. Type A costs Ksh 140 per litre and type B costs Ksh 105 per litre. Find the selling price of the mixture per litre if the trader makes a 20% profit. (4 marks)

- 6 The table below shows the ages of a group of students.

Age in years	14	15	16	17	18
Number of students	2	6	14	16	10

- Draw a pie chart to represent the above information. (3 marks)
- 7 Given that $P = \begin{pmatrix} 1 & -2 \\ -1 & 3 \end{pmatrix}$, $Q = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$ and $R = P^2Q$, determine R . (3 marks)
- 8 Find the number which must be added to the quadratic expression $x^2 + 6x + 1$ to make it a perfect square. (3 marks)
- 9 A point P is located 10 cm from the centre of a circle of radius 6 cm. Calculate the length of a tangent drawn from P to the circle. (2 marks)
- 10 A bag contains balls of identical size of which 36 are blue and the rest yellow. When a ball is drawn at random from the bag, the probability that it is yellow is $\frac{2}{5}$. Calculate the number of yellow balls in the bag. (3 marks)
- 11 In a triangular plot of land ABC, $BC = 18$ m, $AC = 10$ m and angle $ACB = 80^\circ$. Calculate to 2 decimal places:
- (a) the length AB; (2 marks)
- (b) the size of angle CAB. (2 marks)
- 12 Below is part of an income tax table for monthly income in a certain year.
- | Monthly Taxable income in Ksh | Tax Rate in each shilling |
|----------------------------------|---------------------------|
| Up to Ksh 10 164 | 10% |
| From Ksh 10 165 up to Ksh 19 740 | 15% |
| From Ksh 19 741 up to Ksh 29 316 | 20% |
- In that year Wambita's monthly taxable salary was Ksh 18 000. He was entitled to a monthly personal relief of Ksh 1162. Calculate the monthly income tax paid. (4 marks)
- 13 Two towns on the equator differ in local time by 6 hours. Find the distance in km, between the two towns. (3 marks)
- (Take the circumference of the earth to be 40 000 km)

- 14 The first term of an arithmetic progression (A.P) is 7 and the 17th term is 81. There are 15 other terms between them.
Calculate:

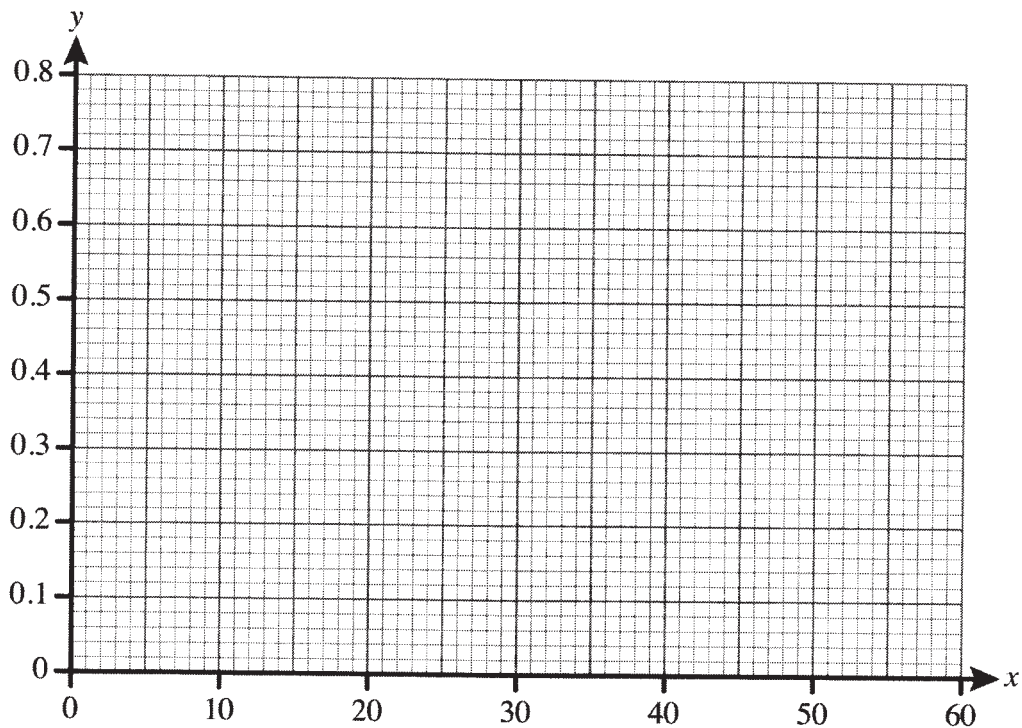
- (a) the sum of the 17 terms; (2 marks)
- (b) the sum of the 15 middle terms of the A.P. (2 marks)

