SECTION I (50 marks)
*Answer all questions in this section.*

1. All odd numbers from $1-10$ are arranged in descending order to form a number.
    (i)   Write the number   (1 mark)
    (ii) Write the total value of the second digit of the number formed in (a) (i)   (1 mark)
    (iii) Express the value of the number in (a) (ii) as a product of its prime factors in power form (2 marks)

2. A shopkeeper bought a bag of sugar. He intends to repack the sugar in 40 g, 250 g and 750 g.
    Determine the least mass in grams of sugar that was in the bag.   (3 marks)

3. Given that $\log_{10} 2 = 0.3010$ and $\log_{10} 3 = 0.4771$ without using tables or calculator find $\log 0.036$ correct
    to 4 significant figures.   (3 marks)

4. Evaluate $\dfrac{\frac{1}{2} \, of \, \frac{3}{2} + 1\frac{1}{2}\left(2\frac{1}{2} - \frac{2}{3}\right)}{\frac{3}{4} \, of \, 2\frac{1}{2} \div \frac{1}{2}}$ (3 marks)

5. Using the grid provided below, solve the simultaneous equation   (3 marks)
    $3x - 4y = 10$

    $5x + 7y = 3$

6. Given that a chord of length 10 cm subtends an angle of 1.2^{c} at the circumference of the circle.
    Calculate the radius of the circle.   (3 marks)

7. When a shopkeeper sells articles at $\text{Ksh } 24.05$, he makes a 30% profit on the cost price. During a sale, he
    reduced the price of each article to $\text{Ksh } 22.95$. Calculate the percentage profit on an article sold at the sale
    price.   (3 marks)

8. The size of one interior angle of an irregular polygon is 80^{0}. Each of the other interior angles is 128^{0}.
    Find the number of sides of the polygon.   (3 marks)

9. Simplify $81^{\frac{3}{4}} - \left(\frac{1}{5}\right)^{-1} - 27^0$ (2 marks)

10. Given the inequalities $x - 6 \le -3x + 2 < -2x + 9$
(a) Solve the inequality (3 marks)
(b) Represent on a number line (1 mark)

11. The diagram below represents a right rectangular based pyramid of 5 cm by 4 cm. The slant edge of the pyramid is 6 cm. Draw and label the net of the pyramid. (3 marks)
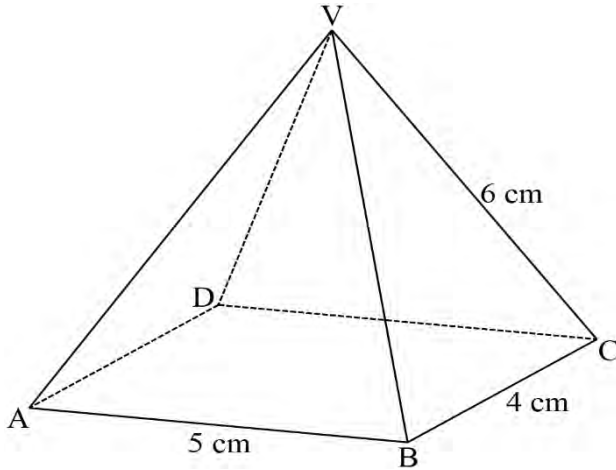

12. Vectors $\mathbf{OA} = 4i + 3j$, $\mathbf{OB} = -2i - j$ and $\mathbf{OC} = -5i - 3j$. Show that points A, B and C are collinear. (3 marks)

13. Find the period, amplitude and phase angle of the function $2y = 3\sin\left(\frac{1}{2}x - 60^0\right)$ (3 marks)

14. Simplify $\dfrac{20 - 11x - 3x^2}{16x - 12x^2}$ (3 marks)

15. Write the following ratios in ascending order $2:3$, $15:16$, $7:6$, $13:15$ (3 marks)

16. Under an enlargement, the image of the points $A(3,1)$ and $B(1,2)$ are $A'(3,7)$ and $B'(7,5)$. Find the centre and scale factor of enlargement. (4 marks)

SECTION II (50 marks)
Answer only five questions in this section.

17. A straight line passes through $P(-1,1)$ and $Q(3,4)$.
(a) Find the length of line PQ (2 marks)
(b) Find the equation of the perpendicular bisector of line PQ, leaving the equation in the form
$y = mx + c$ (4 marks)
(c) Determine the equation of line parallel to line PQ and passes through point $(2,3)$, leaving
your answer in double intercept form. Hence state the y intercept. (4 marks)

18. The marks scored by 30 students in test were recorded as follows

41	43	34	28	19	22
32	38	22	18	25	33
30	41	36	31	28	37
35	34	19	22	29	23
29	44	26	27	29	36

(a) Starting with the class $18 - 22$, make a frequency distribution table for the data. (2 marks)
(b) Using the frequency distribution in (a) above calculate :
(i) the mean (2 marks)
(ii) the median (3 marks)
(c) Draw a frequency polygon to represent the data. (3 marks)

19. The solid below is made up of hemispherical part and a frustum of cone. The top and bottom radius of the frustum are 5 cm and 15 cm respectively. The vertical height of the frustum is 24 cm.
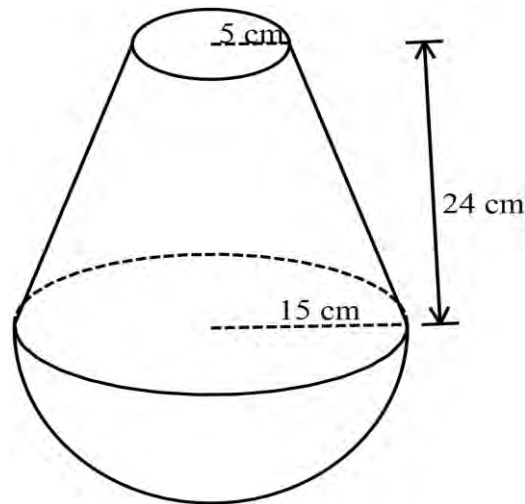

(a) Determine the vertical height of the cone from which the frustum was cut. (2 marks)

(b) Calculate

(i) The volume of the solid correct to 2 decimal places (3 marks)

(ii) The surface area of the solid correct to 2 decimal places (5 marks)

20. (a) (i) Draw the graph of the function $y = 2x^2 - 3x - 5$ for $-2 \leq x \leq 3$ (5 marks)

(ii) Use the graph to solve the equation $2x^2 - 3x - 5 = 0$ (1 mark)

(b) Use the graph to solve the simultaneous equation $y = 2x^2 - 3x - 5$ and $y = -2x - 2$ (3 marks)

(c) Write down the quadratic equation which the line $y = -2x - 2$ is solving. (1 marks)

21. The diagram below shows the speed time graph for a bus travelling between two stations, the bus starts from rest and accelerates uniformly for 75 seconds. It then travels at constant speed for 150 seconds and finally decelerates uniformly for 100 seconds.
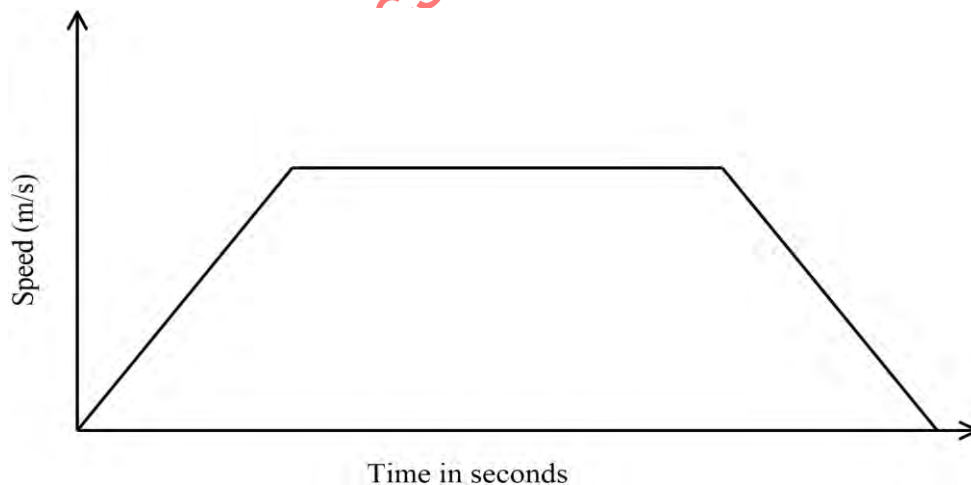
(a) Given that the distance between the two stations is 5225 m. Calculate

(i) Maximum speed in km/h attained by the bus. (3 marks)

(ii) The acceleration of the bus (2 marks)

(c) A van left Nairobi at 8.30 a.m and travelled towards Mombasa at an average speed of 80 km/h.

At 8.30 am a car left Nairobi and travelled along the same road at an average speed of 120 km/h.

(i) Calculate the distance covered by the car to catch up with the van. (4 marks)

(ii) Find the time of the day when the car caught up with van. (1 mark)

22. On the Cartesian plane below, triangle PQR has vertices P(2, 3), Q(1, 2) and R(4, 1) while triangle P''Q''R'' has vertices P''(-2, 3), Q''(-1, 2) and R''(-4, 1).
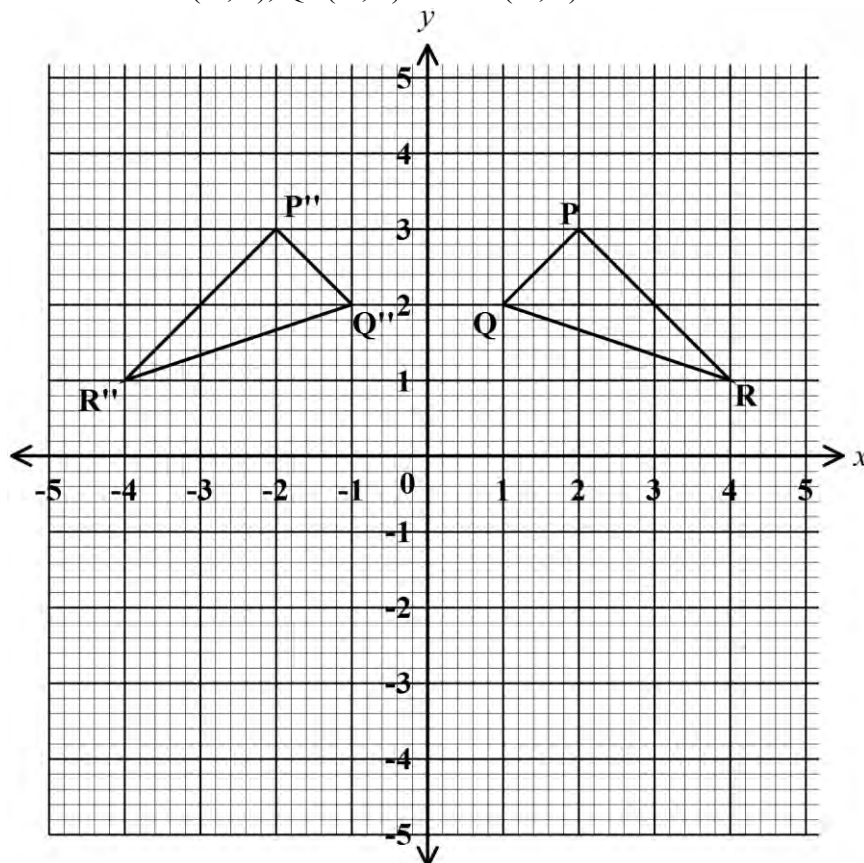
(a) Describe fully the transformation which maps triangle PQR onto triangle P''Q''R''. (1 mark)

(b) On the same plane, draw triangle P'Q'R', the image of triangle PQR under a reflection in the line $y = -x$ (2 marks)

(c) Describe fully a single transformation which maps triangle P'Q'R' onto triangle P''Q''R''. (2 marks)

(d) Draw triangle P'''Q'''R''' such that it can be mapped onto triangle PQR by a positive quarter turnabout (0, 0) (3 marks)

(e) State a pair of triangles that is

i) oppositely congruent (1 mark)

ii) directly congruent (1 mark)

23. The equation of the curve is $y = x^3 - 2x^2 - 1$

(a) Determine

(i) the stationary points (4 marks)

(ii) the nature of the stationary points in (a) (i) above (2 marks)

(b) Determine

(i) the equation of the tangent to the curve at $x = 1$ (2 marks)

(ii) the equation of the normal to the curve at $x = 1$ (2 marks)

24. The boundaries of ranch AB, BC, CD and DA are straight lines such that B is 075^0 from A and a distance of 50 km. C is due east of B and a bearing of $N80^0E$ from A. D is due south of C and a distance of 70 km.

(a) Using a scale of **1 cm** to represent **10 km.** show the relative positions of ABCD. (3 marks)

(b) From the scale drawing, determine

(i) the distance in kilometres between B and C (2 marks)

(ii) the bearing of A from D (2 marks)

(iii) the shortest distance from A to border CD (1 mark)

(c) Calculate the area of the ranch in square kilometer. (2 marks)

SECTION I (50 marks)

SECTION I

1. Use logarithms to 4 decimal places to evaluate (4 marks)

$$\sqrt[3]{\frac{23.56 \times 0.28^2}{4329}}$$

2. Make **s** the subject of the formula (3 marks)

$$d = p\left(\sqrt{\frac{s^2 - w^2}{r^2 + 5^2}}\right)$$

3. Without using tables or calculator, evaluate and simplify (4 marks)

$$\frac{\sin 30^0 + \sin 45^0}{\cos 60^0 - 1}$$

4. Given the position vectors $\overrightarrow{OA} = 4\boldsymbol{i} + 8\boldsymbol{j} - 2\boldsymbol{k}$ and $\overrightarrow{OB} = 3\boldsymbol{k} - \boldsymbol{i} - 2\boldsymbol{j}$. Point C divides vector AB in the ratio of 3:-1. Find the magnitude of $\overrightarrow{OC}$. Give your answer to 2dp (3 marks)

5. Given that the values P=8.2 cm, A=4.1cm and B=7.0 cm were measured to 1dp. Find the percentage error in the evaluation of. (3 marks)

$$\frac{K}{A \times B}$$

6. Expand $\left(1 - \frac{1}{2}x\right)^{10}$ upto the 4th term in the ascending powers of x. Hence evaluate the value of $(0.95)^{10}$ to 3 decimal places. (3 marks)

7. Two types of coffee grade A and B retails at sh.240 and sh.300 respectively. Mohamed sell a mixture of both grades at shs.303 60, making a profit of 10%. Find the ratio in which he mixed the grades (3 marks)

8. Juma a form 2 student was told to pick two number x and y from a set of digits 0, 1, 2, 3, 4, 5 and 6. Find the probability that the $[x - y]$ is at least 3. (3 marks)

9. Two quantities x and y are such that y varies partly as the square of x and partly inversely as the square root of x. Given that when $x = 4, y = 40$ and when $x = 1, y = 18$. Find the value of y when $x = 0.25$. (4 marks)

10. In a triangle ABC, AB=7.2 cm, AC=6.8 cm and angle BAC=120^0.
    Calculate;
    (i) The length of BC to 3s.f (2 marks)
    (ii) If a circle passes through the vertices A, B and C. Find the radius of the circle. (2 marks)

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

Monthly income in Kshs	Tax rate in each kshs
$1 \leq x < 9681$	10%
$9681 \leq x < 18801$	15%
$18801 \leq x < 27921$	20%
$27921 \leq x < 37040$	25%
Over 37040	30%

In that year Mr. Mogaka gets a total deduction of ksh5,000 he gets a personal tax relief of kshs.1056 and pays kshs.3944 for NHIF, WCPS and sacco loan repayment. Calculate
    (i) P.A.Y.E. (1 mark)
    (ii) Monthly income/salary (3 marks)

12. Given that the matrix $\begin{pmatrix} 3x & x \\ x - 6 & -3 \end{pmatrix}$ maps a triangle A(0,0), B(2, 1) and c(3, 5) on to a straight line.
   Find the possible values of x. (3 marks)

13. The 2nd, 10th and 42nd terms of an A.P forms the first three terms of a geometric progression, if the common differences of the AP=3. Find the sum of the first 10 terms of the G.p. (4 marks)

14. Raw data collected from experimental observation normally have errors. Below is a table of results obtained results from an experiment? The results show how length l(cm) of a metal rod various with increase in temperature T(^{0}c).

T(^{0}C)	0	1	2	3	4	5	6	7	8
L(cm)	4.0	4.3	4.7	4.9	5.0	5.5	5.9	6.0	6.4

Plot the values in the graph given below and draw the line of best fit. (2 marks)
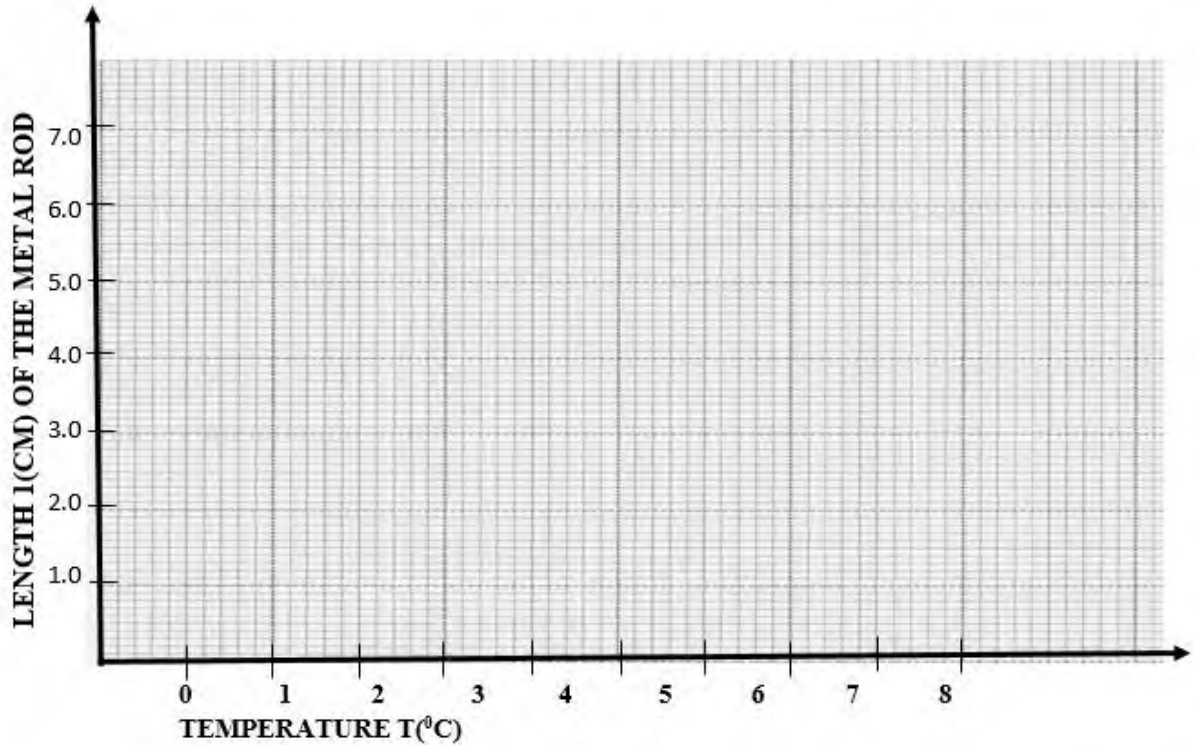
15. Evaluate the value of x in the following trigonometric equation.
$\frac{1}{2} sin^2 2x = +0.25$ for $-180° \leq x \leq 180°$ (3 marks)

16. The points with co-ordinates A (13,3) and B(-3,-9) are the end of a diameter of a circle centre 0. Determine;
(i) The coordinates of 0 (1 mark)
(ii) The equation of the circle expressing it in the form
$x^2 + y^2 + ax + by + c = 0$ (2 marks)

SECTION II

17. The following are the vertices of a triangle PQR P(1,1), Q(3, 1) and R(1,4)
    i) Plot the triangle on the graph given (1 mark)
    ii) Triangle PQR was reflected on the line $x = 0$ to give P^{1}Q^{1}R^1. Draw the triangle on the graph given.
    iii) The triangle P^{1}Q^{1}R^1 was transformed by a matrix $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ to give P^{11}Q^{11}R^{11}. On the axes draw the triangle P^{11}Q^{11}R^{11} on the grid. (2 marks)
    iv) The triangle P^{11}Q^{11}R^{11} was further transformed into a triangle P^{111}Q^{111} and R^{111} using the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$. Draw the triangle and tate its coordinates (3 marks)
    v) Calculate the area of the triangle P^{111}Q^{111} R^{111} drawn above. (2 marks)

18. The table below shows the number of goals scored in handball matches during a tournament

Number of goals	0-10	10-20	20-30	30-40	40-50
Number of matches	2	14	24	12	8

(a) i) Draw a cumulative frequency curve. (3 marks)

    ii) Find the probability of scoring at least 20 goals using your graph. (2 marks)

(b) Using an assumed mean of 25 calculate the standard deviation. (3 marks)

(b) Calculate the 6th decile (2 marks)

19. Using a ruler and a pair of compasses only;

i) Construct a triangle ABC such that AB = 6cm, BC = 8cm and angle ABC = 60^0. (2 marks)

i) On the same side of BC as A construct the locus of **m** such that angle BMC=60^0. (2 marks)

ii) Draw the locus of a point **Q** which is equidistant from B and C. (2 marks)

iii) Draw the locus of a point R such that RC=3cm. (1 mark)

iv) Draw the locus of a point P such that the area of triangle BPC=12cm^2. (2 marks)

v) Locate the region by shading such that; (2 marks)

Angle BMC $\geq 60^0$, BQ $\geq$ QC, RC<3 and area of BPC> 12cm^2

20.
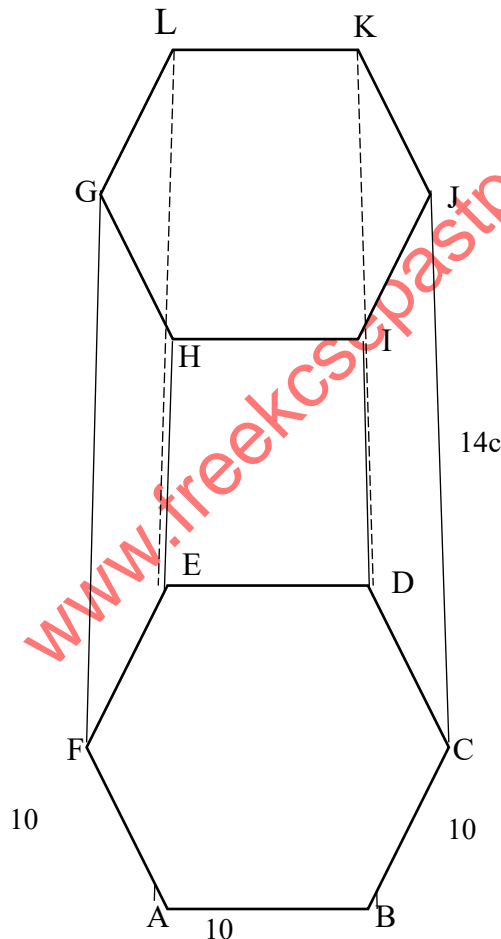
A B C D E F G H I J K L is a solid frustum which was cut two thirds way from the base of a regular hexagonal based pyramid of side 10cm. If the slant edge is 14cm. Calculate;

i) Perpendicular height of the pyramid (2 marks)

ii) Find the angle between the surface ABIH and ABCDEF (3 marks)

iii) Calculate the angle between HA and the base ABCDEF (2 marks)

iv) Calculate the angle between LK and BI (2 marks)

21. An Aeroplane moves from point A to D via B and C
    (a) Give the position of B if the plane moves due north from A(30°s, 20^{0}W) to B covering a distance of 3600 nm. (2 marks)
    (b) Calculate the distance from B to C along the parallel of latitude given that C lies on 50^{0}E (2 marks)
    (c) Calculate the shortest distance from C to D(30^{0}N, 130^{0} W) if the plane moves from C to D. (3 marks)
    (d) Given that the plane left A at 0700h and stopped at B for 3 minutes and at C for 45 minutes. Calculate the day and time it will arrive at D. If the speed of the plane was 300 knots (3 marks)

22. Complete the table below for the function $y = x^2 - 3x - 4$ (1 mark)

x	-2	-1.5	-1.0	-0.5	0	0.5	1.0	1.5	2.0	2.5	3.0
y											

    (a) Use the table and trapezoidal rule with 11 ordinate to estimate the area bounded by the curve $y = x^2 - 3x - 4$, $x = -2$, $x = 3$ and $x - axis$ (2 marks)
    (b) Use the mid ordinate rule with 5 strips to estimate the area bounded by the curve $y = x^2 - 3x - 4, x = -2, x = 3$ and $x - axis$ (2 marks)
    (c) Calculate the exact area above (3 marks)
    (d) Find the percentage error involve in using the mid-ordinate role. (2 marks)

23. A particle moves in such a way that the velocity V at any given time is
    v = 10t – ½ t² – ¹⁵/₂ mls.
    (a) Calculate the initial velocity (1 mark)
    (b) Calculate the velocity when the time t=3 (2 marks)
    (c) Find the displacement during the 5th second (4 marks)
    (d) Calculate the maximum velocity attained (3 marks)

24. The ministry of health made an order of both Astrazenica and Johnson and Johnson vaccines for a health centre. The total number of both vaccines should be more than 600 boxes. The number of boxes of Johnson and Johnson should be less than 500 boxes and more or equal to twice the number of Astrazenica. Letting x to represent the number of Johnson and Johnson boxes and y – to represent the number of boxes of Astrazenica.
    (a) i) Form all the in equalities in x and y to represent the above information. (3 marks)
        ii) Represent the inequalities on a graph (4 marks)
    (b) If the cost of importing 1 box of Johnson and Johnson is sh1000 and astrazenica is shs.800. Find maximum cost of importing the vaccines. (3 marks)

SECTION I (50 marks)

Answer all questions in this section.

1. All odd numbers from $1-10$ are arranged in descending order to form a number.
   - (i) Write the number (1 mark)
   - (ii) Write the total value of the second digit of the number formed in (a) (i) (1 mark)
   - (iii) Express the value of the number in (a) (ii) as a product of its prime factors in power form (2 marks)

2. A shopkeeper bought a bag of sugar. He intends to repack the sugar in 40 g, 250 g and 750 g. Determine the least mass in grams of sugar that was in the bag. (3 marks)

3. Given that $\log_{10} 2 = 0.3010$ and $\log_{10} 3 = 0.4771$ without using tables or calculator find $\log 0.036$ correct to 4 significant figures. (3 marks)

4. Evaluate $\dfrac{\frac{1}{2} \, of \, \frac{3}{2} + 1\frac{1}{2}\left(2\frac{1}{2} - \frac{2}{3}\right)}{\frac{3}{4} \, of \, 2\frac{1}{2} \div \frac{1}{2}}$ (3 marks)

5. Using the grid provided below, solve the simultaneous equation (3 marks)
   $3x - 4y = 10$
   $5x + 7y = 3$

6. Given that a chord of length 10 cm subtends an angle of 1.2^c at the circumference of the circle. Calculate the radius of the circle. (3 marks)

7. When a shopkeeper sells articles at Ksh 24.05, he makes a 30% profit on the cost price. During a sale, he reduced the price of each article to Ksh 22.95. Calculate the percentage profit on an article sold at the sale price. (3 marks)

8. The size of one interior angle of an irregular polygon is 80^0. Each of the other interior angles is 128^0. Find the number of sides of the polygon. (3 marks)

SECTION I (50 MARKS)
Answer ALL Questions in this Section

1. Evaluate the following; **(3 marks)**

$$\frac{\frac{2}{3} - 1\frac{1}{4} + \frac{5}{6}}{\frac{2}{7} + 3\frac{1}{5} \; of \; \frac{7}{8} \div \frac{6}{11} - \left[5\frac{1}{3} + \frac{9}{10}\right]}$$

2. Use square roots, reciprocal and square tables to evaluate to 4 significant figures the expression; **(3 marks)**

$$(0.06458)^{\frac{1}{2}} + \left(\frac{2}{0.4327}\right)^2$$

3. Solve for x in the equation $\frac{1}{2}\log_2 81 + \log_2(x^2 - \frac{x}{3}) = 1$ **(3marks)**

4. A farmer has a piece of land measuring 840m by 396m. He divides it into square plots of equal size. Find the maximum area of one plot. **(3 marks)**

5. The following data was obtained from the mass of a certain animal. Complete the table and the histogram below. **(3 marks)**
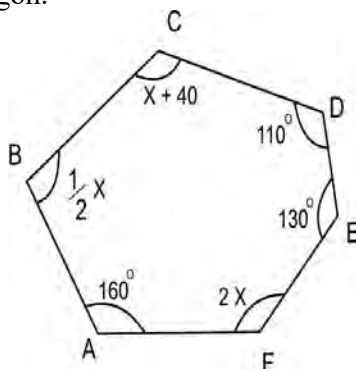
| Mass(kg)	41-50	51-55	56-65
frequency	20		40
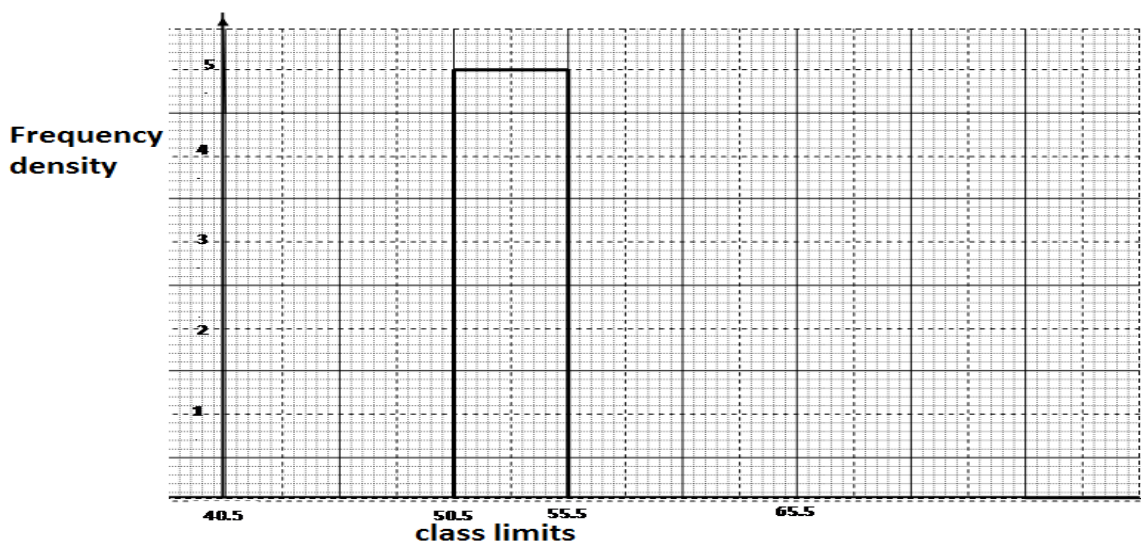
6. Solve the following inequalities and state the integral values **(3 marks)**
   $2x - 2 \leq 3x + 1 < x + 11$

7. The figure below shows a regular polygon A B C D E F with the interior angles indicated. Find the value of the smallest angle in the polygon. **(3 marks)**

8. The figure below represents a plot of land ABCD such that AB=85m, BC=75m, CD=60m, DA=50m and angle ACB = 90^0. (Not drawn to scale).
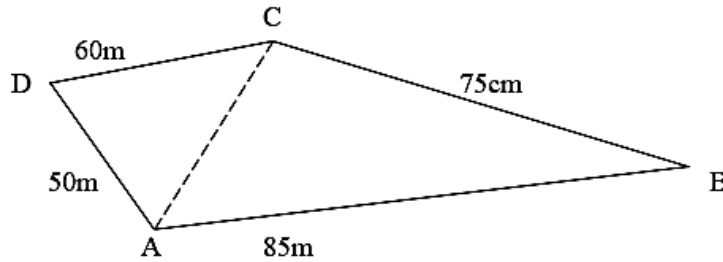
Determine the area of the plot, in hectares, correct to two decimal places. **(3marks)**

9. A rectangular tank has a hole in it such that $11cm^3$ of water leaks out every 5 seconds. Using π as 3.142. Calculate:-

(i) The capacity of the water lost from the tank every hour. **(2marks)**

(ii) The time it takes to fill a cylindrical tank of radius 30cm and height 30cm into which the leaking water drains; in hours to 4 significant figures. **(2marks)**

10. Find the value of x if. **(3 marks)**

$$\left(\frac{27}{8}\right)^{x+7} = \left(\frac{4}{9}\right)^{-3x}$$

11. The image of a point K(1,2) after translation is K^1 (-1,2). What is the coordinate of the point R whose image is R^1 (-3,3) after undergoing the same translation. **(3 marks)**

12. Mugo, a fruit vendor obtained a total of Kshs. 6144 from her sales of oranges on Monday at Kshs. 8.00 each. She had bought 560 more oranges to add to what had remained on Sunday where she had sold 240 more oranges than on Saturday. She had sold 750 oranges on Saturday. Calculate the total number of oranges Mugo had bought on Saturday. **(4 marks)**

13. Simplify the following expression by reducing it to a single fraction. **(3 marks)**

$$\frac{2x - 3}{3} - \frac{x - 2}{2} - \frac{1 - x}{4}$$

14. Water and ethanol are mixed such that the ratio of the volume of water to that of ethanol is 3: 1. Taking the density of water as 1 g/cm^3 and that of ethanol as 1.2g/cm^3, find the mass in grams of 2.5 litres of the mixture. **(3 marks)**

15. A Kenyan bureau buys and sells foreign currencies as shown below

|	Buying (In Kenya shillings)	Selling (In Kenya Shillings)
1 Hong Kong dollar	9.74	9.77
100 Japanese Yen	75.08	75.12

A tourists arrived in Kenya with 105 000 Hong Kong dollars and changed the whole amount to Kenyan shillings. While in Kenya, she pent Kshs 403 897 and changed the balance to Japanese Yen before leaving for Tokyo. Calculate the amount, in Japanese Yen that she received. **(3 marks)**

16. Draw triangle ABC such that AB=4.4cm, BC=4cm and angle ABC=120^0, construct an orthocenter of the triangle ABC and mark it X. **(3 marks)**

17. A line L$_1$ passes through the points $(-2, 3)$ and $(-1, 6)$ and is perpendicular to L$_2$ at $(-1, 6)$.

a) Find the equation of L_1. **(2 marks)**

b) Find the equation of L_2 in the form $ax + by - c = 0$ where a, b and c are constants. **(2 marks)**

c) Given that another line L_3 is parallel to L_1 and passes through point $(1,2)$, find the x and y intercepts of L_3
. **(3 marks)**

d) Find the point of intersection of L_2 and L_3. **(3 marks)**

18. A sector of angle 108^0 is cut from a circle of radius 20 cm. It is folded to form a cone. Calculate to 1 decimal place: **(use $\pi = \frac{22}{7}$)**

(a) The curved surface area of the cone. **(2 marks)**

(b) The base radius of the cone. **(3 marks)**

(c) The vertical height of the cone. **(2 marks)**

(d) If 12 cm of the cone is chopped off to form a frustum as shown below.
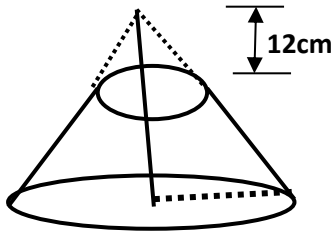
Calculate the volume of the frustum formed. **(3 marks)**

19. A village Q is 7 km from village P on a bearing of 045^0. Village R is 5 km from village Q on a bearing of 120^0 and village S is 4 km from village R on a bearing of 270^0.

a) Taking a scale of 1 m to represent 1 Km, locate the three villages. **(3 marks)**

b) Use the scale drawing to find the:

i. Distance and bearing of the village R from village P. **(2 marks)**

ii. Distance and bearing of village P from village S. **(2 marks)**

c) Calculate the area enclosed by the three villages **(3 marks)**

20. The floor of a rectangular room can be covered completely by a carpet costing sh. 200 per square metre. The total cost of the carpet would be sh. 5600. Taking the length of the room to be x m;

a) Express width of the room in terms of x **(2marks)**

b) If a uniform width of $\frac{1}{2}$ m is left uncovered all round. The cost is sh. 2000 less. Form and solve an equation to determine the value of x. **(5marks)**

c) Later it was decided that the floor left uncovered in (b) above should also be covered. However the cost of the carpet had then gone up by sh. 150 per square metre. Determine the cost in covering the previously uncovered region. **(3marks)**

21. a)   Given that the matrix $A = \begin{pmatrix} 2 & 3 \\ 3 & 4 \end{pmatrix}$, find A^{-1}, the inverse of A.   **(2 marks)**

     b)   Kariuki bought 400 goats and 600 sheep for a total of Kshs 1,700,000. Maina bought 180 goats and
          240 sheep for a total of Kshs 720,000. If the price of a goat is sh. X and that of a sheep is shs y,

     i)   Form two equations to represent the above information.   **(2 marks)**
     ii) Use the matrix A^{-1} to find the price of one goat and one sheep.   **(3 marks)**

     c)   John bought 450 goats and 720 sheep. He was given a total discount of shs 66,600.
          If the discount on the price of a goat was 2%, calculate the percentage discount on the price of a
          goat.   **(3 marks)**

22. The distance between two towns A and B is 460 km. a minibus left town A at 8.45 am and travelled
     towards Bat an average speed of 65km/hr. A matatu left B at 10.55 am on the same day and travelled
     towards A at an average speed of 80km/hr.

(a) How far from town B did they meet?   **(4 marks)**

(b) At what time did the two vehicles meet?   **(2 marks)**

(c) A motorist started from his home at 9.15am on the same day and travelled to B at an average speed of
     120km/hr. he arrived at the same time as the minibus. Calculate the distance from B to his home.
                                                                                     (4 marks)

23. Three partners Mutua, Muthoka and Mwikali contributed Sh. 600,000, Sh. 400,000 and Sh. 800,000
     respectively to start a business of a matatu plying Mbumbuni – Machakos route. The matatu carries 14
     passengers with each paying Sh. 250. The matatu makes two round trips each day and ever full. Each day
     Sh. 6000 is used to cover running costs and wages.

(a) Calculate their net profit per day.   **(2 marks)**

(b) The matatu works for 25 days per month and is serviced every month at a cost of KSh. 10,000. Calculate
     their monthly profit in June.   **(1 mark)**

(c) The three partners agreed to save 40% of the profit, 24% is shared equally and the rest to be shared in the
     ratioof their contribution. Calculate Muthoka's share in the month of June.   **(4 marks)**

(d) The matatu developed mechanical problems and they decided to sell it through an agent who charged a
     commission of 5% on selling price. Each partner received KSh. 475,000 from the agent after he had taken
     his commission. Determine the price at which the agent sold the matatu.   **(3 marks)**

24. The displacement S metres of a body moving along a straight line after t seconds is given by
     $S = -2t^3 + \dfrac{3}{2}t^2 + 3t$

(a) Find its initial acceleration.   **(3 marks)**

(b) Calculate:-

     (i)   The time when the body was momentarily at rest.   **(3 marks)**
     (ii) Its displacement by the time it comes to rest momentarily   **(2 marks)**

(c) Calculate the maximum velocity attained   **(2 marks)**

SECTION I (50 MARKS)
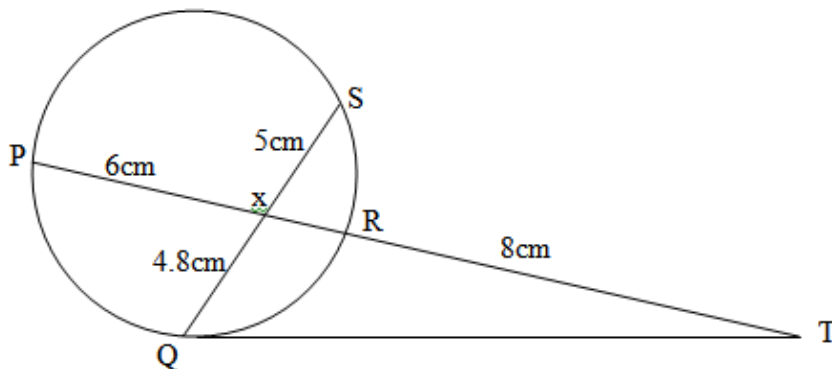*Answer all the questions from this section*

1. Use Logarithms correct to four significant figures to evaluate.   (4marks)

$$\sqrt[3]{\frac{24.36 \times 0.066547}{1.48^2}}$$

2. Find the value of x given that the matrix $\begin{bmatrix} x+7 & 4 \\ -3 & x \end{bmatrix}$ is singular   (3 marks)

3. In the figure below QT is a tangent to the circle at Q. PXRT and QXS are straight lines.
    PX = 6cm, RT = 8cm, QX = 4.8cm and XS = 5cm.

    Find the length of QT   (3 marks)

4. Use the trapezium rule with seven ordinates to find the area bounded by the curve $y = x^2 + 1$
    lines x = -2, x = 4 and x – axis   (3 marks)

5. Given that $x = \sqrt{\frac{tp}{2\,m+p}}$ make p the subject of the formula   (3 marks)

6. (a) Construct triangle PQR such that PQ = 7cm, QR = 5cm and $< PQR = 30°$ (2 marks)
    (b) Construct the focus L_1 of points equidistant from P and Q to meet the locus L2 of points equidistant
         from Q and R   (2 marks)

7. The points (5, 5) and (-3, -1) are ends of a diameter of a circle centre A. Determine:
    a) The coordinates of A.   (1 mark)
    b) The equation of a circle expressing it in form $x^2 + y^2 + ax + by + c = 0$ (2 marks)

8. A transformation is represented by the matrix $\begin{bmatrix} 1 & 3 \\ 4 & 2 \end{bmatrix}$. This transformation maps a triangle ABC of the area
    12.5cm^2 onto another triangle A′B′C′. Find the area of triangle A′B′C′.   (3marks)

9. Pipe A can fill a tank in 2 hours, pipes B and C can empty the tank in 5 hours and 6 hours respectively.
    How long would it take
    (a) To fill the tank if A and B are left open and C closed   (2 Marks)
    (b) To fill the tank with all the pipes open   (2 Marks)

10. i)   Expand and simplify (1-3x)^5 upto the term in x^3 (2 marks)
    ii) Hence use your expansion to estimate (0.97)^5 correct to 4d.p.   (2 marks)

11. Solve for x in the equation:
    $2cos4x = -1$ for $0^0 \le$ x $\le 180^0$ (3 marks)

12. Wanjiku pays for a car on hire purchase in 15 monthly instalments. The cash price of the car is Ksh.300,
    000 and the interest rate is 15%p.a. A deposit of Ksh.75, 000 is made. Calculate her monthly repayments.
                                                                                                   (3 marks)

13. The gradient function of a curve is given $\frac{dy}{dx} = 3x^2 – 8x + 2$. If the curve passes through the point, (2, –2),
    find its equation.   (3 marks)

14. Simplify the following surds leaving your answer in the form $a + b\sqrt{c}$ (3marks)

$$\frac{\sqrt{5}}{2\sqrt{2} - \sqrt{5}} + \frac{\sqrt{2}}{2\sqrt{2} + \sqrt{5}}$$

15. The sum of two numbers is 24. The difference of their squares is 144. What are the two numbers? (3marks)

16. The data below represents the marks scored by 9 form 4 students in an exam:
   40, 37, 39, 40,41,43,44, 37,44
   Calculate the interquartile range of the above data (3 marks)

SECTION II (50 MARKS)
Answer five questions only from this section

17. The following table shows the rate at which income tax was charged during the year 2021

Monthly taxable income in Ksh.	Tax rate %
0 – 9860	10
9861 – 19720	15
19721 – 29580	20
29581 – 39440	25
39441 – 49300	30
49301 – 59160	35
over 59160	40

Maina earns a basic salary of Ksh.42000 and a monthly house allowance of sh.13000. He contributes 7.5 % of his basic salary to pension scheme. This contribution is exempted from taxation. He is entitled to a personal relief of sh.2400 per month. Calculate:
a) His monthly Taxable income (2 marks)
b) Calculate his net monthly tax (6 marks)
c) Maina's monthly salary (2 marks)

18.
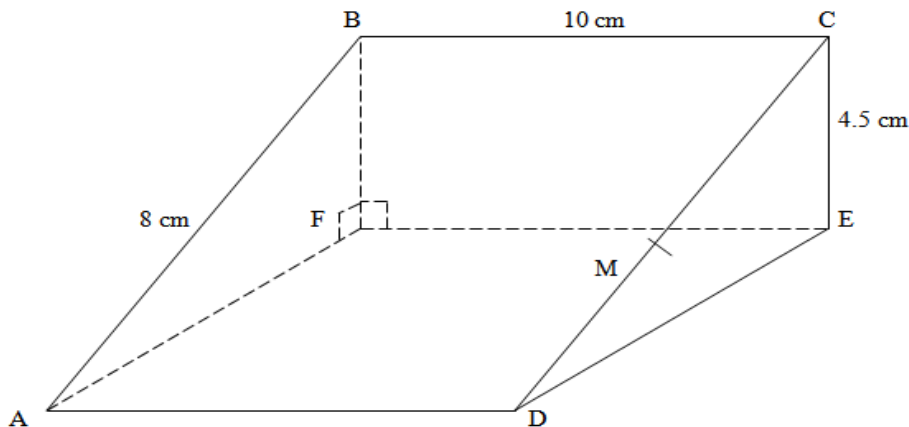
The above diagram represents a wooden prism. ABCD is a rectangle. Points E and F are directly below C and B respectively. M is the mid-point of CD. AB = 8 cm, BC = 10 cm and CE = 4.5 cm.
(a) Calculate the size of angle CDE (2 marks)
(b) Calculate the
(i) Length of AC (2 marks)
(ii) Angle AC makes with the plane ADEF (2 marks)
(c) Find the:
(i) Length of MB (2 marks)
(ii) Angle CBM (2 marks)

19. An aeroplane left town $P(65^oN, 15^oE)$ to another town $Q(65^oN, 165^oW)$ at a speed of 200 knots using the shortest route. $(Take\ \pi = \frac{22}{7}, R = 6370km)$
a) Find
i) The shortest distance travelled in nautical miles. (3 marks)
ii) The time taken from P to Q in hours. (2 marks)

b) Another plane left P at 1.30 p.m local time and travelled to T (65^0N, 60 ^{0}E) along the parallel of latitude. Find

i) The distance between P and Q to the nearest kilometres. (3 marks)

ii) The local time of arrival at T if the plane flew at 470km/hr. (2 marks)