- 15 The matrix $\begin{pmatrix} 4 & 1 \\ 6 & 2 \end{pmatrix}$ maps point P onto its image P'.
Determine the matrix that maps the image P' onto P. (3 marks)

- 16 Corresponding value of x and y in a given relation are as shown in the table below.

x	15	18	23	30	35	40	45	53
y	0.10	0.18	0.23	0.34	0.40	0.50	0.55	0.74

- On the grid provided, plot all the points and draw the line of best fit. (3 marks)



SECTION II (50 marks)

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

- 17 Three machines P, Q and R take 8 hours, 12 hours and 16 hours respectively to complete a task. The three machines were set to work together for $1\frac{1}{2}$ hours. Machine Q was then switched off while machines P and R were left to complete the remaining task.
- (a) Find the fraction of the task done by P, Q and R in the first hour. (2 marks)
- (b) Calculate the fraction of the task:
- (i) done by P, Q and R in $1\frac{1}{2}$ hours; (2 marks)
- (ii) left after $1\frac{1}{2}$ hours. (2 marks)
- (c) Determine the time, in hours and minutes, taken by machines P and R to complete the remaining task. (4 marks)
- 18 The third and the sixth terms of a geometric progression are 18 and 486 respectively. Calculate:
- (a) the common ratio; (3 marks)
- (b) the first term; (2 marks)
- (c) the sum of the ninth and tenth terms; (3 marks)
- 19 The coordinates of points A, B and C are A(2,2), B(5,6) and C(9,8). Point D is such that $\mathbf{AD} = 3 \mathbf{BC}$.
- (a) Find:
- (i) \mathbf{BC} ; (2 marks)
- (ii) the coordinates of point D. (4 marks)
- (b) Given that T is the midpoint of \mathbf{AD} , find:
- (i) the coordinates of point T; (2 marks)
- (ii) the magnitude of \mathbf{TC} , correct to 2 significant figures. (2 marks)
- 20 Two towns, T and U are 36 km apart. A cyclist travelled from town T to town U at an average speed of x km/h. On his journey back from town U to town T his average speed was $(x + 3)$ km/h.
- (a) Write down an expression in terms of x for the time in hours the cyclist took to travel from:
- (i) town T to town U; (1 mark)
- (ii) town U to town T. (1 mark)

- (b) The journey from town T to town U took one hour longer than the journey from town U to town T. Form an equation in x and hence determine the average speed of the cyclist on his journey back from town U to town T. (5 marks)
- (c) Calculate to one decimal place, the cyclists' average speed for the whole journey from town T to town U and back. (3 marks)