20. The probability that a student goes to school by a boda-boda is $\frac{2}{3}$ and by a matatu is $\frac{1}{4}$. If he uses a boda-boda the probability that he is late is $\frac{2}{5}$ and if he uses matatu the probability of being late is $\frac{3}{10}$. If he uses other means of transport the probability of being late is $\frac{3}{20}$.

a) Draw a tree diagram to represent this information. (3marks)

b) Find the probability that he will be late for school. (3marks)

c) Find the probability that he will be late for school if he does not use a matatu. (2marks)

d) What is the probability that he will not be late to school? (2marks)

21. A farmer has 50 acres of land. He has a capital Shs. 2,400 to grow carrots and potatoes as cash crops. The cost of growing carrots is Shs.40 per acre and that of growing potatoes is Shs.60 per acre. He estimates that the respective profits per acre are Shs.30 (on carrots) and Shs. 40 (on potatoes). By letting x and y to represent the acres of carrots and potatoes respectively:-

a) Form suitable inequalities to represent this information. (4marks)

b) By representing this information on a graph, determine on how many acres he should grow each crop for maximum profit (4marks)

c) Find the maximum profit. (2marks)

22. The 2nd and 5th terms of an arithmetic progression are 8 and 17 respectively. The 2nd, 10th and 42nd terms of the A.P. form the first three terms of a geometric progression. Find

(a) the 1st term and the common difference. (3marks)

(b) the first three terms of the G.P and the 10th term of the G.P. (4marks)

(c) The sum of the first 10 terms of the G.P. (3marks)

23. In the triangle PQR below L and M are points on PQ and QR respectively such that PL:LQ=1:3 and QM:MR=1:2, PM and RL intersect at X, given that **PQ** = **b** and **PR** = **c**
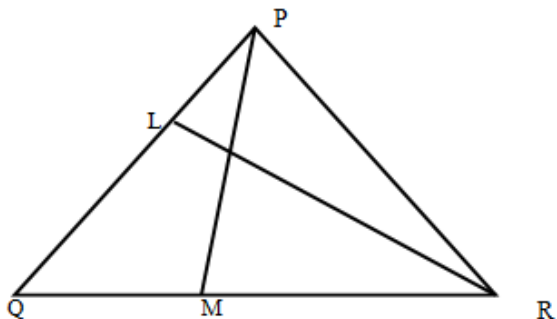
(a) Express the following vectors in terms of **b** and **c**

(i) **QR** (1mark)

(ii) **PM** (1mark)

(iii) **RL** (1mark)

(b) By taking PX = h**PM** and RX = k**RL** where h and k are constants find two expressions of PX in terms of h, k, **b** and **c**. Hence determine the values of the constant h and k. (6marks)

(c) Determine the ratio LX:XR (1mark)

24. Given that *y = 2sin 2x* and y = *3cos (x + 45)^o*

a) Complete the table below. (2mks)

x	0^0	20^0	40^0	60^0	80^0	100^0	120^0	140^0	160^0	180^0
2sin2 x	0		1.97		0.68	-0.68	-1.73		-1.29	0.00
3cos (x+ 45^0)	2.12	1.27		-0.78		-2.46			-2.72	-2.12

b) Use the data to draw the graphs of *y = 2 sin 2x* and *y = 3 cos (x + 45°)* for 0°≤ x ≤ 180°onthe same axes. (4marks)

a. State the amplitude and period of each curve. (2marks)

b. Use the graph to solve the equation *2 sin 2x – 3cos (x + 45^0) = 0* for 0^0≤ *x ≤ 180^0* (2marks)

Section I (50 marks)
Answer all the questions in this section.

1. Without using calculators evaluate $^1/_3$ of $\left(2\frac{3}{4}-5\frac{1}{2}\right)\times 3\frac{5}{7}\div\frac{3}{4}$ {2 marks}

2. Use the method of completing the square to solve the quadratic equation
   $2x^2 - 13x + 15 = 0$ {3 marks}

3. Solve for θ in the equation $6 \cos^2 \theta - \text{Sin } \theta - 4 = 0$ in the range $0^o \leq \theta \leq 180^o$.   {3 marks}

4. The sides of a rectangle are x cm and (x + 1) cm. A circle has radius of (x + 2) cm. If the sum of the area

   of the rectangle and the circle is 184 cm^2. Using π as $\dfrac{22}{7}$ find the value of x.   {4 marks}

5. In the figure below ABCD is a cyclic quadrilateral and BD is a diagonal. EADF is a straight line,
   $\angle CDF = 68^0$, $\angle BDC = 45^0$ and $\angle BAE = 98^0$
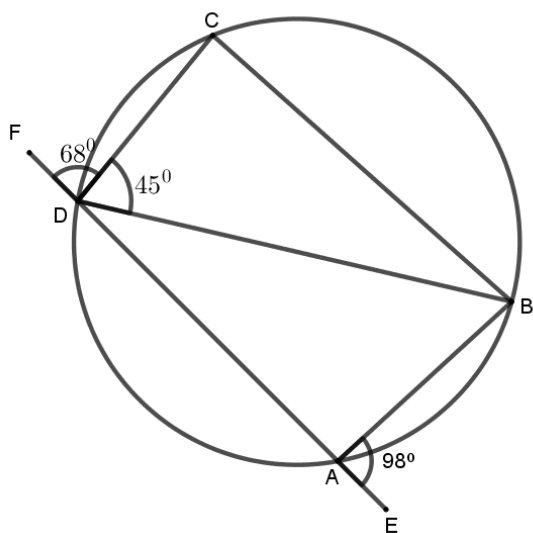
   Calculate the size of
a) $\angle ADB$ (2 marks)
b) $\angle ABD$ (2 marks)

6. A line L_1 passes through point (1, 2) and has a gradient of 5. Another line L_2 is perpendicular to L_1 and
   meets it at a point where x = 4. Find the equation for L_2 in the form y = mx + c.   {4 marks}

7. Find the value of x in the following equation.   {3 marks}
   $9^x + 3^{2x} - 1 = 53$

8. The first and the last terms of an AP are 2 and 59 respectively. If the sum of the series is 610, find the
   number of terms in the series and the common difference.   {4 mks}

9. All prime numbers less than ten are arranged in descending order to form a number.
a) Write the number formed   (1 mark)
b) State the total value of the second digit in the number formed in (a) above   (1 mk)

10. Use reciprocals, square and square roots tables to evaluate, to 4 significant figures.   (4 marks)

$$\frac{2}{\sqrt{0.3446}} + (0.8673)^2$$

11. Solve the inequality $3 - 2\text{x} \leq \text{x} \leq \dfrac{2x+5}{3}$ and show the solution on the number line.   {4 marks}

12. A Kenyan bank buys and sells currencies at the exchange rates below.

Currency	Buying Ksh	Selling Ksh
1Euro	147.87	148.00
1Us dollar	74.22	74.50

An American tourist arrived in Kenya with 24,000 Euros He converted all the Euros to Kenya shillings at the bank. He spent a total of Sh. 200,000 while in Kenya and converted the rest to into US dollars at the bank. Find the amount in dollars that he received   to the nearest whole number.   (3 marks)

13. A salesman earns a basic salary of sh. 9,000 per month. In addition, he is also paid a commission of 5% for sales above sh. 15,000. In a certain month he sold goods worth sh. 120,000 at a discount of 2½%. Calculate his total earnings that month.   {3 marks}

14. 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}

15. Vector **OP** = 6i + j and **OQ** = -2i + 5j. A point N divides **PQ** internally in the ratio 3:1. Find **PN** in terms of i and j.   {3 marks}

16. Without using mathematical tables or calculators express in surd form and simplify

$$\frac{1 + Cos\,30^{o}}{1 - Sin\,60^{o}}$$

          {3 marks}

SECTION II (50 marks).
Answer *only five* questions in this section.

17. The figure below shows a frustum. The top and bottom radii are 5cm and 10cm respectively, while the vertical height of the frustum is 12cm.
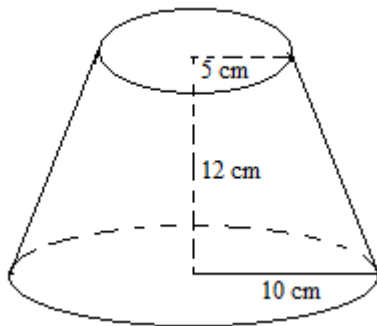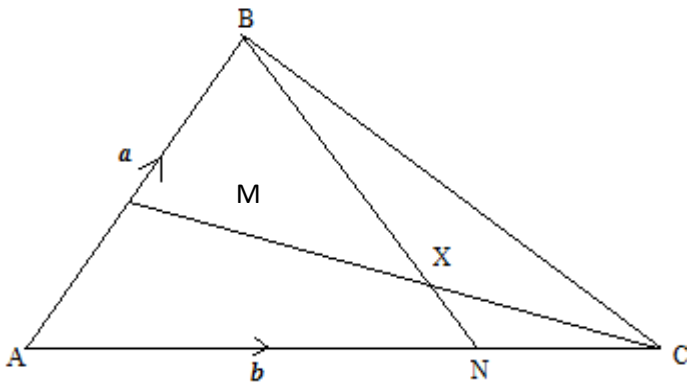

Find the: -
a) Slant height of the frustum.   (3marks)
b) Curved area of the frustum.   (3marks)
c) Volume of the frustum.   (4marks)

18. Bumala is a market centre 600km from Kisumu town. A bus starts from Kisumu for Bumala at 7.00am at an average speed of 80 km/h. At 8.30 am a car started from Kisumu to Bumala and moved at an average speed of 120 km/hr. Calculate
i) The distance bus covered before the car started moving.   (3marks)
ii) The relative speed for the two vehicles.   (2marks)
iii) The time the car overtook the bus.   (1 mark)
iv) Distance covered by the car before overtaking the bus.   (2marks)
v) Distance from Bumala to the car at the time the car was overtaking the bus.   (2marks)

19. The height of 36 students in a class was recorded to the nearest centimeter as follows:-

148   159   158 163   166   155   155   179   158
161   160   157 165   165   175   173   172   178
147   168   157 172   165   154   170   157   167
155   159   173 171   168   160   172   156   167

a) Make a frequency distribution table using a class interval of 5 and starting with the class 145 – 149.
          (2marks)
b) From the table above
i) Calculate the mean mark   (3marks)
ii) Calculate the median   (3marks)
a) Draw a frequency polygon using the table in (a) above.   (2 marks)

256

20. Bujumba Boys Secondary School. Intends to buy a certain number of chairs For Ksh. 16,200. The supplier agreed to offer a discount of Ksh. 60 per chair which will enable the school to get 3 chairs more. Taking y as the originally intended number of chairs: -
a) Write an expression in terms of y for
i) Original price per chair. (1mark)
ii) Price per chair after discount. (1mark)
b) Determine
i) The number of chair the school originally intended to buy. (4marks)
ii) Price per chair after discount. (2marks)
iii) The amount of money the school would have saved per chair of it got the intended number of chairs at a discount of 15%. (2marks)

21. a) Without using a protractor, construct triangle ABC such that angle ABC = 60^0, BC = 8cm and AC = 9cm.Measure AB. (3marks)
b) Drop a perpendicular from A to BC and measure its length. (2marks)
c) Hence calculate the area of triangle ABC. (2marks)
d) Locate a point D on BC such that the area of triangle ABC is three times that of triangle ABD. (3marks)

22. In triangle ABC, shown below, AB = a AC = b point M lies on AB such that AM: MB = 2:3 and point N lies on AC such that AN: NC = 5:1 line BN intersects line MC at X.

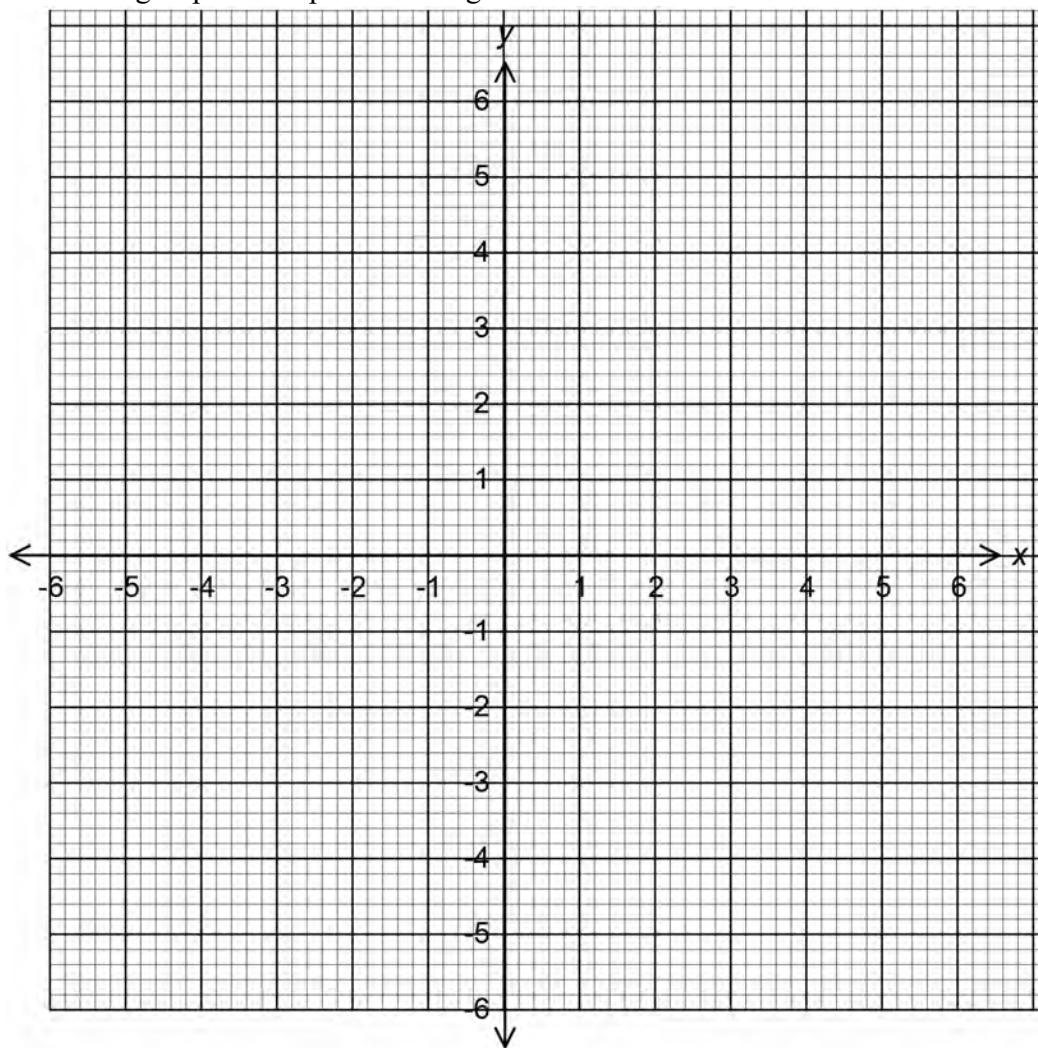a) Express the following in terms of a and b
i) **BN** (1 mark)
ii) **CM** (1 mark)
b) Given that **BX** = k**BN** and **CX** = r**CM** where k and r are scalars
i) Write two different expressions for **AX** in term of a, b, k and r (4marks)
ii) Find the values of k and r (4 marks)

23. A triangle ABC has vertices A(2,1), B(5,2) and C(0,4).
    (a)   On the grid provided plot the triangle ABC.   (2 marks)

    (b) $A^1B^1C^1$ is the image of ABC under a translation $\begin{pmatrix} 2 \\ -5 \end{pmatrix}$. Plot $A^1B^1C^1$ and state its coordinates.

                                                                                         (2 marks)
    (c)   Plot $A^{11}B^{11}C^{11}$ the image of $A^1B^1C^1$ after a rotation about the origin through a negative quarter turn.
           State its coordinates.   (3 marks)
    (d) $A^{111}B^{111}C^{111}$ is the image of $A^{11}B^{11}C^{11}$ after a reflection on the line y = 0.
           Plot $A^{111}B^{111}C^{111}$ and state its coordinates.   (3 marks

24.   Three business partners Abila, Bwire and Chirchir contributed Ksh 120,000, Ksh 180,000 and Ksh
      240,000 respectively to boost their business. They agreed to put 20% of the profit accrued back into the
      business and to use 35% of the profits for running the business. The remainder was to be shared among the
      business partners in the ratio of their contribution. At the end of the year, a gross profit of Ksh 225,000
      was realised.
a.   Calculate the amount.
(i)   Put back into the business.   (2mks)
(ii) Used for official operations.   (1mk)
b.   Calculate the amount of profit each partner got.   (4mks)
c)   If the amount put back into the business was added to individual's shares proportionately of their initial
      contributions, find the amount of Chirchir's new shares.   (3mks
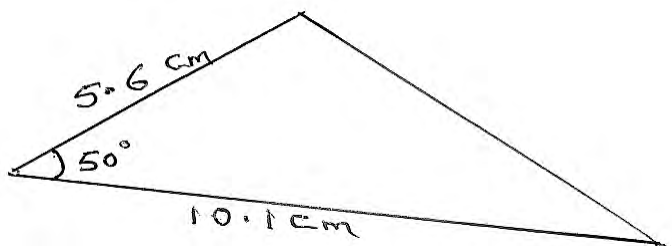
SECTION I: Answer all questions in this section.

1. Find the quadratic equation whose roots are $\frac{-3}{4}$ and $\frac{2}{3}$ and write it in the form
   $ax^2 + bx + c = 0$ where a, b and c are integers. (3mks)

2. Given that $G = (2-qn)\sqrt{\frac{n}{m2}}$. Express m in terms of n, q and G. (3mks)

3. The heights, in centimeters of 7 students were; 143, 139, 145, 154, 159, 147,156. Find the mean absolute deviation of the data. (3mks)

4. Triangle ABC has vertices A (4, 1), B (6, 1) and C (8, 3). The image of ABC under a transformation N is A' (2, 1), B' (4, 1) and C' (2, 3). Find the matrix N. (3mks)

5. State the amplitude, period and phase angle of;
   $y = 2 \sin \frac{1}{2}\left[x + 30^0\right]$ (3mks)

6. The points P (-6, 5) and Q (2, -1) are the ends of a diameter of a circle centre M. Determine:
(a) The coordinates of M (1mk)
(b) The equation of the circle in the form $x^2 + y^2 + ax + by + c = 0$ (2mks)

7. Without using mathematical table or a calculator, express sin 45º in surd form. Hence simplify;
   $\frac{\sqrt{8}}{1 + Sin\ 45^o}$ leaving your answer in surd form. (3mks)

8. Simplify completely; (3mks)
   $\frac{9x^2 - 16x + 7}{162x^2 - 98}$

9. A sum of Ksh 8000 was partly lent at 10% p.a simple interest and 12.5% p.a simple interest. The total interest after 2 years was Ksh. 1775. How much was lent at 10% simple interest? (3mks)

10. The position vectors of points X and Z are 8i + 3j - 4k and 4i + 6j -2k respectively. If Y divides line XZ in the ratio 9: -5, find the coordinates of Y. (3mks)

11. In the figure below AB is a tangent to the circle centre O and radius 12cm. The area of the triangle AOB is 120cm². OXB is a straight line.
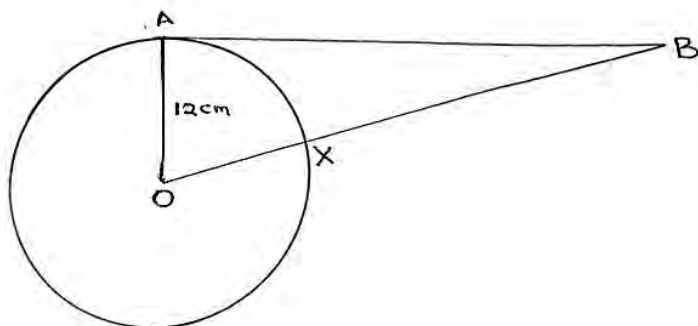
Calculate XB. (3mks)

12. A die and a coin are cast simultaneously.
    (i) Draw a table to show all possible outcomes. (2mks)
    (ii) What is the probability of a tail and a number less than 4 showing up. (1mk)

13. Calculate the percentage error in the area of the triangle below given the included angle is exactly 50º.

(3mks)

14. Use binomial expansion to simplify;

$$(\sqrt{2} + \sqrt{5})^4 - (\sqrt{2} - \sqrt{5})^4$$ (4mks)

15. Solve the simultaneous equation. (4mks)

$$2x - y = 3$$
$$x^2 - xy = -4$$

16. Without using logarithms table or calculator, solve for x in
Log 5 – 2 + log (2x +10) = log (x-4) (3mks)

SECTION II: Answer ANY FIVE questions in this section.

17. In the figure below OP = p, OQ = q. QX meets OY at R, OX: OP = 2:3 and QY: YP = 1:3.
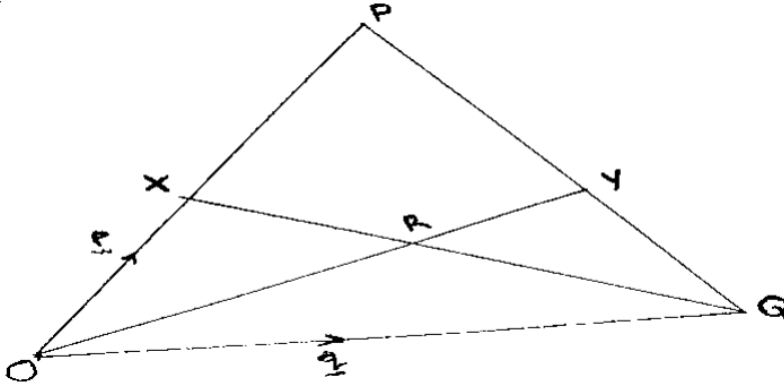
    (a)   Express the following in terms of p and q.
    (i)   QP (1mk)
    (ii)   OY (2mks)
    (iii)   QX (1mk)
    (b)   Given that OR = hOY and QR = kQx
    (i)   Express OR in terms of h, q and p. (1mk)
    (ii)   Express OR in terms of k, q and p. (1mk)
    (iii)   Solve for h and k (4mks)

18. The sum of quantities A and B is y. A varies inversely as x and B varies directly as x. When x = 4,
Y =17 and when x =6, y = 13.
    (i)   Express y in terms of x. (7mks)
    (ii)   Find y when x = 10 and x when y = 11.5. (3mks)

19. The figure below is a right pyramid on a rectangle base. TC = TB =TA = 17cm and TO = 15cm. AB is
twice BC
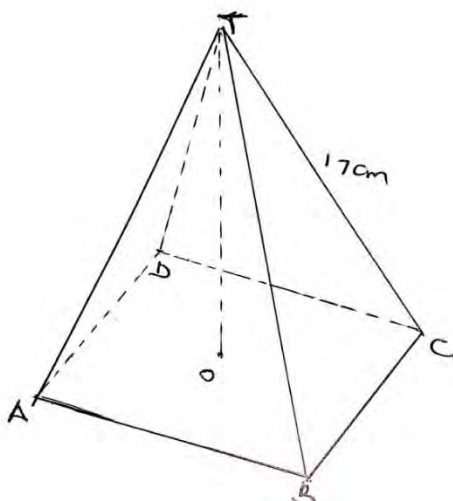
    Calculate;
(i)   The length AB (4mks)
(ii)   The angle between TC and plane ABCD. (2mks)
(iii)   The angle between TO and plane TAB. (2mks)
(iv)   The angle between TAD and ABCD. (2mks)

20. (a) In mathematics, the scores obtained by 30 students were recorded as shown in the table below.

Score x	59	61	65	k	71	72	73	75
No. of students	2	3	5	6	7	4	2	1

Given that $\frac{\Sigma fd}{\Sigma f}$ = -1.2 where d = x – 69, determine;

(i) Score k (4mks)
(ii) Standard deviation (4mks)
(b) The data below represents the ages in months at which 9 babies started walking
9, 11, 12, 11, 10, 8, 10, 13, 9. Find quartile range (2mks)

21. Under a transformation represented by the matrix M = $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$, the image of A(-1, 2), B (-1, -1) and

c (1, -1) are A' (-3, 2), B' (0,-1) and C' (x, y)
(a) Find the matrix m. (3mks)
(b) Find the coordinates of C' (1mk
(c) Plot triangles ABC and A'B'C' on the grid provided below. (2mks)
(d) Describe fully the transformation M. (2mks)
(e) Draw the triangle A'' B''C'', the image of A'B'C' under a stretch of scale factor -2 with the y-axis invariant. (2mks)

22. (a) The first term of an arithmetic progression (AP) is 6. The sum of the first 7 terms of the AP is 126.
(i) Find the common difference of the AP (2mks)
(ii) Find the 19th term of the AP. (1mk)
(b) The 2nd, 3rd and 11th terms of an increasing arithmetic progression (AP) form the first 3 terms of a geometric progression (GP). The first term of the AP is -2.
(i) Find the common difference of the AP and the common ratio (r) of the GP. (4mks)
(ii) Find the sum of the first 5 terms of the geometric progression (GP) (3mks)

23. (a) Complete the table below.

x	0	30	60	90	120	150	180	210	240	270	300	330	360
y = Sin (x+30⁰)	0.50					0.00	-0.50						
y = 2Cos (x+30⁰)	1.73		0.00		-1.73							2.00	1.73

(b) On the same axes, draw the graphs of y = sin (x+30)° and y = 2Cos (x + 30⁰) (5mks)
(c) Use your graphs to solve the equation. (2mks)
$\frac{2 Cos (x + 30^0)}{Sin (x + 30^0)}$ = 1.
(d) State the amplitude of Sin (x + 30⁰) (1mk)

24. Using a ruler and a pair of compasses only for all constructions in this question.
(a) Construct triangle ABC in which AB = 6cm, BC =7cm and angle ABC = 75⁰. (3mks)
(b) Find the locus x such that Ax = 3cm. (1mk)
(c) On the same side of BC as Δ , Construct the locus of P such that angle BPC = 120°. (3mks)
(d) Show by stating the locus of Q inside triangle ABC such that ∟BPC ≥ BQC. (1mk)
(e) On the side of AB opposite C, construct the locus of T such that the area of triangle ATB is 60cm². (2mks)

MURANG'A SOUTH MOCK EXAMINATION
Kenya Certificate of Secondary Education
121/1
MATHEMATICS
PAPER 1
TIME: 2 ½ HOURS

SECTION I (50 Marks)
Answer all questions in this section.

1. Evaluate the following; (3 marks)

$$\frac{\left(8\frac{1}{2} - 6\frac{2}{3}\right) \div \frac{4}{9}}{\frac{2}{5} \text{ of } 6\frac{1}{4} + 1\frac{1}{4}}$$

2. Simplify; (3 marks)

$$\left(\frac{27}{125}\right)^{-\frac{2}{3}} \times \left(\frac{16}{81}\right)^{\frac{1}{4}}$$

3. In a covid-19 vaccination centre, teachers may receive their jabs from either of the two doctors stationed at the two tents. On an average, one doctor takes 2 minutes while the other doctor takes 3 minutes to serve one teacher. If the two doctors start to serve the teachers at the same time, find the shortest time it takes to vaccinate a total of 300 teachers. (3 marks)

4. Simplify the expression; (3 marks)

$$\frac{6a^2 + ab - 2b^2}{4a^2 - b^2}$$

5. Solve for ϑ if $\sin(2\vartheta - 50°) = \cos(\vartheta + 10°)$. (3 marks)

6. The velocity V m/s of a particle projected into space is given by the formula $V = 5t^2 - 2t + 9$ where t is the time in seconds elapsed since projection. Determine the acceleration of the particle when $t = 4$ seconds. (3 marks)

7. The interior angles of a heptagon are $(2y + 35)°, 100°, 135°, 150°, 125, (3y + 25)°,$ and $(2y - 20)°$. Find the value of y. (3 marks)

8. Two similar cylinders have diameter of 14 cm and 42 cm. If the larger cylinder has a volume of $12\ 474\ cm^3$, find the volume of the smaller cylinder. (3 marks)

9. The figure below shows a circle centre O, PQRS is a cyclic quadrilateral and QOS is a straight line. Angle PRQ is 70°.
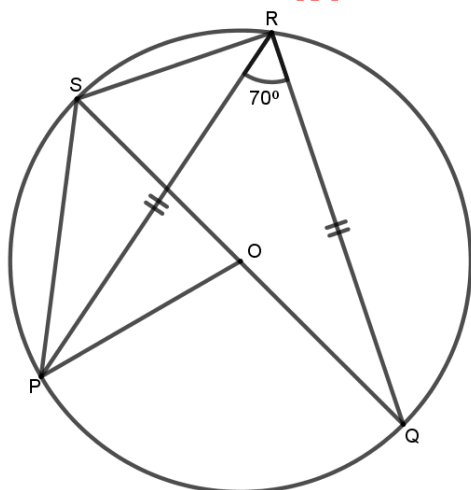
Giving reasons for your answers, find the size of
   (a) Angle POQ (1 mark)
   (b) Angle PRS. (2 marks)

10. Solve for x and state the integral values. (4 marks)

$$23 - 2x > x + 2 \geq -\frac{1}{4}x - 3$$

11. Given that $\tilde{a} = 3i - 2j + 3k$ and $\tilde{b} = 2i - 4j - 3k$ where $i, j\ and\ k$ unit vectors are. Find $|2a + 2b|$ (3 marks)

12. Use the exchange rates below to answer this question

	Buying (Kshs)	**Selling (Kshs)**
1 US dollar ($)	105.00	105.40
1 UK Sterling Pound (£)	145.20	145.75

A tourist arrived in Kenya from Britain with 7,800 UK£. He converted the whole amount of money to Kenya Shillings. While in Kenya, he spent 70% of this money and changed the rest to US $. Calculate the amount of money to the nearest dollar that he received. (3 marks)

13. Construct triangle ABC in which BC = 6 cm, AB = 4.5 cm and angle $ABC = 135°$.Drop a perpendicular from point B to line AC and determine the shortest distance from point B to line AC. (4 marks)

14. Use tables of cubes, cube roots and reciprocals to find the value of; (3 marks)

$$\frac{4}{(8.63)^3} + \left(\frac{5}{34.46}\right)^{\frac{1}{3}}$$

15. A juice seller blends three types of juices P, Q and R in the ratios $P:Q = 3:4$ and $Q:R = 1:2$. The blend contains 16.8 litres of R
    a) Find the ratio P: Q: R (1 mark)
    b) Find the required capacity of P in the blend (3 marks)

16. A hawker bought 1948 sweets on the first day and sold 570 sweets on the same day. On the second day he sold 204 more than the first day. On the third day he added 650 sweets to his stock. He sold all the sweets on the same day at the price of Sh. 5 each. Calculate the amount of money he received on the third day. (3 marks)

SECTION II (50 Marks): Attempt any _five_ questions only in this section.

17. (a) A triangle with vertices $A(-4,2)$ $B(-6,6)$ and $C(-6,2)$ is enlarged by a scale factor -1 and center $(-2,6)$ to produce triangle $A'B'C'$. Draw triangle ABC and $A'B'C'$ and state its coordinates. (4 marks)
    (b) Triangle $A'B'C'$ is then reflected in the line $y = x$ to give triangle $A''B''C''$. Draw $A''B''C''$ and state its coordinates . (3 marks)
   (c) If triangle $A''B''C''$ is mapped on to $A'''B'''C'''$ whose coordinates are $A'''(0,-2)$, $B'''(4,-4)$, and $C'''(0,-4)$ by a rotation. Find the center and angle of rotation. (3 marks)

18. The table below shows heights of 50 students.

Height (cm)	$150 - 154$	$155 - 159$	$160 - 164$	$165 - 169$	$170 - 174$	$175 - 179$
Number of students	5	13	12	x	7	3

    a) Determine the value of X. (1 mark)
    b) Calculate the mean height (4 marks)
    c) (i) On the grid provided, draw a histogram to represent the above information.
           Use a scale of 1 cm to represent 5 students and 2 cm to represent 5 cm. (2 marks)
       (ii) On the histogram, draw a vertical line to show where the median mark lies. (3 marks)

19. The figure below shows a test tube used to store laboratory reagents during a research study.
    One of the study reagents was filled into the test tube up to 80% full.

8 cm

10.5 mm
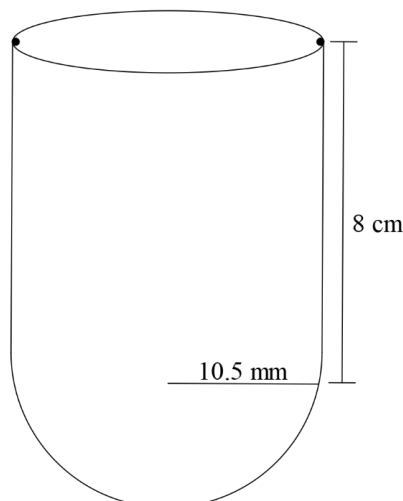
Calculate:
a) The volume of the reagent in the test tube. (3 marks)
b) The height of the reagent in the test tube. (3 marks)
c) The total surface area of the tube in contact with the reagent. (4 marks)

20. A bus left Mombasa and travelled towards Nairobi at an average speed of 60km/hr. After 2hrs and 30 minutes, a car left Mombasa to Nairobi and travelled along the same road at an average speed of 100km/hr. If the distance between Mombasa and Nairobi is 500km.
   a. Determine
      i. The distance of the bus from Nairobi when the car took off. (2 marks)
      ii. The distance the car traveled to catch up with the bus. (4 marks)
   b. Immediately the car caught with the bus the car stopped for 25 minutes. Find the new average speed at which the car traveled in order to reach Nairobi at the same time as the bus (4 marks)

21. The velocity of a particle after t seconds is given by $V = t^2 - 2t + 4$.
   (a) Use the mid ordinate rule with six strips to estimate the displacement of the particle between t = 1 and t = 13 (3 marks)
   (b) Determine;
      i. The exact area of the particle between t = 1 and t = 13. (3 marks)
      ii. Acceleration of the particle at t = 4 (2 marks)
   (c) Calculate the percentage error arising from the estimated area in (a) above. (2 marks)

22. A shopkeeper planned to buy some fridges from a sum of 1.8 million shillings. Before she could buy the fridges, the price per unit was reduced by Sh. 4 000. As a result she was able to buy five more fridges using the same amount of money as originally planned.
   a) Determine the number of fridges that the shopkeeper bought. (6 marks)
   b) If two of the fridges purchased got damaged while in store and the rest were sold making a profit of 20 %, calculate her profit per fridge. (4 marks)

23. The equation of a line L_1 is $3y - 2x = 10$
   a) Find in form of $y = mx + c$ where m and c are constants,
   i. The equation of line L_2 passing through point N (-5,2) and parallel to L_1. (2 marks)
   ii. The equation of L_3 perpendicular to L_2 at M (1, −8). (3 marks)
   b) Find the angle of inclination of the line L_2 with the horizontal (2 marks)
   c) Find the magnitude of MN (3 marks)

24. The diagram below shows a garden in the shape of a quadrilateral PQRS in which $PQ = SR = 120m, QR = 45\,m, \angle PQR = \angle SPQ = 90°$ and $\angle QRS = 135°$
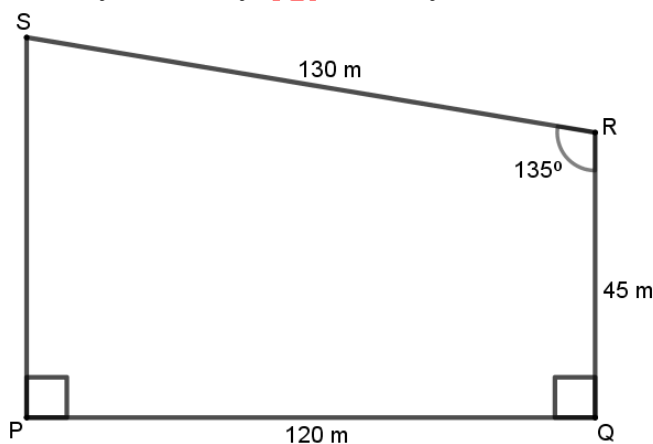
(a) Calculate to 1 decimal place:
   (i) The size of angle QPR. (3 marks)
   (ii) The length PS (4 marks)
(b) Calculate the area of the garden in hectares, correct to 3 decimal places. (3 marks)

121/2
MATHEMATICS
PAPER 2
TIME: 2½ HOURS

SECTION I (50 Marks)
Answer all the questions in this section.

1. Use logarithms to evaluate; (4 marks)

$$\left(\frac{415.3 \times 0.0152}{\sin 75°}\right)^{\frac{1}{3}}$$

2. The base and perpendicular height of a triangle measured to the nearest centimetre are 12 cm and 8cm respectively. Find the absolute error in calculating area of the triangle (3 marks)

3. (a) Expand $\left(3 + \frac{2}{x}\right)^5$ up-to the term x^4. (1 mark)

    (b) Hence estimate the value of $(3.5)^5$ to 4 s.f. (2 marks)

4. Find the radius and centre of the a circle whose equation is $3x^2 + 3y^2 - 12x + 18y = 9$ (3 marks)

5. An aero plane leaves town A(40°N, 155°W) for town B(40°N, 25°E) using the shortest route at a speed of 300 knots. Calculate the time it takes to travel from A to B. (3 marks)

6. The third term and the sixth term of a geometric series are $3\frac{1}{3}$ and $11\frac{1}{4}$ respectively. Calculate the;

a) Common ratio (2 marks)
b) First term (1 mark)

7. The graph below is part of a straight line obtained from initial equation $y = ax^n$. Use the graph to calculate the values of **a** and **n**. (4 marks)
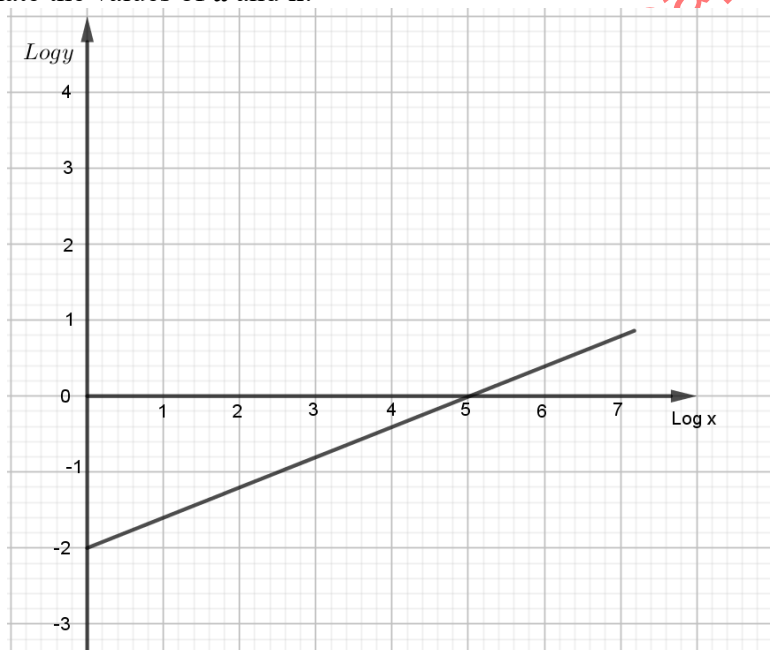
8. Given that $A = \begin{pmatrix} 2 & 3 \\ 1 & 4 \end{pmatrix}$ and $B = \begin{pmatrix} -1 & 3 \\ 2 & -1 \end{pmatrix}$, find matrix C where $AC = B$. (3 marks)

9. A quantity P is partly constant and partly varies inversely as square of t. P = 6 when t = 6 and P = 18 when t = 3. Find t when P = 11. (3 marks)

10. A mobile phone can be purchased in cash Ksh. 30,000 or by paying Ksh. 1,750 for 24 months. Calculate the rate of interest charged on instalment buying. Give your answer correct to 2 decimal places. (3 marks)

11. Solve for x in $3 \log_3 x + 4 = \log_3 24$ (3 marks)

12. Solve for x in the equation
    $6 \sin^2 x - \cos x - 5 = 0$ for $0° \leq x \leq 360°$ (3 marks)

13. Two brands of tea costing Sh. 160 and Sh. 140 per kilogram respectively are mixed in the ration 2: 3 by mass. The mixture is sold at Sh. 240 per kilogram. Find the percentage profit made. (3 marks)

14. Triangle $A'B'C'$ is the image of triangle ABC under transformation represented by the matrix $\begin{pmatrix} 3 & 1 \\ 5 & 4 \end{pmatrix}$.
    If the area of triangle $A'B'C'$ is $140 \ cm^2$, find the area of triangle ABC (3 marks)

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15. Given that PR = 2cm, PN = 12cm and PM = 3cm. Find the length of:
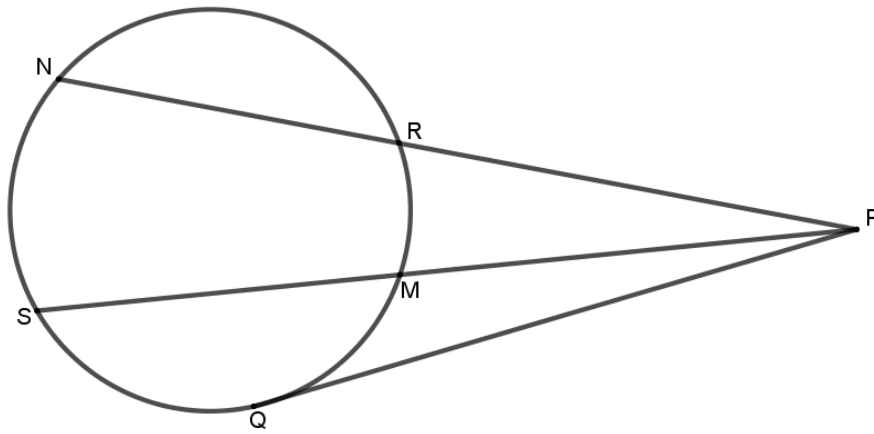
(i) PS   (2 marks)
(ii) PQ   (1 mark)
16. Given that $\tan x = \frac{1}{\sqrt{3}}$, find the value of $tanx + \cos x$.   (3 marks)

SECTION II (50 Marks)
Answer any five questions only in this section.
17. In a science class, $\frac{2}{3}$ of the class are boys and the rest are girls. 80% of the boys and 90% of the girls are right handed. The probability that the right handed student will break a test tube in any session is $\frac{1}{10}$ and that for the left handed student is $\frac{3}{10}$,regardless of whether boy or girl.
(a) Draw a tree diagram to represent this information   (2 marks)
(b) Using the tree diagram drawn, find the probability that:
(i) A student chosen at random from the class is left handed   (2 marks)
(ii) A test tube is broken by a left handed student.   (2 marks)
(iii) A test tube is broken by a right handed student.   (2 marks)
(iv) A test tube is not broken in any session   (2 marks)

18. In a triangle ABC, E is the midpoint of BC, D is a point on AC such that AD: DC = 3: 2 and F is the point of intersection of AE and BD. Vectors $AB = \tilde{b}$ and $AC = \tilde{c}$
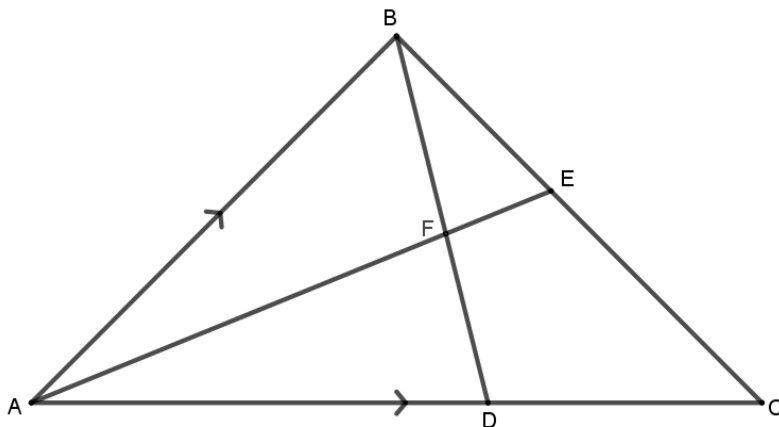
(a) Express the following vectors in terms of $\widetilde{b}$ and $\tilde{c}$ only
(i) AE   (2 marks)
(ii) BD   (1 mark)
(b) By expressing vectors BF in two ways, find the ratio BF: FD given that BF = hBD and AF = tAE where h & t are constants   (5 marks)
(c) Hence find vector BF in terms of b and c only   (2 marks)

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19. The table below shows the rates at which income tax is charged on annual income.