21 Matata, a horticulture farmer, carried out the following transactions in the month of April 2010.

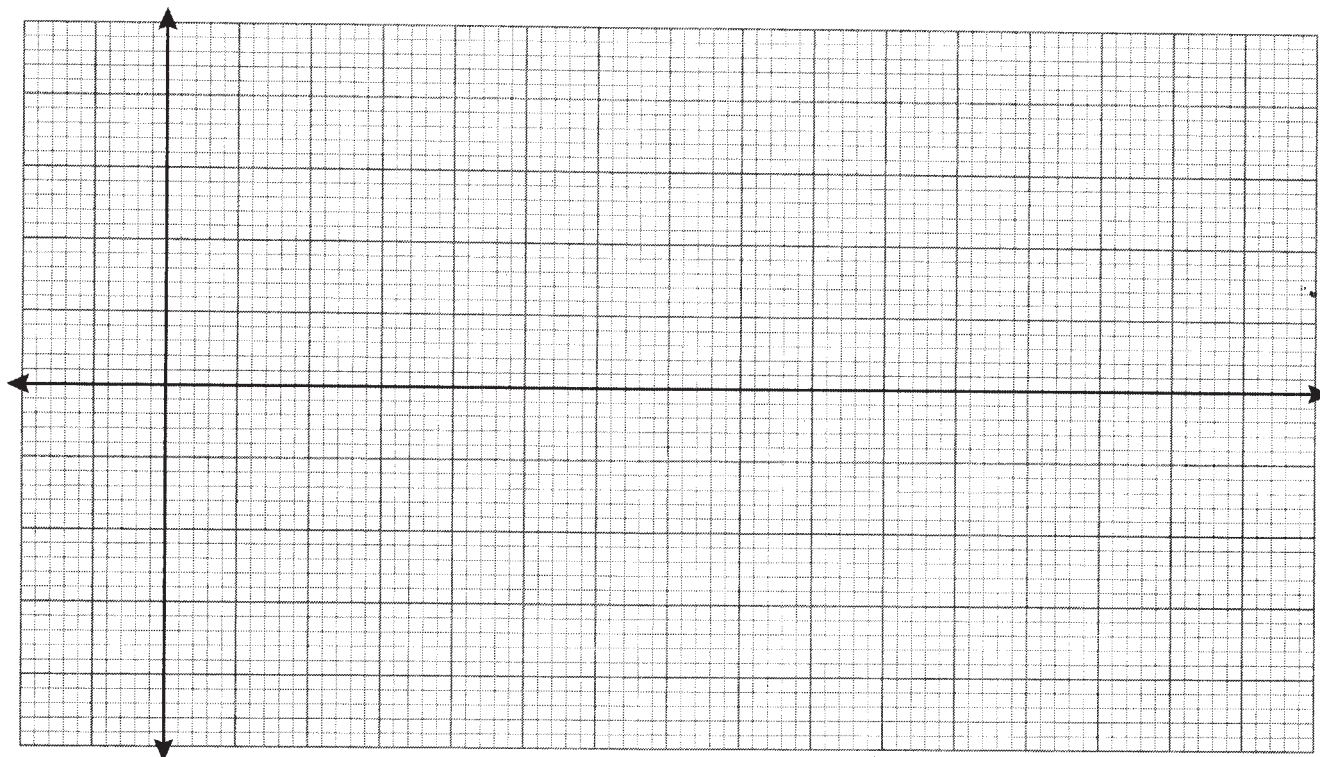
- April 1: Had Ksh 8 000 carried forward from March 2010.
4: Bought 2 bags of fertilizer @Ksh 1 750.
5: Paid Ksh 600 for water.
9: Bought spraying chemicals for Ksh 1 500.
12: Received Ksh 15 000 from the sale of bananas.
15: Sold cabbages for Ksh 5 000.
16: Paid wages to two casual workers at Ksh 1 500 each.
20: Sold tomatoes for Ksh 9 500.
24: Paid Ksh 840 for electricity.
25: Bought seeds for Ksh 450.
28: Sold onions for Ksh 2 500.
30: Bought a spray pump for Ksh 7 500.

Prepare a single column cash book for Matata's transactions and balance it as at 30th April, 2010. (10 marks)

- 22 (a) (i) Complete the table below for $y = 2\sin x^\circ$. (2 marks)

x°	0	30	60	90	120	150	180	210	240	270	300	330	360
$y = 2\sin x^\circ$	0	1			1.73		0	-1				-1	0

- (ii) On the grid below draw the graph of $y = 2\sin x^\circ$ for $0^\circ \leq x \leq 360^\circ$. Use 1 cm for 30° on the x-axis and 2 cm for 1 unit on the y-axis. (4 marks)



- (b) Use the graph to find:
- (i) the values of x for which $y = 1.5$; (2 marks)
- (ii) the range of values of x for which $2\sin x^\circ > 1$. (2 marks)

- 23 The masses in kilograms of forty chicken slaughtered in a restaurant on a certain day are as shown in the table below.

Mass in kg	1.2	1.3	1.4	1.5	1.6	1.7	1.8
Number of chicken	2	4	6	12	8	5	3

Calculate the:

- (a) mean mass, correct to 2 significant figures; (3 marks)
- (b) variance; (5 marks)
- (c) standard deviation, correct to 4 significant figures. (2 marks)
- 24 (a) Complete the table below for the function $y = x^2 + x + 4$. (2 marks)

x	-3	-2	-1	0	1	2	3	4
y								

- (b) (i) On the grid provided, draw the graph of the function $y = x^2 + x + 4$ for $-3 \leq x \leq 4$. (4 marks)
- (ii) Use the trapezium rule with 7 strips of equal width to estimate the area bounded by the curve, the x-axis and the lines $x = -3$ and $x = 4$. (4 marks)