Annual taxable income (K£)	Rates (Sh per K£)
1 − 2800	3
2801 − 4600	5
4601 − 7200	6
7201 − 9000	7
9001 − 11 800	9
11 801 − 13 600	10
Over 13 600	12

A company employee earns a basic monthly salary of Ksh. 18 600 and a house allowance of 15% of his basic salary. If the employee is married and claims a monthly family relief of Sh. 250, calculate;

a) His annual taxable income in Kenya pounds. (2 marks)
b) His net salary per month. (8 marks)

20. The marks obtained by 50 students in an examination were recorded in the table below

Marks	0 − 9	10 − 19	20 − 29	30 − 39	40 − 49	50 − 59	60 − 69	70 − 79
Number of student	3	6	10	12	9	5	3	2

Using 44.5 as the assumed mean, calculate

(i) The actual mean mark (4 marks)
(ii) The standard deviation to 2 decimal place (3 marks)
(iii) The quartile deviation (3 marks)

21. Given that $y = 2\sin2x$ and $y = 3\cos(x + 45°)$
(a) Complete the table below: (2 marks)

x	0°	20°	40°	60°	80°	100°	120°	140°	160°	180°
$2\sin 2x$	0		1.97		0.68	−0.68	−1.73		−1.28	0
$3\cos(x + 45°)$	2.12	1.27		−0.78		−2.46			−2.72	−2.12

(b) Use the data to draw the graph of $y = 2\sin 2x$ and $y = 3\cos(x + 45°)$ for $0° \le x \le 180°$ on the same axis on the grid provided below. (5 marks)
(c) State the amplitude and period of each curve (2 marks)
(d) Use the graph to solve the equation $2\sin 2x − 3\cos(x + 45°) = 0$ for $0° \le x \le 180°$ (1 mark)

22. VABC is a pyramid standing on an equilateral triangular base ABC whose sides are 6 cm. VO is the perpendicular height. $VA = VB = VC = 15\ cm$.
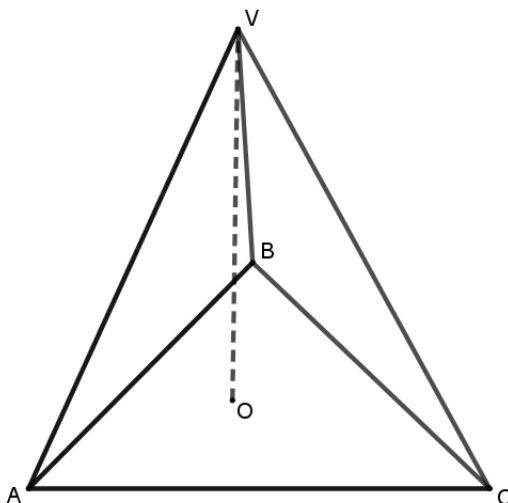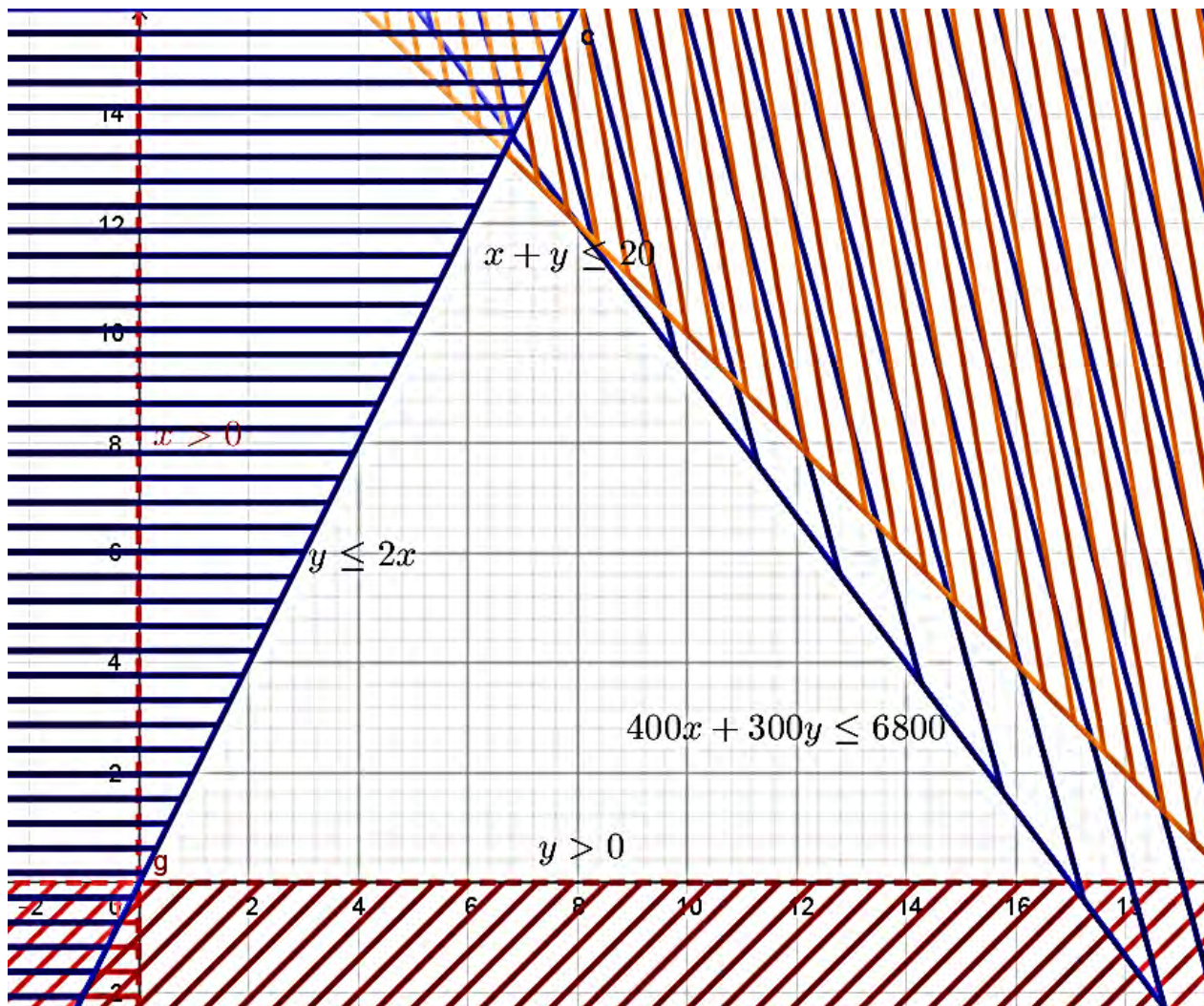

Calculate to 2 d.p.

a) Height VO. (3 marks)
b) The inclination of VAB to ABC. (2 marks)
c) The inclination of VB to ABC. (3 marks)
d) The volume of the pyramid. (2 marks)

23. A small-scale farmer wishes to buy some sheep and goats for rearing. Sheep cost Sh 400 and a goat cost Sh.300.The farmer has enough space for only 20 animals and may spend at most Sh. 6 800. The number of goats should not exceed twice the number of sheep.
a) By letting *x* and *y* to represent the number of sheep and goats he can buy respectively, write down all inequalities from the above information. (4 marks)
b) Represent the inequalities on the grid provided (4 marks)
c) From your graph, find the maximum number of animals he can buy at the lowest cost (2 marks)

24. The displacement of a particle S metres, t seconds after passing a fixed-point O is given by
$S = 3 + 2t - 5t^2$.
Calculate:
a) The displacement of the particle 2 seconds later (2 marks)
b) The time taken for the particle to return to O (3 marks)
c) The maximum displacement of the particle (3 marks)
d) The initial velocity of the particle (2 marks)

On the graph:
- $x + y \leq 20$
- $x > 0$
- $y \leq 2x$
- $400x + 300y \leq 6800$
- $y > 0$

24		
	(a) $3 + s(2) - 5(2) = -13$	M1 A1
	(b) $5t^2 - 2t - 3 = 0$	M1
	$\quad 5t(t-1) + 3(t-1) = 0$	M1
	$t = -\dfrac{3}{5} \, or \, t = 1$	A1 for $t = 1$
	$\;$ hence $t = 1$	M1 for differentiation
	(c) At maximum height, Velocity is zero	
	$2 - 10t = 0$	
	$\quad t = \dfrac{1}{5}$	M1
		A1
	$S = 3 + 2\left(\dfrac{1}{5}\right) - 5\left(\dfrac{1}{5}\right) = 3\dfrac{1}{5}\,\text{m}$	
	(d) $2 - 10t \xrightarrow{yields} 2 - 10(0) = 2$ m/s	M1 A1

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MOMALICHE 2 CYCLE 10
Kenya Certificate of Secondary Education
121/1
MATHEMATICS
PAPER 1
TIME: 2½ HOURS

SECTION I (50 MARKS)
Answer ALL questions in this section.

1. Without using mathematical tables or calculator evaluate; (3mks)

$$\sqrt{\frac{1.90 \times 0.032 \times 1.08}{2.00 \times 0.0038}}$$

2. Simplify completely $\dfrac{9a^2y - 16b^2y^3}{4by^2 - 3ay}$ (3mks)

3. A water tank has a capacity of 50 litres. A similar model tank has a capacity of 0.25litres. If the larger tank has a height of 100cm. calculate the height of the model tank. (3mks)

4. Simplify $\sqrt{\dfrac{12x^4\,y^{-1}\,Z^5}{3x^{-2}y^{-3}\,Z^3}}$ (2 mks)

5. One interior angle of a certain polygon is 84^0. If each of the other angles is 147^0, how many sides does this polygon have? (3 mks)

6. During a certain period the exchange rates at a Pesa point were;

|	Buying shs	Selling shs
Riyal	19.68	19.78

A tourist arrived with 5480 Riyal which he changed to Kshs. He spend $\frac{2}{3}$ of the total in visiting various sites. As he was leaving he changed all he had to Riyal. How much did he leave with? Answer to 1 d.p.
(3 mks)

7. Find the area of the triangle below given that lines AB=25cm, BC = 15cm, AC = 14cm, BD = 28cm and $CBD = 32°$ (4mks)
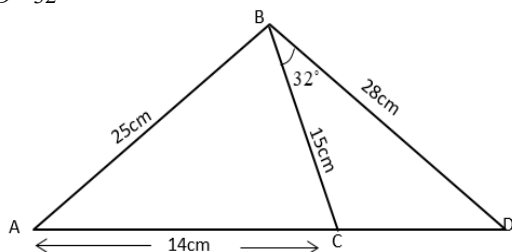
8. A shear parallel to the x-axis maps point (1,2) onto a point (7, 2). Determine the shear factors and hence state the shear matrix (invariant line is y = 0) (3mks)

9. The diagram below shows a circle ABCDE. The line FEG is a tangent to the circle at point E. Line DE is parallel to CG,


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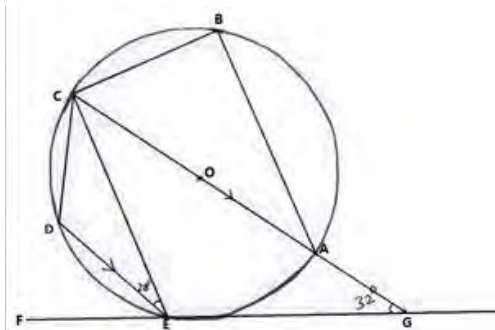
Calculate:
(a) AEG (2mks)
(b) ABC (2mks)
10. Wasike and Wanjala live 40km apart. Wasike starts cycling from his home at 8.00a.m toward's Wanjala's house at 16km/h. Wanjala stars cycling towards Wasike's house 30 minutes later at 8km/h. **what** time did they meet. (3mks)
11. The line which joins the point A (3, K) and B (-2, 5) is parallel to the line whose equation is 5y+2x-7=0. Find the value of K. (3mks)
12. Given that $Cos\ A = \frac{5}{13}$ and angle A is acute, without using tables or calculator, find the value of 2 tan A + 3 sin A. (3 mks)
13. Find the greatest integral value of x which satisfies. $\frac{2x + 3}{2} < \frac{8 - 3x}{5} < \frac{5x + 6}{3}$ (3mks)
14. The figure below (**not drawn to scale)** is a right pyramid with slant height of 5cm and square base of 3cm.
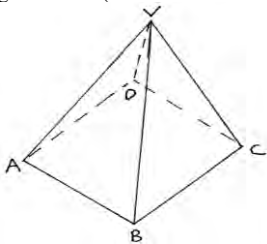
(a) Draw its net and label it. (2mks)
(b) Calculate the total surface area. (2mks)
15. A plane leaves town P to town Q on a bearing of 130º and a distance of 350km. it then flies 500km on a bearing of 060º to town R. Find, by scale drawing the distance between town R and town P. (3 mks)
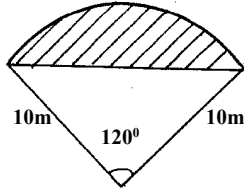16. The following data was obtained from the mass of a certain animal. Complete the table and the histogram below. (3 marks**)**

Mass(kg)	frequency
41-50	20
51-55	
56-65	40
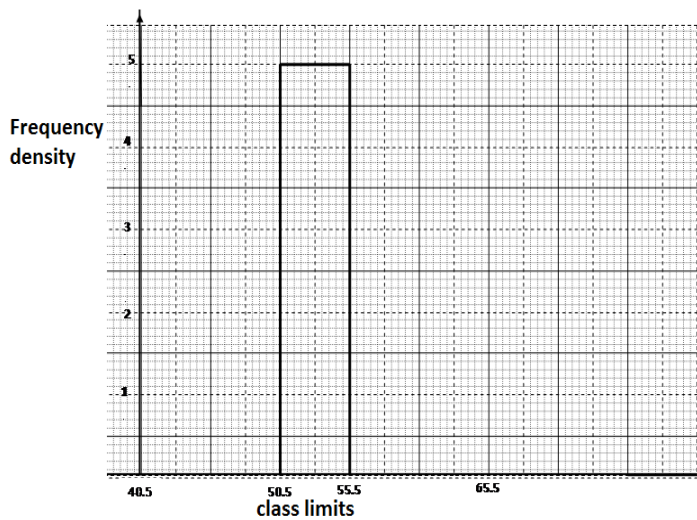
17. The ends of the roof of a workshop are segment of a circle of radius 10m. The roof is 20m long .The angle at the centre is 120^0 as shown in the figure below.

(a) Calculate:
(i) The area of one end of the roof. (4mks)
(ii) The area of the curve surface of the roof. (2mks)
(b) What would be cost to the nearest shilling of covering the two ends and the curved surface with galvanized iron sheet costing sh.80 per square meter? (4mks)

18. A rectangular tank whose internal dimensions are 1.7m by 1.4m by 2.2m is three quarters full of milk.
a) Calculate the volume of milk in litres. (3 marks)
b) The milk is packed in small packets in a shape of a right pyramid with an equilateral base triangle of side 16cn. The height of each packet is 13.6cm. Full packets obtained are sold at ksh.25 per packet.
i) The volume in cm^3 of each packet to the nearest whole number. (3 marks)
ii) The number of full packets of milk. (2 marks)
iii) The amount of money realized from the sale of milk. (2 marks)

19. (a) On the grid provided below, plot the polygon A(3, 7), B(5, 5), C(3, 1), D(1, 5) on a Cartesian plane (2mks)

(b) $A^1B^1C^1D^1$ is the image of ABCD under a translational $T\begin{pmatrix} -6 \\ -9 \end{pmatrix}$. Plot $A^1B^1C^1D^1$ and state its coordinates. (2mks)

(c) Plot $A^{11}B^{11}C^{11}D^{11}$, the image of $A^1B^1C^1D^1$ after a rotation about (-1, 0) through a positive quarter turn. State its coordinates. (3mks)

(d) $A^{111}B^{111}C^{111}D^{111}$ is the image of $A^{11}B^{11}C^{11}D^{11}$ after a reflection in the line $Y=x + 2$. Plot $A^{111}B^{111}C^{111}D^{111}$ and state its coordinates (3mks)

20. A straight line passes through the points (8, -2) and (4, 4).
a) Write its equation in the form $ax + by +c = 0$, where a, b and c are integers. (3 Marks)
b) If the line in (a) above cuts the x-axis at point P, determine the coordinates of P. (2 Marks)
c) Another line, which is perpendicular to the line in (a) above passes through point P and cuts the y axis at the point Q. Determine the coordinates of point Q. (3 Marks)
d) Find the length of QP (2 Marks)

21. Matrix P is given by
$\begin{pmatrix} 4 & 7 \\ 5 & 8 \end{pmatrix}$

(a) Find p^{-1} (3mks)
(b) Two institutes regions and Alphax purchased beans at sh. B per bag and maize at sh. M per bags. Regions purchased 8 bags of beans and 14 bags of maize for sh. 47,600. Alphax purchased 10 bags of beans and 16 bags of maize for sh. 57,400.
(i) Form a matrix equation to represent the information above (2mks)
(ii) Use the matrix p^{-1} to find the prices of one bag of each item (3mks)
(c) The price of bean later went up by 5% and that of maize remain constant. Regions bought the same quality of beans but spent the same total amount of money as before on the two items. State the new ratio of beans and maize. (2mks)

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22. In the diagram below, the coordinates of points A and B are (1, 6) and (15, 6) respectively. Point N is on OB and that 3 ON = 2 OB.ne OA is produced to L such that OL = 3 OA
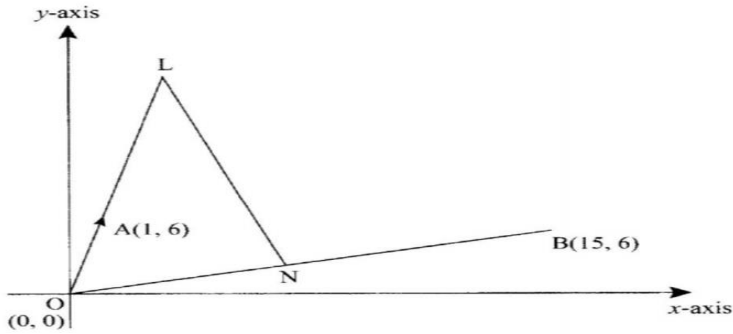
(a)   Vector LN.   (3 marks)
(b)   Given that a point M is on LN such that LM : MN = 3:4, find the coordinate of M.   (2 marks)
(c)   If line OM is produced to T such that OM : MT = 6:1
(i)   Find the position vector of T.   (1 mark)
(ii) Show that points L, T and B are collinear.   (4 marks)

23. a)   Complete the table below for the functions $y = 2x^2 - 3x - 5$ $for - 2 \le x \le 3$ (2 mks)

x	-2	-1	0	1	2	3
y						

(b)   Draw the graph of $y = 2x^2 - 3x - 5$ from the table above.   (2 mks)

(c)   Use your graph to solve the equation $y = 2x^2 - 3x - 5 = 0$ (1 mk)

(e)   From your graph, find the value of X which satisfy the simultaneous equations.   (1 mk)
      $y = 2x^2 - 3x - 5$
      $y = 2x - 2$

(d)   Write down the equation which is satisfied by the values of x in (e) above in the form
      $ax^2 + bx + c = 0$ (2 mks)

24. The diagram below shows a circle ABC with AB=12cm, BC=15cm, and AC=14cm
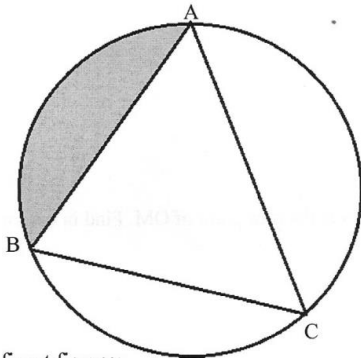
Calculate to 4 significance figures.
(a)   The angle ACB   (3mks)
(b)   The radius of the circle.   (3mks)
(c)   The area of the shaded region   (4mks)

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SECTION 1 (50 MARKS)
Answer all questions in this section.

1. A positive two digit number is such that the product of the digits is 24. When the digits are reversed, the number formed is **greater** than the original number by 18. Find the number. (3mks)

2. Use tables of squares, square roots and reciprocals to evaluate (4mks)

$$\frac{234}{\sqrt{0.02698}} + \frac{16}{(0.18149)^2}$$

3. The height and radius of a cone are measured as 21 cm and 14.0 cm respectively. Taking π= 3.142, find the **percentage error** in the volume of the cone. (3mks)

4. Express the following in **surd form** and simplify by rationalizing the denominator without using a calculator and leave your answer in the form $a + b\sqrt{c}$ (3mks)

$$\frac{1 + Cos\ 30^0}{1 - Sin\ 60^0}$$

5. Solve for **x** in: $Log_2(x + 7) - Log_2(x - 7) = 3$ (3mks)

6. A businessman obtained a loan of Ksh 450,000 from a bank to buy a Matatu that was valued at the same amount. The bank charges interest at 24% per annum compounded quarterly per year. Calculate the **total amount** of money the businessman paid to clear the loan in $4\frac{1}{2}$ years to the nearest shilling. (3mks)

7. In the diagram below, BT is a tangent to the circle at B. AXCT and BXD are straight lines. AX = 6cm, CT = 8cm, BX = 4.8cm and XD = 5cm.
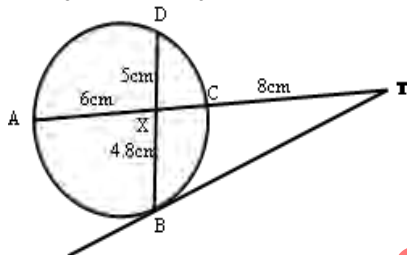
   Find the length of **BT**. (3Marks)

8. Find the possible values of x given that $\begin{pmatrix} x + 8 & 8 \\ 6 & x \end{pmatrix}$ is a **singular** matrix. (3mks)

9. The cost C of operating an electronic business is partly constant and partly varies as the square of labour input L. If **C=25,000** when **L=20** and **C=45,000** when **L=30**. Find **C** when **L=8.** (3mks)

10. The 2nd, 4th and 7th terms of an A.P. are the first 3 consecutive terms of a G.P. Find the **common ratio** of the G.P if the common difference of the A.P. is 2. (3mks)

11. P and Q are two points such that OP = i + 2j + 3k and OQ = 4i + 5j – 3k. M is a point that divides PQ externally in the ratio 3:2. Find the co-ordinates of M, given that O is the origin. (3mks)

12. A circle Centre C (5, 5) passes through points A (1, 3) and B (a, 9). Find the equation of the circle and hence the possible values of a. (4mks)

13. Tap A can fill an empty tank in 3 hours, while tap B can fill the same tank in 2 hours. When the tank is full, tap C can empty the tank in 5 hours. Tap A and C are opened for 4 hours and then closed.
a) Determine the fraction of the tank that is still empty. (1mks)
b) Find how long it would take to fill the remaining fraction of the tank if all the three taps are opened. (2mks)

14. Determine the interquartile range for the following set of numbers. (2mks)
   4, 9, 5, 4, 7, 6, 2, 1, 6, 7, 8.

15. Solve the equation $Sin(3x – 10)^0 = 0.4337$ for $0^0 \leq \Theta \leq 180^0$ (3mks)

16. (a) Expand and simplify $(3x – y)^4$ (2mks)
   (b) Use the first three term of the expansion to approximate the value of $(6 – 0.2)^4$ (2mks)

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17. Mrs. Mutua earns a basic salary of K£ 12,000 p.a. and is housed by the employer at a nominal rent of Shs 1,200 per month. She is entitled to a personal relief of K£ 1,320 p.a. and a premium relief of 10% on her insurance premium of K£ 800 p.a. The table of tax rate is as below.

Taxable income (K£ p.a.)	Rate (%)
1 – 2100	10
2101 – 4200	15
4201 – 6300	20
6301 – 8400	25
Over 8400	30

Calculate;
   a) Calculate the net tax per annum. (7mks)
   b) Other deductions includes W.C.P.S Shs 600 per month, NHIF Shs. 500 per month. Calculate her net pay per month. (3mks)

18. The Line AB = 5cm is a side of a triangle ABC in which angle ABC = 90⁰ and angle BAC = 60⁰.
   a) Construct triangle ABC (2mks)
   b) Construct the Locus P such that angle APB = angle ACB (2mks)
   c) Locate by construction points Q1 and Q2 which satisfy the conditions below:
   (i) Q1 and Q2 lie on the same side of line AB and C (3mks)
   (ii) Area of triangle AQ1B=Area of triangle AQ2B= 3/4 Area of triangle ABC
   (iii) Angle AQ1B=Angle AQ2B =30⁰
      Measure the length of the line Q1Q2 (3mks)
   d) Calculate the area above the line Q1Q2 bounded by the locus of point P (3mks)

19. The diagram below shows a square based pyramid **V** vertically above the middle of the base. **PQ** = 10cm and **VR** = 13cm. **M** is the midpoint of **VR**.
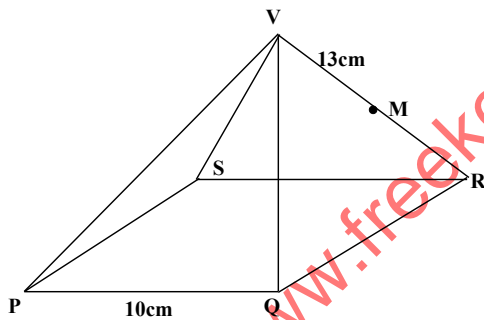
Find to 2 decimal places
   (a) i) the length **PR**. (2mks)
      ii) the height of the pyramid. (2mks)
   (b) i) the angle between **VR** and the base **PQRS**. (2mks)
      ii) the angle between **MR** and the base **PQRS**. (2mks)
      iii) the angle between the planes **QVR** and **PQRS**. (2mks)

20. a) Complete the table below for y=sin 2x and y=sin (2x + 30) giving values to 2d.p (2mks)

x	0	15	30	45	60	75	90	105	120	135	150	165	180
Sin 2x	0				0.87				-0.87				0
Sin (2x +30)	0.5				0.5				-1				0.5

   b) Draw the graphs of y=sin 2x and y = sin (2x + 30) on the axis. (4mks)
   c) Use the graph to solve $sin (2x + 30) - sin 2x = 0$ (1mk)
   d) Determine the transformation which maps $sin 2x$ $onto$ $sin (2x + 30)$ (1mk)
   e) State the period and amplitude of $y = sin (2x + 30)$ (2mks)

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21. OABC is a parallelogram with verities 0(0,0), A(2,0) B(3,2) and C(1,2). O, A, B, C is the image of

OABC under transformation matrix. $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$

    a)   Find the coordinates of $O^1A^1B^1C^1$ (2mks)

    ii)   On the grid provided, draw OABC and $O^1A^1B^1C^1$ (2mks)

    b)   Find $O^{11}A^{11}B^{11}C^{11}$, the image of $O^1A^1B^1C^1$ under transformation matrix $\begin{pmatrix} 1 & 0 \\ 0 & -2 \end{pmatrix}$ (2mks)

    ii)   On the same grid draw $O^{11}A^{11}B^{11}C^{11}$ (1mk)

    c)   Find a single matrix that maps $O^{11}A^{11}B^{11}C^{11}$ onto OABC   (3mks)

22. The following table shows the distribution of marks obtained by 50 students in a test.

Marks	45-49	50-54	55-59	60-64	65-69	70-74	75-79
No. of Students	3	9	13	15	5	4	1

By using an assumed mean of 62, calculate

    a)   The mean   (5mks)

    b)   The variance   (3mks)

    c)   The standard deviation   (2mks)

23. A box contains 3 brown, 9 pink and 15 white cloth pegs. The pegs are identical except for the colour.

    (a)   Find the probability of picking.

    (i)   A brown peg.   **(1mark)**

    (ii)   A pink or a white peg.   **(2 marks)**

    (b)   Two pegs are picked at random, one at a time without replacement. Find the probability that:

    (i)   At least one brown peg is picked   **(4marks)**

    (ii)   both pegs are of the same colour.   **(3marks)**

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

    a.   (i)   A retailer bought 10 kg of blend A rice. To this blend, the retailer added some Tamu rice to prepare a new mixture blend X. The ratio of Refu rice to Tamu rice in blend X was **1:2.** Determine the amount of Tamu rice that was added.   (3marks)

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

    b.   The wholesaler prepared another mixture, blend B, by mixing *x* kg of blend A rice with *y* kg of Tamu rice. Blend B has a wholesale price of Ksh130 per kg.

        Determine the ratio *x* : *y*.   (4mks)

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KIRINYAGA CENTRAL SUB-COUNTY
EFFECTIVE 40 JOINT EXAMINATION 2023
Kenya Certificate of Secondary Education
121/1
MATHEMATICS
Paper 1
2 ½ hours

SECTION I: (50 Marks)
Answer all the questions in this section.

1. Evaluate without using a Mathematical table or a calculator

$$\frac{-2^2 + 11 \ x - 0.\dot{6} \ of \ 50}{9 - (25 \ x \ 0.2) \div 2}$$

(3marks)

2. Using logarithms to evaluate correct to 4 significant figures. (4marks)

$$\frac{(152.9 \ x \ 0.006347)^2}{\sqrt[3]{28.53}}$$

3. The G.C.D of three numbers is 30 and their L.C.M is 900. Two of the numbers are 60 and 150. Find the least possible third number. (3 marks)

4. David's clock loses 15 seconds every hour. He gets 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)

5. Two similar containers have masses of 256 kilograms and 128 kilograms respectively. If the surface of the smaller container has an area of $810cm^2$, what is the area of the corresponding surface of the larger container to 2 decimal places? (3 marks)

6. Find the value of y in the equation (3 marks)

$$36^{y-1} + 6^{2y} = 222$$

7. Mwangi spends one-third of his salary on food, one quarter on rent, three-fifth of the remainder on transport and saves the rest. If he spends Ksh. 8400 on transport, find how much money he saves. (3 marks)

8. A Kenyan bureau buys and sells foreign currencies as shown below.

	Buying (in Kenya shillings)	Selling (in Kenya shillings)
1 Hong Kong dollar	9.74	9.77
100 Japanese Yen	75.08	75.12

A tourist arrived in Kenya with 105,000 Hong Kong dollars and changed the whole amount to Kenya shillings. While in Kenya, she spent Kshs. 403897 and changed the balance to Japanese Yen, before leaving for Tokyo. Calculate the amount in Japanese Yen that she received. (3 marks)

9. The coordinates of A, B, C and D are A(-3, 6), B(2, 4), C(4, -3) and D (3, -5) respectively. If A^1 is (-6, 7) under a translation T. Find the coordinates of B^1, C^1 and D^1 under T. (3 marks)

10. Solve; $4x - 3 \le 6x - 1 < 3x + 16$ hence state the integral values. (3 marks)

11. In the figure below AOC is a diameter of a circle centre O. ABDE is a cyclic quadrilateral and angle $COD = 28^0$.
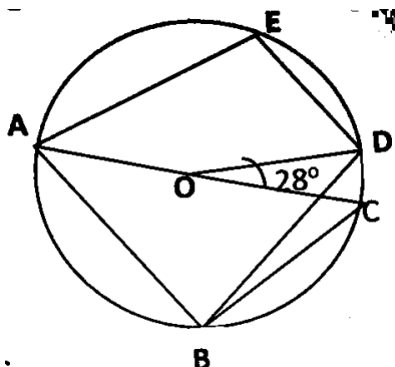
Determine the size of
(a) Angle AED (2 marks)
(b) Angle CAD (2 marks)

12. An aircraft left town A and flew eastwards along a latitude to town B (60^0N, 35^0E). If it took $5^1/_2$ hours at a speed of 910km/hr, find the position of A.
(Take $\pi = {}^{22}/_7$, R = 6370km) (3marks)

13. Object A of area 10cm^2 is mapped onto its image B of area 60cm^2 by a transformation whose matrix is given by $P = \begin{pmatrix} x & 4 \\ 3 & x+3 \end{pmatrix}$. Find the positive values of x. (3marks)

14. Simplify $\dfrac{6b^2 - 8ab - 8a^2}{4b^2 - 16a^2}$ (3 Marks)

15. Solve the following simultaneous equations. (3 marks)
$\dfrac{10}{a} - \dfrac{4}{b} = 4$ and $\dfrac{6}{a} + \dfrac{8}{b} = 5$

16. The base ABCDE of a right pyramid is a regular pentagon of side 3cm. Point V is a vertex of the pyramid and the length of the slanting edge is 4cm. Draw a labeled net of the pyramid. (3 marks)

SECTION II : (50 Marks)
Answer only FIVE questions in this section

17. A line passes through P(k, -3) and Q (5, k), where k is a positive non zero integer. The magnitude of PQ is $\sqrt{34}$ units.
(a) Find the value of k. (3 marks)
(b) Determine the equation of the perpendicular bisector of PQ in the form of ax + by + c = 0
Where a, b and c are integers. (4 marks)
(c) Find the equation of a line parallel to PQ and passing through (-1, 3) in the form of y = mx + c. (3 marks)

18. A carpenter constructed a closed wooden box with internal measurements 1.5m long, 0.8m wide and 0.4m high. The wood used in constructing the box was 1.0cm thick and had a density of 0.6g/cm^3. Determine:
(a) (i) the volume (in cm^3) of the wood used. (4 marks)
(ii) the mass of the box in kg correct to 1 decimal place. (2 marks)
(b) Identical cylindrical tins of diameter 10cm, height 20cm with a mass of 120 grams each were packed in the box. Calculate the:
(i) maximum number of tins that were packed. (2 marks)
(ii) total mass of the box with the tins in kilograms. (2 marks)

19. The figure below represents a triangular flower garden ABC in which AB = 4m, BC = 5m and $\angle$ BCA = 30^0. Point D lies on AC such that BD = 4m and < BDC is obtuse.
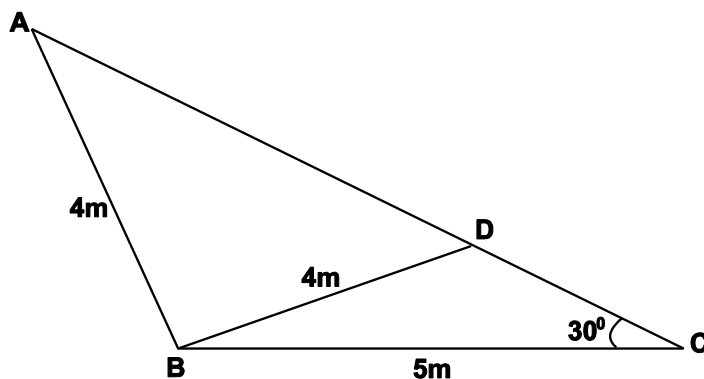
Find correct to 2 decimal places.
(a) $\angle$BDC (3 marks)
(b) the length of AD (3 marks)
(c) the length of DC (2 marks)
(d) the area of the flower garden ABC (2 marks)

20. A particle moves along a straight line such that its displacement S metres from a given point is;
$S = t^3 - 5t^2 + 3t + 4$. Where t is time in seconds. Find;
(a) The displacement of the particle at t = 5 sec. (2 marks)
(b) The velocity of the particle when t = 5 sec. (2 marks)
(c) The values of t when the particle is momentarily at rest. (3 marks)
(d) The acceleration of the particle when t = 2 sec. (3 marks)

21. (a) On the graph provided, draw the graph of;
$y = x^3 - 5x^2 + 2x + 9$ for $-2 \le x \le 5$ using a scale of 1cm for 1 unit on the x-axis and 1 cm
for 5 units on the y – axis. (5 marks)
(b) Use the graph to estimate the roots of the equations.
(i) $x^3 - 5x^2 + 2x + 9 = 0$ (2 marks)
(ii) $x^3 - 5x^2 + 4x + 3 = 0$ (3 marks)

22. John is a civil servant who earns a basic salary of Ksh. 38,300, house allowance of Ksh. 12,000 and a
medical allowance of Ksh. 3600 every month. He claims a family relief of Ksh. 1172 and insurance relief of
3% of the premium paid. Using tax table below; calculate;

Taxable Income K£ p.a	Tax rates Ksh. per pound
1 – 8800	2
8801 – 16800	3
16801 – 24800	5
24801 – 36800	7
36801 – 48800	9
Over 48800	10

(a) John's annual taxable income in Kenya pounds per annum. (2 marks)
(b) Tax due every month from John's to 2 d.p (5 marks)
(c) If further deductions are made every month from his salary'
- WCPS of 2% of basic salary
- Life insurance premium of sh 4600
- Sacco Loan repayment of sh 14200
Calculate:
(i) John's total deductions (1 mark)
(ii) John's net salary per month (2 marks)

23. In a road safety survey, 1000 vehicles were examined. 62 of these were found to have defective tyres, 30 had
defective steering wheels and 45 had defective brakes.
Assuming that this sample accurately represent all the vehicles in the country, find the probability that a
vehicle in the country picked at random has;
(a) (i) Defective brakes (1 mark)
(ii) Defective brakes but neither of the other two defects (3marks)
(iii) Has no defects (2 marks)
(b) If the owner of a defective vehicle is warned if his car has one or two of these defects, but is fined sh
300 if his car has all three defects, what is the total amount of fined that one would expect to be
imposed after 10,000 vehicles had been inspected at random? (4 marks)

24. A bus and a Nissan left Nairobi for Cheptiret a distance of 340 km at 7.00am. The bus traveled at 100km/h
while the Nissan at 120km/h. After 30 minutes, the Nissan had a puncture which took 30 minutes to mend.
(a) How far from Nairobi did the Nissan catch up with the bus? (5 marks)
(b) At what time of the day did the Nissan catch up with the bus? (2 marks)
(c) At what time did the bus reach Cheptiret? (3 marks)

KIRINYAGA CENTRAL SUB-COUNTY
EFFECTIVE 40 JOINT EXAMINATION 2023
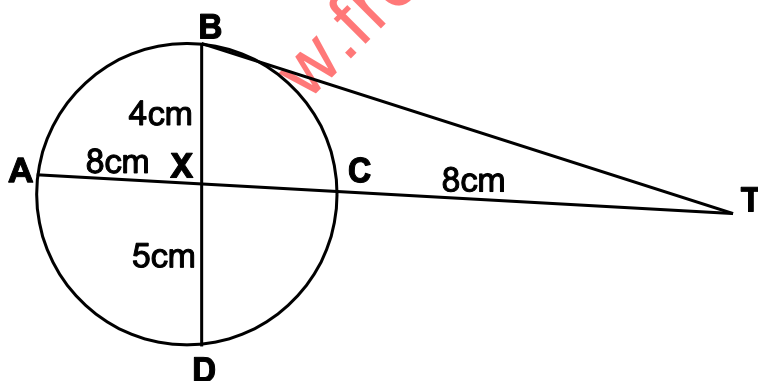**Kenya Certificate of Secondary Education**
121/2
MATHEMATICS
Paper 2
$2\frac{1}{2}$ hours

SECTION I: (50 Marks)
Answer all the questions in this section.

1. Solve for n by completing the square method.
   $2n^2 - 6n + 4 = 0$ (3marks)

2. The matrix $\begin{pmatrix} x & -3 \\ 0 & x-6 \end{pmatrix}$ is a singular matrix. Find possible values of x; to 2 d.p. (3 marks)

3. Evaluate $\int_{1}^{5}\left(x^2 - \frac{1}{x^2}\right)dx$ (3 marks)

4. Solve for x in $\text{Log}_{10}5 - 2 + \text{Log}_{10}(2x+10) = \text{Log}_{10}(x-4)$ (4 marks)

5. Make b the subject of the formula (3 marks)

   $$\frac{bd}{\sqrt{b^2+d}} = \frac{1}{r}$$

6. The sides of a rectangle are measured as 8cm by 5cm correct to the nearest centimeter.
   Determine the percentage error in calculating its perimeter correct to 4 significant figures. (3 marks)

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

8. A trader bought two brands of rice. Type A cost sh 100 and type B cost sh 80 per kilogramme. She mixed the two brands and sold the mixture at sh 96 per kilogramme. Determine the ratio in which she mixed the two brands. (3 marks)

9. In the figure below, BT is a tangent to the circle at B. AXCT and BXD are straight lines. AX = 8cm, CT = 8cm, BX = 4cm and XD = 5cm

   Calculate the length
   (i) XC (2 marks)
   (ii) BT (1 mark)

10. Solve for x in the equation Cos $(3x - 30^0) = 0.5$ where $0 \le x \le 360^0$. (3 marks)

11. Given that $\overrightarrow{OA} = 2i + 3j$ and $\overrightarrow{OB} = 3i - 2j$. Find the magnitude of AB to one decimal place. (3 marks)

12. The equation of a curve is given by $y = x^3 - 4x^2 - 3x$.
    Find the equation of the normal to the curve at x = 1. (3marks)

13. The equation of a circle is given by $4x^2 + 4y^2 - 8x + 20y - 7 = 0$ (3marks)
    Determine the centre and the radius of the circle.

14. The 5th and 10th terms of an arithmetic progression are 18 and -2 respectively.
    Find the common difference and the first term. (3 Marks)

15. (a) Expand the expression $\left(1 - \frac{3}{10}x\right)^5$ in ascending powers of x, leaving co-efficient as fractions in their lowest form upto to x^3. (2 marks)

(b) Use the first three terms of the expression in part (a) above to estimate the value of $(0.97)^5$. (2 marks)

16. Mogaka and Onduso working together can do a piece of work in 6 days. Mogaka, working alone takes 5 days longer than Onduso. How many days does it take Onduso to do the work alone. (3 marks)

SECTION II: (50 Marks)
Answer only   FIVE questions in this section.

17. (a) Using ruler and pair of compasses only.
Construct triangle ABC such that angle $ABC = 45^0$ and angle $BAC = 60^0$ and AB = 6cm. (3 marks)

(b) Locate the Locus of P using the triangle in (a) above such that angle $APC = 120^0$. (4 marks)

(c) Locate a point Q 3cm from AB and 4cm from B. (3 marks)

18. (a) Complete the table below for the equation (2 marks)
y = Sin 2x

x	0^0	15^0	30^0	45^0	60^0	75^0	90^0	105^0	120^0	135^0	150^0
Sin 2x	0					0.5					−0.87

(b) Draw the graph of y = Sin 2x for $0^0 \leq x \leq 150^0$.
Using scale x – axis 1cm : 15^0
          y – axis 1cm : 0.2 (3 marks)

(c) Using the graph in (b) above solve
150 sin 2x + x = 60^0 (3 marks)

(d) State the amplitude and period of y = Sin 2x (2 marks)

19. In the figure below ABCDEFG is a cuboid with a square base. EG = 5cm, AE = 12cm
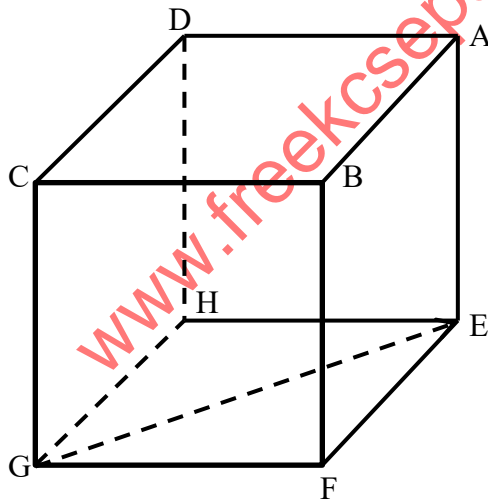
(a) Name the projection of AG on plane GFEF. (1 mark)

(b) Calculate the length GF to 2 d.p (2 marks)

(c) Calculate the volume of the cuboid. (1 mark)

(d) Calculate the angle between line AG and plane GFEH. (2 marks)

(e) Calculate the angle between lines GE and AB, to 2 S.F. (2 marks)

(f) Calculate the angle between planes GFEH and DAFG. (2 marks)

20. A matrix $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$ represents the transformation T, where the triangle ABC with A(1, 1), B (5, 1) and C (2, 4) is transformed by T onto $\Delta A^1B^1C^1$

(a) (i) Find the coordinates fo the image $A^1B^1C^1$ of ABC under transformation T. (2 marks)

(ii) Draw the triangle $A^1B^1C^1$ and ABC on the same Cartesian plane. (2 marks)

(b) (i) Triangle $A^1B^1C^1$ undergoes another transformation R whose matrix is $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ and is mapped onto $A^{11}B^{11}C^{11}$. Determine the coordinates of $A^{11}B^{11}C^{11}$, hence draw it on the same Cartesian plane. (2 marks)

    (iii) Describe the transformation in b(i) above fully. (1 mark)

(c) Find, by calculation a single matrix that would map $A^{11}B^{11}C^{11}$ onto ABC. (3 marks)

21. The table below shows marks scored in a Mathematics in a class of 40 students.

Marks	10-19	20-29	30-39	40-49	50-59	60-69	70-79
No. of students	2	6	7	13	6	4	2

(a) Using an assumed mean of 44.5, determine

(i) the mean of the distribution. (3 marks)

(ii) the variance (3 marks)

(iii) the standard deviation to 4 decimal places, (1 mark)

(b) Estimate the medium of the distribution to 4significant figures (3 marks)

22. An Arithmetic Progression (A.P) has its first term as a and a common difference d.

a) Find in terms of a and d, the first, third and eleventh terms of the AP. (2 marks)

b) The AP above is increasing and the first, third and eleventh terms form in the first three terms of a Geometric Progression (G.P). The sum of the fifth and ninth terms of the AP is 80.

(i) Find the values of a and d. (4 marks)

(ii) Calculate the sum of the first 10 terms of the A.P. (2 marks)

c) Determine the 5th term of the G.P. (2 marks)

23. The diagram below shows a triangle OPQ in which M and N are points on OQ and PQ respectively such that $\overrightarrow{OM} = {}^2/_3$ OQ and $\overrightarrow{PN} = {}^1/_4$ PQ. Lines PM and ON meets at X.
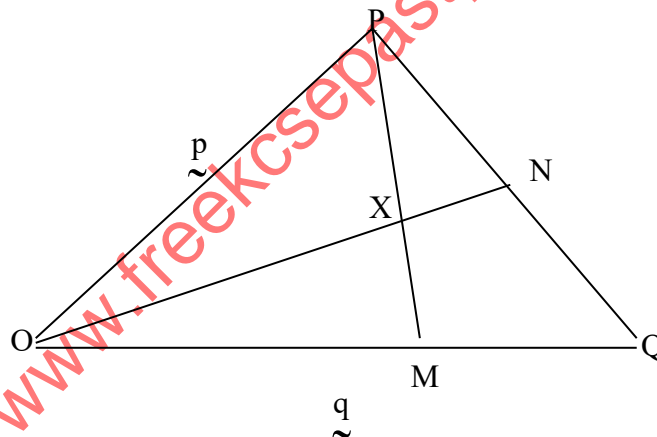
(a) Given that OP = p and OQ = q, express in terms p and q the vectors.

(i) PQ (1 mark)

(ii) PM (1 mark)

(iii) ON (2 marks)

(b) You are further given that OX = kON and PX = hPM.

(i) Express OX in terms of p and q in two different ways. (2 marks)

(ii) Find the value of h and k. (3 marks)

(iii) Find the ratio PX : XM (1 mark)

24. An aircraft leaves town P (30^0S, 17^0E) and moves directly northwards to Q (60^0N, 17^0E). It then moved at an average speed of 300 knots for 8 hours westward to town R.
Detemine:-

(a) The distance PQ in nautical miles (2 marks)

(b) The position of town R. (4 marks)

(c) The local time at R in 24-hour system if the local time at Q is 3.12 pm. (2 marks)

(d) The distance moved from P to R in km.
(Take 1nm = 1.853 km) (2 marks)

Kenya Certificate of Secondary Education (KCSE)

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MATHEMATICS ALT A

PAPER 1

**SECTION 1** (*50 marks*)

Answer all the questions in this section.

1. Evaluated: (3mks)

$$\frac{2\frac{1}{2} \, of \, 1\frac{3}{4} - 5\frac{1}{4}}{1\frac{2}{5} + 2(1\frac{1}{4} - 2\frac{3}{4})}$$

2. Use logarithms to evaluate the following to 4 significant figures to: (4mks)

$$\left(\frac{95.75 \, X \, 0.85}{4.524 + 1.234}\right)^{\frac{2}{3}}$$

3. An electrician made a loss of 30% by selling a multi plug at sh.1400.what percentage profit would he has made if he sold the multi plug at sh. 2300. (3mks)

4. In the triangle ABC below, BC=9cm, angle ABC=80°.and angle ACB=30°.
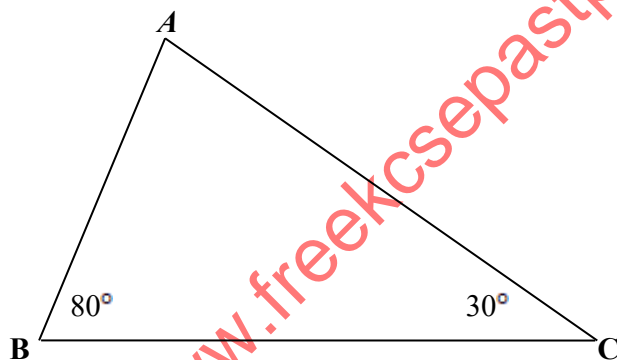
Calculate, correct to 4 significant figures, the area of the triangle. (3mks)

5. Given that the exterior angle of a regular hexagon is 2x. Find the value of x. Hence find the size of each interior angle of the hexagon. (3mks)

6. Two numbers t and s are such that $t^4 x \, s^2 = 5625$. Find t and s (3mks)

7. Find the obtuse angle the line with equation $2y+5x+2=0$ makes with the x-axis. (3mks)

8. Simplify the expression (3mks)

$$\frac{12x^2 + ax - 6a^2}{9x^2 - 4a^2}$$

9. A plot is in the shape of a right-angled triangle. The length of the shorter side is 15m and the area is 456.8m². Calculate the length of the longest side of the garden. (3mks)

10. The diagram below shows a region R bounded by three lines L_1, L_2 and L_3. Form the three inequalities that satisfies the given region R (3mks)
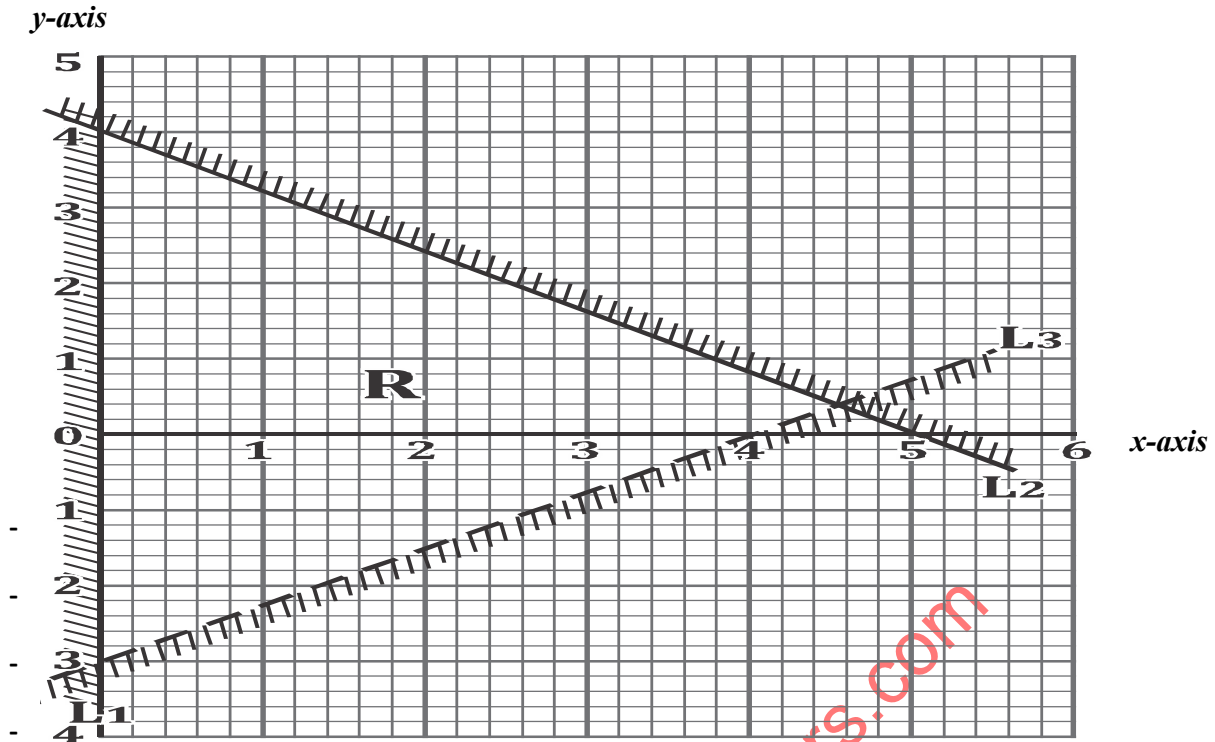
11. A bus travelled at an average speed of 63km/h left the station at 9.15 am. A car later left the same station at 10.00am and caught up with bus at 11.45 am. Find the average speed of the car. (3mks)

12. A tourist came in Kenya and exchanged 1250 US dollars into Kenyan shillings at the rate shown below.

        Buying (Kshs)   selling (Kshs)
        1US dollar 105.5   110.8

He spent Ksh. 85400 after which he converted the remaining balance to US dollars. How much US dollars did he get back to the nearest dollar. (3mks)

13. a) Complete the table below for $y=x^2+5$ (1mk)

x	0	1	2	3	4	5	6
$y = x^2 + 5$	5						

b) Use the trapezoidal rule with 7 ordinates to estimate the area bounded by the curve $y=x^2+5$, x –axis , y-axis and x=6 (2mks)

14. Given that $\mathbf{a} = \begin{pmatrix} 6 \\ 2 \end{pmatrix}$, $\mathbf{b} = \begin{pmatrix} -2 \\ -4 \end{pmatrix}$ and $3\mathbf{a}-2\mathbf{b}+2\mathbf{c}= \begin{pmatrix} 32 \\ 20 \end{pmatrix}$, find $\mathbf{c}$ (3mks)

15. A triangle T with vertices A(2,4), B(6,2) and C(4,8) is mapped onto triangle T' with vertices A'(10,0) , B'(8,-4) and C'(14,-2) by a rotation .
a) on the grid provided draw triangle T and its image T' (2mks)
b) Determine the centre and the angle of rotation that maps T onto T' (2mks)

16. A small cone of height 8cm is cut off from a bigger cone leaving a frustum of height the 16cm. If the volume of the smaller cone is 160cm³, find the volume of the frustum. (3mks)

Section II (50MKS)

*Answer any **five** questions in this section.*

17. Three businessmen, Hassan, Mutua and Wanyonyi decided to start a business. The initial capital which was needed was Ksh. 4,000,000 of which they were able to raise 30% by making contributions in the ratio 3:3:2 respectively. The rest of the amount was obtained from a bank and was to be paid back within one year with an interest of 25% in the same ratio 3:3:2. The three men were to share the profit of the business in the ratio of their contribution. During the year, the business realized a profit of ksh.4, 800,000.

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a) How much of the initial amount did Wanyonyi raise?   (3mks)
b) How much did Hassan pay to the bank at the end of the year?   (4mks)
c) After paying the bank at the end of the year, how much was Mutua left with?   (3mks)

18. The marks scored by 50 students in a geography examination are as follows:

| 60	54	40	67	53	73	37	55	62	43
44	69	39	32	45	58	48	67	39	51
46	59	40	52	61	48	23	60	59	47
65	58	74	47	40	59	68	51	50	50
71	51	26	30	38	70	46	40	51	42

a) Prepare a frequency distribution table using a class interval of 10 starting from 21-30   (3mks)
b) Draw a histogram to represent the distribution   (4mks)
c) Use your histogram to estimate the modal class   (1mk)
d) Using the histogram estimate the mean of the distribution of the data.   (2mk

19. A petrol tanker has a cross-section in the shape shown below. It is used to transport petrol. Its internal length is 7m while its internal radius is 3.5 m. Obtuse angle POQ = 144^0.On one of its trips, it was filled to capacity. Taking $\pi = \frac{22}{7}$
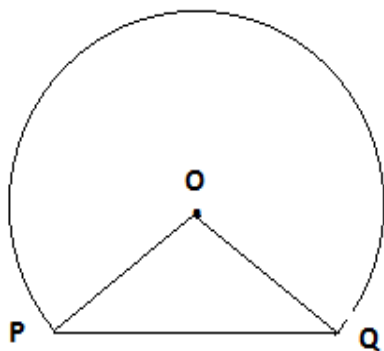
(a) Calculate the volume of petrol in the tanker in
(i)   m^3 (2 marks)
(ii) litres   (1mark)
(b) In the parking lot at night, a third of the petrol was stolen.
i)   How many litres of petrol was the owner left with?   (2 marks)
ii) What was the mass of the remaining petrol given that one cubic metre of petrol has a mass of 700kg?
                                                                                          (3 marks)
(iii) At the weigh bridge, any vehicle carrying excess of 50,000 Kg was charged Sh. 12.50 for every extra kilogram. How much fine did the owner of the tanker pay?   (2 marks)

20. The figure below represents a quadrilateral piece of land ABCD divided into three triangular plots. The lengths BE and CD are 100m and 80m respectively. Angle ABE = 30^0, ACE = 45^0 and   ACD = 100^0.
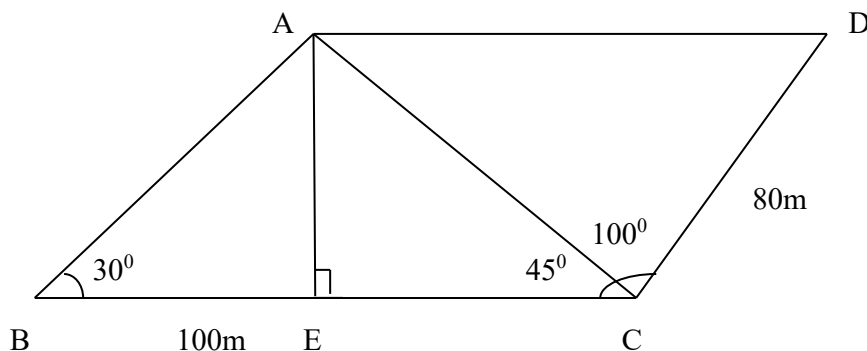
(a) Find to four significant figures:
(i)   The length of AE.   (2mks)
(ii) The length of AD.   (2mks)
(iii) The perimeter of the piece of land.   (3mks)

(b) The plots are to be fenced with five strands of barbed wire leaving an entrance of 2.8m wide to each plot. The type of barbed wire to be used is sold in rolls of lengths 480m. Calculate the number of rolls of barbed wire that must be bought to complete the fencing of the plots. (3mks)

21. A straight line **L₁** has a gradient **-½** and passes through point **P (-1, 3).** Another line **L₂** passes through the points **Q (1,-3)** and **R (4, 5)**.
Find:
(a) The equation of **L₁** (2 marks)
(b) The equation of **L₂** in the form ax + by + c = 0 . (3 marks)
(c) The equation of a line passing through a point **S (0, 5)** and is perpendicular to **L₂**. (3 marks)
(d) The equation of a line through **R** parallel to **L₁**. (2 marks)

22. a) A port B is on a bearing 080° from a port A and a distance of 95 km. A Submarine is stationed at a port D, which is on a bearing of 200° from A, and a distance of 124 km from B. A ship leaves B and moves directly Southwards to an Island P, which is on a bearing of 140° from A. The Submarine at D on realizing that the ship was heading to the Island P, decides to head straight for the Island to intercept the ship. Using a scale of 1 cm to represent 10 km, make a scale drawing showing the relative positions of A, B, D and P. (4 marks)
Hence find:
b) The distance from A to D. (2 marks)
c) The bearing of the Submarine from the ship when the ship was setting off from B. (1 mark)
d) The bearing of the Island P from D. (1 mark)
e) The distance the Submarine had to cover to reach the Island P. (2 marks)

23. (a) Find the inverse of the matrix: (1mk)
A=$\begin{pmatrix} 4 & 3 \\ 3 & 2 \end{pmatrix}$

b) Amina bought 20 bags of oranges and 15 bags of mangoes for a total of sh. 9,500. Nafula bought 30 bags of oranges and 20 bags of mangoes for a total of sh. 13,500. If he price of a bag of oranges is X and that of mangoes is y:
a) Form two equations to represent the information above. (2mks)
ii) Hence use the matrix A^{-1} above to find the price of one bag of each item. (4mks)
(c) The price of each bag of oranges was increased by 10% and that of mangoes reduced by 10%. The businesswomen (Amina and Nafula) bought as many oranges and as many mangoes as they bought earlier. Find the total cost of oranges and mangoes that each businesswoman bought after the percentage change. (3mks)

24. 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 (2mks)
b) Determine:
i) the velocity of the particle when t=5 seconds; (3mks)
ii) the value of t when the particle is momentarily at rest (3mks)
c) find the time , when the velocity of the particle is maximum (2mks)

MBORANU II FORM FOUR JOINT EVALUATION 2023

Kenya Certificate of Secondary Education (KCSE)

121/2

MATHEMATICS ALT A

PAPER 2

SECTION 1 (*50 marks*)

Answer all the questions in this section.

SECTION I (50mks)
(Answer all questions in this section)

1. Simplify without using mathematical tables or calculator. (4mks)

$$\frac{2(\log_{10} 2.5 + \log_{10} 40)}{3 \log_{10} 0.05 + 2\log_{10} 2 - \log_{10} 0.5}$$

2. Simplify $\frac{2}{2+\sqrt{5}} - \frac{2\sqrt{5}}{2-\sqrt{5}}$ and express your answer in the form a+b√c where a, b and c are constants. (3mks)

3. A wedding committee did a budget for a wedding ceremony as follows:
   Food: Ksh.   58,205
   Chairs: Ksh.   11,950
   Entertainment: 8,453

   The sum of the budget was done by first rounding each figure to 3 significant figures.
   a) Determine the sum of the budget (2mks)
   b) Determine the percentage error in this sum of the budget (2mks)
4. Solve the equation $4\sin^2 x + 4\cos x = 5$ for $0^0 \le x \le 360^0$ (3mks)
5. a)   Expand $(1- x)^4$ using the binomial expansion (1mk)
   b). Use the first three terms of the expansion in (a) above to find the value of $(0.998)^4$
         Correct to the nearest hundredth (3mks)
6. Make w the subject of the formula (3mks)

$$P = \sqrt{\frac{vw^2}{v^2 - w^2}}$$

7. Given that $y = 3 \sin (½ x + 60)^0$ find, amplitude, period and the phase angle of the function. (3mks)
8. A ship sails due North from latitude 20^0 S for a distance of 1440nm. Find the latitude of the point it reaches (2mks)
9. The equation of a circle is given by $3x^2 + 3y^2 + 3x + 42y + 30 = 0$. Determine the radius and the coordinates of the centre circle. (3mks)
10. a)   i)   Draw a straight-line MN such that MN=7cm (1mk)
       ii) Construct the locus P such that $\angle MPN = 90^0$ (1mk)
    b)   On the locus of P in (a) above, mark point T such that T is equidistant from M and N. (2mks)

11. The table below shows tax table for monthly income

Monthly taxable income in Ksh.	Tax rate % in each shilling
0- 9680	10
9681- 18800	15
18801-27920	20

   In a certain month, Kamau's tax was sh. 3336. Determine his income during that month. (3mks)

12. In the figure below OC is the tangent to the circle. If OE=8cm and OC=6cm, find EA.   (2mks)
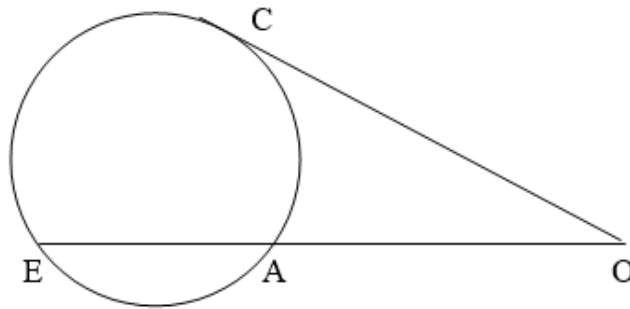
13. Evaluate $\int_1^4 (3x^2 + 1)dx$ (3mks)
14. Liquid P contains 30% of water while liquid Q contains 48% of water. In what ratio should P and Q be mixed so that the mixture contains 42% of water?   (3mks)
15. The probability that it is rainy in the morning is 0.6. The probability that John carries an umbrella while going to work is 0.4. Find the probability that
i) It is not rainy and John does not carry an umbrella.   (2mks)
ii) It is rainy and John carries an umbrella   (1mk)
16. Solve the simultaneous equations
   $x - 2y = 1$, $x^2 + y^2 = 29$ (3mks)

SECTION II (50 MARKS)
(Answer five questions in this section)
17. The first three consecutive terms of a geometric progression are 3^{2x+1}, 9^x and 81 respectively
a) Calculate the value of x (3mks)
b) Find the common ratio of the series   (2mks)
c) Calculate the sum of the first ten terms of this series   (2mks)
d) Given that the fifth and the seventh terms of this Geometrical Progression form the first two consecutive terms of an arithmetic sequence calculate the sum of the first 20 terms of the arithmetic sequence.   (3mks)
18. In an experiment, the length of 100 rats were measured to the nearest 0.1cm and the frequency tabulated as follows:

Length in *(cm)*	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Frequency	1	4	x	20	25	26	7	1	1

a) Find the value of x (2mks)
b) Calculate the mean length using assumed mean of 42   (4mks)
c) Calculate the standard deviation   (4mks)

19. Complete the table below for the function
   $y = x^3 + 6x^2 + 8x$ (2mks)

x	-5	-4	-3	-2	-1	0	1
x^3	-125	-64		-8	-1	0	1
$6x^2$		96	54		6	0	6
$8x$	-40		-24	-16		0	8
y			3	0	-3	0	15

a) Draw the graph of the function y = x^3+6x^2+8x for $-5 \le x \le 1$ (3mks)
   (Use a scale of 2 big squares to represent 1 unit on the *x*-axis and 1big square to represent 2 units on the *y*-axis)
b) Use your graph to estimate the roots of the equations
i. $x^3 + 6x^2 + 8x = 0$ (1mk)
ii. $x^3 + 5x^2 + 4x = -x^2 - 3x - 1$ (2mks)
c) Find the values of *x* which will satisfy the inequality $x^3 + 6x^2 + 8x > 1$ (2mks)

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20. The figure below is a square based pyramid ABCDV with AD = DC = 6cm. VO = 10cm
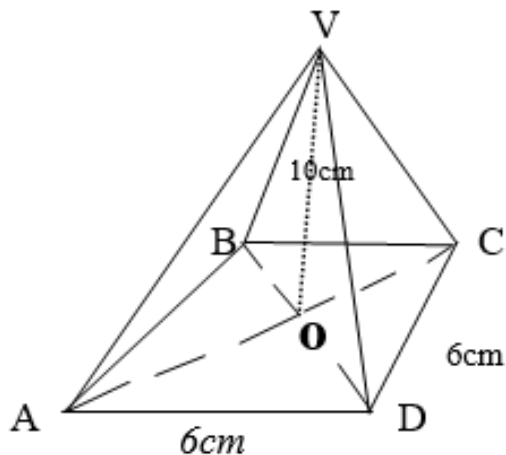
a) State the projection of VA on the base ABCD   (1mk)
b) Find:
i. The length of VA   (3mks)
ii. The angle between the planes VA and ABCD   (2mks)
iii. The angle between the planes VDC and ABCD   (2mks)
iv. The volume of the pyramid   (2mks)

21. The points A (0,0), B (-3,1), C (1,3) and (4,2) are the vertices of a parallelogram ABCD.

a) A$^/$B$^/$C$^/$D$^/$ is the image of ABCD under the matrix of transformation $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$

Draw ABCD and A$^/$B$^/$C$^/$D$^/$ on the grid. Write down the coordinates of A$^/$B$^/$C$^/$D$^/$ (3mks)

b) The points A$^{//}$(0,0) B$^{//}$ (-6,2) C$^{//}$(2,6) and D$^{//}$(8,4) are the vertices of A$^{//}$ B$^{//}$C$^{//}$D$^{//}$ the image of ABCD under a certain transformation. Draw A$^{//}$ B$^{//}$C$^{//}$D$^{//}$ on the same grid as ABCD. Describe this transformation fully.
                                                                                  (3mks)
c) A single transformation T maps A$^/$B$^/$C$^/$D$^/$ on to A$^{//}$ B$^{//}$C$^{//}$D$^{//.}$ Determine the matrix of T   (4mks)

22. A sum of money is deposited in a bank that pays simple interest at a rate r. After 3 years the total amount of money in the account is Ksh. 358,400. The interest earned each year is Ksh. 12,800.
a) Calculate: i) The amount of money which was deposited.   (2mks)
ii) The rate of interest r.   (2mks)
b) A computer whose marked price is Ksh. 40,000 is sold at ksh. 56,000 on hire purchase terms.
i) James bought the computer on hire purchase terms. He paid a deposit of 25% of the hire purchase price and cleared the balance by equal monthly instalments of ksh. 2625. Calculate the number of instalments.
                                                                                  (3mks)
ii) Had James bought the computer on cash price he would have been allowed a discount of 12.5% on the marked price. Calculate the difference between the cash price and the hire purchase price and express it as a percentage of the cash price.   (3mks)

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23. In the figure below OPQ is a triangle in which $OS = \frac{3}{4}\overrightarrow{OP}$ and $\overrightarrow{PR}:\overrightarrow{RQ} = 2:1$. Lines $\overrightarrow{OR}$ and $\overrightarrow{SQ}$ meet at T.
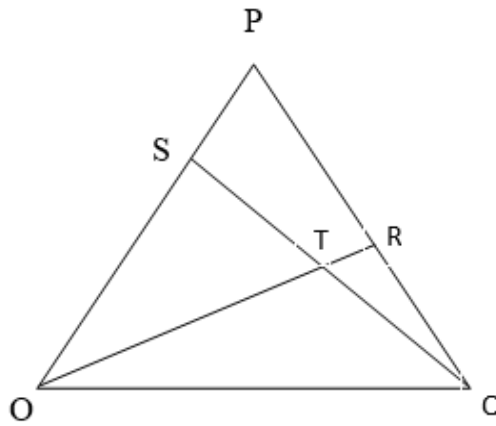
a) Given that $\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OQ} = \mathbf{q}$. Express the following vectors in terms of p and q:

i. $\overrightarrow{PQ}$ (1mk)

ii. $\overrightarrow{OR}$ (2mks)

iii. $\overrightarrow{SQ}$ (2mks)

b) Given that $\overrightarrow{ST} = m\overrightarrow{SQ}$ and $\overrightarrow{OT} = n\overrightarrow{OR}$ where m and n are consonants, determine the values of m and n (4mks)

c) Find the ratio of ST:TQ (1mk)

24. During installation of electricity bulbs in street lighting a dealer is required to supply two types of bulbs A and B. The total number of bulbs should not be more than 400. He must supply more of type A than of type B and type A should not be more than 300 and type B should not be less than 80.

a) By letting the number of type A bulbs to be x and the number of type B bulbs to be y, write all the inequalities representing the above information. (3mks)

b) On the grid provided draw all the inequalities (4mks)

c) If type A bulbs cost sh.450 per piece and type B cost sh.350 per piece and that the higher the cost the higher the profit:

i. Use your graph to determine the number in each type of bulb that he should supply to maximize the profit. (1mk)

ii. Calculate the maximum cost of lighting the street (2mks)

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KIHARU – KAHURO FORM 4 JOINT EXAMINATION
(KENYA CERTIFICATE OF SECONDARY EDUCATION)
121/1
MATHEMATICS
PAPER 1
TIME: 2 ½ HOURS

SECTION 1 (50 MARKS)
Answer all questions in this section.

1. Evaluate without using a calculator; (3 marks)

$$\frac{\frac{5}{6} \text{ of } \left(4\frac{1}{3} - 3\frac{5}{6}\right)}{\frac{5}{12} \times \frac{3}{25} + 1\frac{5}{9} \div 2\frac{1}{3}}$$

2. In August, Michael donated ⅙ th of her salary to children's home while Ali donated ⅕ th of his salary to the same children's home. Their total donation for August was Kshs 11,200. In September, Michael donated ⅛ th of her salary to the children's home while Ali donated $\frac{1}{12}$ th of his salary to the children's home. The total donation for September was Ksh 6,000. Calculate Ali's monthly salary. (3marks)

3. Show that if OA = -i – 7j, OB = 3i – 5j and OC = 5i – 4j, then points AB and C are collinear. (4marks)

4. At the end of his stay in Kenya, a French tourist had 3420 French francs which he decided to change into Euros. Given the exchange rate was;
   1 French franc = Ksh. 11.25
   1 Euro = Ksh. 72.50
   Calculate the number of Euros he received if the bank charged him 2% commission. (3marks)

5. A polygon has n sides. Two of its interior angles are each right angled and each of the remaining angles are 144^0 each. Find the value of n. (3marks)

6. Use tables of squares, square roots and reciprocals only to evaluate: (4marks)

$$\frac{3}{\sqrt{0.012575}} + \frac{2}{0.459^2}$$

7. The angle of elevation of the top of the tower from the foot of a building is 43.4^0. The angle of depression of the top of the building from the top of the tower is 15.2^0. The building and the tower are 30m apart. Find
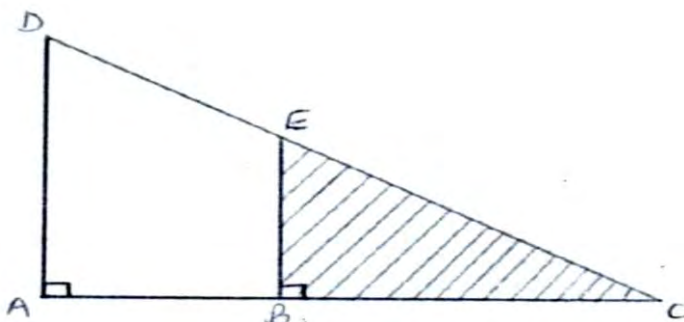
a) The height of the tower (1mark)
b) The height of the building (2marks)

8. Simplify (3marks)

$$\frac{4xy - 3x + 8y^2 - 6y}{6 - 8y}$$

9. Find the area of the shaded region in the figure below given that AD = 15 cm, BE = 3 cm, AB = 3cm, ∠DAB = ∠EBC = 90^0 (3marks)


10. (a) Using a ruler and a compass only, construct triangle ABC in which BC = 8 cm, angle ABC = 30^0 and angle ACB = 45^0 (1 mark)
    (b) At A drop a perpendicular to meet BC at D and measure AD. (2marks)

11. The equation of line AB in the figure below is y=3x+5 and A is the point (0, a). Line PQ is parallel to AB and AP = 7 units.
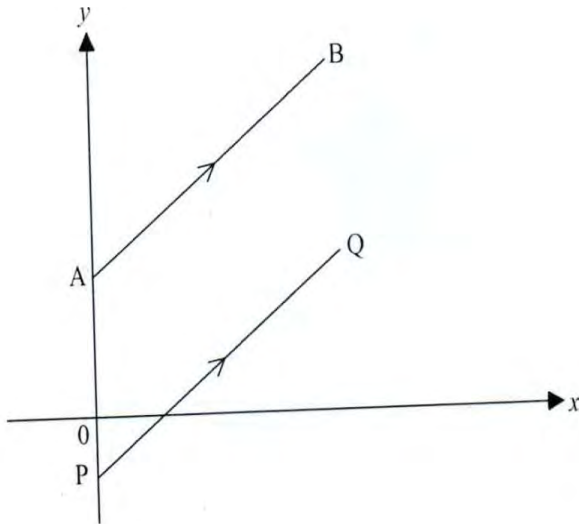

(i) Find the value of a. (1 mark)
(ii) Write down the equation of PQ. (2marks)
12. The ratio of the fourth to the first term of a G.P is ⅛. If the first term exceeds the second term by 5, find the first and the 8th terms of the sequence. (3marks)
13. Three bells ring at intervals of 4 minutes, 9 minutes and 12 minutes. The bells will next ring together at 11.00 p.m. find the time the bells had last rung together. (3 marks)
14. Write down all the inequalities that define the unshaded region R in the figure below. (3marks)
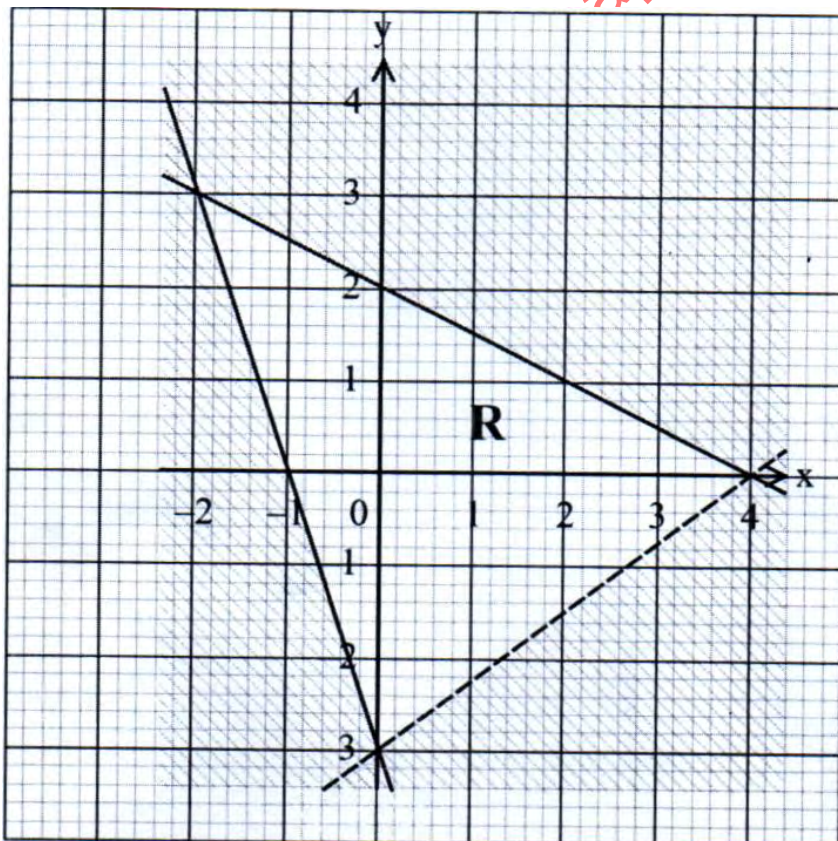
15. Solve for x and y in the following equations: $2^x + 3^y = 59$
$2^{x+3} - 3^{y+2} = 13$ (4 marks)

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16. The diagram below shows a histogram from marks obtained in a certain test.
    Develop a frequency distribution table for the data given. (3 marks)
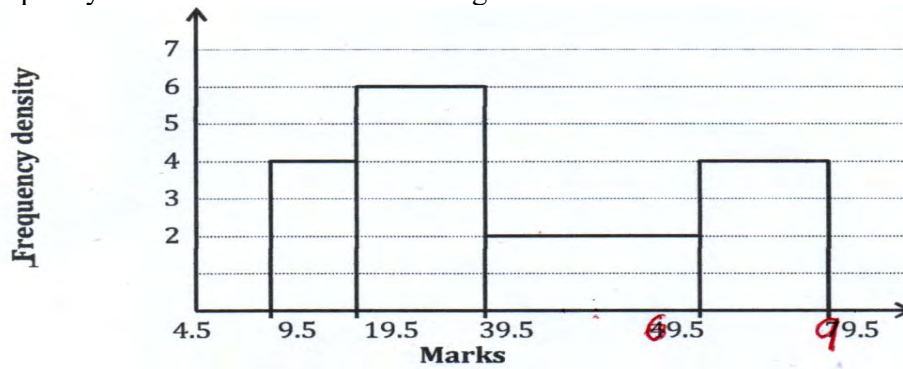
Section II (50 marks)
## Answer only five questions in the spaces provided.

17. A truck left Embu at 8.45 a.m and travelled toward Yala at an average speed of 50 km/hr. A car left town Embu at 11.1 5 a.m on the same day and travelled along the same road at an average speed of 90 km/h. The distance between the two town is 420 km.
a) Calculate the time of the day when the car overtook the truck. (5 marks)
b) The distance from Yala when the car overtook the truck. (2 marks)
c) After overtaking the bus, both vehicles continued towards Yala at their original speeds. Find how long the car had to wait at town Yala before the truck arrived. (3marks)

18. (a) Complete the table below for the function $y = x^3 - 3x^2 + x$ (2 marks)

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

(b) Using the trapezoidal rule, with 6 strips estimate the area bounded by the curve $y = x^3 - 3x + 2$, x = -4 and x = 2 and the x – axis. (3 marks)
(c) Calculate the actual area bounded by the curve $y = x^3 - 3x + 2$, x = -4 and x = 2 (3 marks)
(d) Calculate the percentage error. (2marks)

19. Line L_1 passes through the points (-2, 3) and (-1, 6) and is perpendicular to L_2 at (-1, 6).
a) Find the equation of L_1 (2marks)
b) Find the equation of L_2 in the form ax +by – c =0 where a, b and c are constants. (2 marks)
c) Given that another line L_3 is parallel to L_1 and passes through point (1, 2), find the x and y intercepts of L_3. (3marks)
d) Find the point of intersection of L_2 and L_3. (3 marks)

20. A pirate boat sails from port A on a bearing of 050^0 at a speed of 112 km/h, for 2 ½ hours to port B. From port B it changes its course and travelled on a bearing of 170^0 at a speed of 75 km/h for $2\frac{2}{3}$ hours toward part C. From C it travelled to port D. D is on a bearing of 130^0 and 160 km from A.
a) Using a scale of 1 cm to represent 40 km, Draw a diagram showing the positions of the ports A, B, C and D. (4 marks)
b) Use your drawing to find.
i. The distance CD (1 mark)
ii. The bearing of C from D (1 mark)
c) A marine police patrol leaves port A to intercept the pirate boat at M as it moves from B to C in the shortest time possible.
i. How far from A will the two boats met at M. (2 marks)
ii. If the boats meet after 2 hours, what is the speed of the marine police boat? (2marks)

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21. In the figure below, PQRS is a cyclic quadrilateral. Given that TPX is a tangent at P and O is the centre of the circle. PQ = QR, RQX is a straight line with angle RPQ = 50^0 and angle TPS = 25^0. The length of PX = 18 cm.
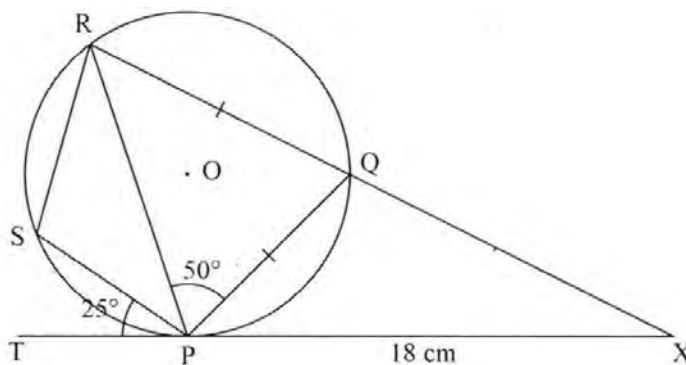
a) Giving reasons in each case, find:
i). Angle PSR. (2 marks)
ii). Angle PXQ. (2 marks)
iii). Angle POS. (2 marks)
b) Calculate correct to 1 decimal place:
i. The length RX (2 marks)
ii. The radius of the circle. (2 marks)

22. The vertices of quadrilateral OABC are O (0, 0), A (2, 0) B (4, 2) and C (0, 3). The vertices of its image under a rotation are O' (1, -1), A' (1, -3) B' (3, -5) and C' (4, -1).
a) On a grid, draw OABC and its image O'A'B'C. (2 marks)
b) By construction, determine the centre and angle of rotation. (3 marks)
c) On the same grid as (a) above, draw O" A" B" C", the image of O' A' B' C' under a reflection in the line y = x and state the co-ordinates of O' A' B' C' (3 marks)
d) From the quadrilaterals drawn, state the pairs that are:
i. Directly congruent; (1 mark)
ii. Oppositely congruent: (1 mark)

23. Abdalla bought 100 packets of biscuits and 50 packets of sweets for a total of Kshs. 25,000. Jane bought 40 packets of biscuits and 30 packets of sweets for a total Kshs. 12,000. If the price of a packet of biscuit is Kshs. X and a packet of sweet is Kshs. Y,
a)
(i) Form two equations to represent the information above and simplify them (2 marks)
(ii) Use the matrix method to find the prices of one packet of each item. (4 marks)
b) Makoti bought 225 packets of biscuits and 360 packets of sweets. He was given a total discount of Kshs. 4,815. If the discount on the price of a packet of biscuit was 10%, calculate the percentage discount on the price of a packet of sweet. (4 marks)

24. The displacement S meters of a body moving along a straight line after t seconds is given by
S = $-2t^3 + \frac{3}{2}t^2 + 3t$.
a) Find its initial acceleration. (3marks)
b) Calculate
i. The time when the body was momentarily at rest. (3 marks)
ii. Its displacement by the time it comes to rest momentarily. (2 marks)
c) Calculate the maximum velocity attained. (2 marks)

KIHARU – KAHURO FORM 4 JOINT EXAMINATION
(KENYA CERTIFICATE OF SECONDARY EDUCATION)
121/2
MATHEMATICS
PAPER 2
TIME: 2½ HOURS

SECTION I (50 MARKS)
Answer all questions in the spaces provided.

1. Use logarithm tables to evaluate. (4 marks)

$$\left(\frac{693.5}{(0.9823)^2 \times 58.32} \right) 0.\dot{3}$$

2. A mixture contains two grades of rice A and B with masses in the ratio 3:5. If the mixture is sold at Ksh 270 per kilogram making a profit of 20% and grade A rice costs Ksh. 200 per Kilogram, find the cost of grade B rice. (3 marks)

3. Express the following in surd form and simplify by rationalizing the denominator without using a calculator and leave your answer the form $a + b\sqrt{c}$ (3 marks)
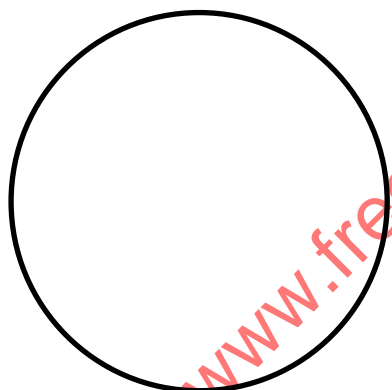$$\frac{1 + \cos 30^0}{1 - \sin 60^0}$$

4. Make n the subject of equation. (3 marks)
$$\frac{p}{q} = \frac{m^2}{\sqrt[3]{1 - n^2}}$$

5. Find the area of a sector that subtends an angle of 0.420^c of the centre and has an arc length of 2.31 cm. (3 marks)

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

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

7. It takes a pipe A 8 hours to fill an empty water tank. Pipe B can fill the same tank in 4 hours. When the tank is full, pipe C can empty it in 5 hours. Pipes A and B are opened at the same time when the tank is empty. Two hours later, pipe C is opened. Find to the nearest minute the total time taken to fill the tank. (3marks)

8. The coordinates of the end points of diameter of a circle are A (3,4) and B (-3, 6). Find the equation of the circle in the form $ax^2 + by^2 + cx + dy + e = 0$ (3 marks)

9. Evaluate
$$\int_{-1}^{3} (3x + 1)(2x - 2)$$ (3marks)

10. The data given below shows the deviation from the mean of marks scored by seven candidates in a mathematics quiz: -1, 7, 5, -4, -2, P, -3

i. Determine the value of P (1 mark)
ii. The standard deviation (2 marks)

11. (a) Expand $(4x^2 + 4x + 1)^3$ in ascending powers of x up to the fourth term. (1 marks)
    (b) Use the expansion in (a) above to estimate the value of 1.26^6 correct to 4 d.p (2marks)

12. The image area of an object after two successive transformations given by $\begin{bmatrix} 2 & 1 \\ 3 & 5 \end{bmatrix}$ and $\begin{bmatrix} 3 & 1 \\ 0 & 1 \end{bmatrix}$ in that order becomes 168 square units. Find the image area of the object. (3 marks)

13. In the figure below ABC is a triangle in which AB = 15cm, BC = 7.7 cm and BC is produced to D angle BAC = 30^0 and angle ACD = 80^0. Calculate to one decimal place area of triangle ABC (3marks)
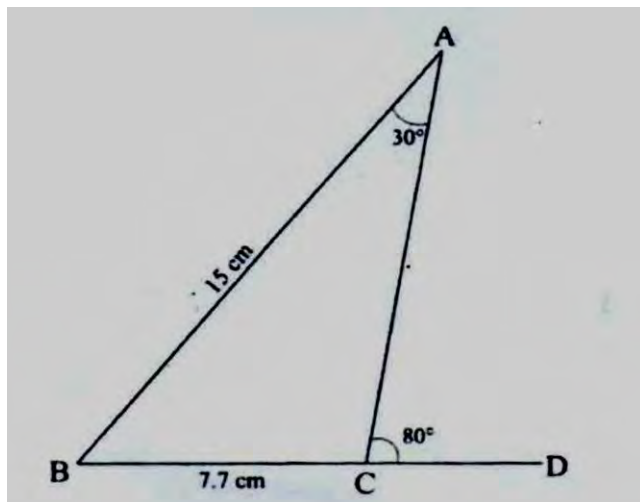
14. The probability that a boy takes cold water in the morning is ¼. If he takes cold water the probability that he gets sick is 1/5 and if he takes hot water the probability of being sick is 3/10. What is the probability that;

The boy was sick in a given Monday. (3 marks)

15. Solve for x in the equation (3 marks)

Log₃ 4 + log₃x + 1 – log₃5 = log₃ 2

16. The table below shows the relationship between two variable x and y.

x	0	1	2	3	4	5	6
y	3.0	3.6	4.3	4.7	5.4	6.0	6.6

(a) Draw a line of best fit for the above values. (2marks)
(b) Find the formula connecting x and y. (1mark)

SECTION II (50 MARKS)
Answer any five questions.

17. A triangle ABC with vertices at A (1, -1), B (3, -1) and C (1 ,3) is mapped onto triangle A¹ B¹ C¹ by a transformation whose matrix $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$
Triangle A¹ B¹ C¹ is mapped onto A¹¹ B¹¹ C¹¹ with vertices at A¹¹ (2, 2), B¹¹ (6, 2) and C¹¹, (2, -6) by a second transformation.

(a) Find the coordinates of A¹ B¹ C¹ (2marks)
(b) Find the matrix which map A¹ B¹ C¹ onto A¹¹ B¹¹ C¹¹ (3marks)
(c) Determine the ratio of the area of triangle A¹ B ¹ C¹ to triangle A¹¹ B¹¹ C¹¹. (3marks)
(d) Find the transformation matrix which maps A¹¹ B¹¹ C¹¹ onto ABC. (2marks)

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18. The table below shows the income tax rates for the year 2021

Monthly table income in Kenya shillings	Percentage tax rate in each shilling
1 – 9680	10%
9681 – 18800	15%
18801 – 27930	20%
27931 – 37080	25%
Above 37080	30%

Mr. Kamau a civil servant paid income tax of Ksh. 27 900 in the month of February 2021. His total monthly taxable allowances amounted to Ksh. 36 700 and was entitled to a monthly personal relief of ksh. 1056, he also had a life insurance policy for which he paid Ksh. 9000 premium monthly and which entitled him to a further relief of 15% of premium paid.

(a) Calculate Mr. Kamau's
i. Gross tax (2marks)
ii. Basic salary (5marks)
(b) Mr. Kamau's other monthly deductions are union dues Ksh 1600, NHIF 1700, cooperative shares Ksh 6000 and KCB bank loan repayment of Ksh 28 600. Determine his net monthly income. (3marks)

19. The frequency distribution below shows the marks distribution of a class of 30 students in an examination. The mean of the distribution is 52.

Marks	10	20	30	40	50	60	70	80	90
Frequency	1	1	x	5	y	1	4	3	1

Calculate:
a) The value of x and y. (6 marks)
b) The mode (1 mark)
c) The median (3marks)

20. The first term of A. P is 3.5; the common difference is d if the difference of 20th and 6th terms is 42.
a. (i) Find the common difference, d (2 marks)
   (ii) Calculate the sum of the first 40 terms of the AP (2 marks)
b. The progression is such that the 2nd, 4th and 8th terms of the AP forms the first 3 terms of a G.P. If the common difference of A.P is 2;
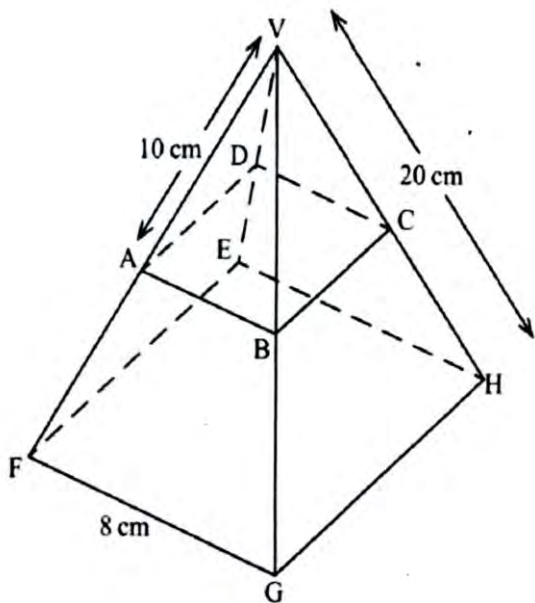   **Find:**
(i) 2nd term of the G.P (3 marks)
(ii) Sum of the first 10 terms of G.P (2 marks)

21. A ship left points P (10^0 S, 161^0 W) and sailed to a point Q (10^0S, 142^0 E) using the shorter route along parallel of latitude at a speed of 20 knots.

(a) Taking $\pi = \frac{22}{7}$, R = 6370 km and 1nm = 1.853 km, calculate to 2 decimal places.
(i) The distance travelled by the ship in kilometres. (3 marks)
(ii) Time taken from P and Q (2 marks)
(b) After docking at port Q the ship took 10 hours to offload goods and then proceeded northwards to a port R a distance of 600 nautical miles.
(i) Find the longitude of port R. (2 marks)
(ii) If the ship left P on Tuesday 0700 hours, find the time and day of docking at port R if the speed of the ship between port Q and R was 15 knots. (3 marks)

22. (a) Use a ruler and a pair of compasses only to construct triangle ABC such that AB = 10cm ∠ABC = 30^0 and ∠BAC = 45^0 (3 marks)
   (b) Draw the locus L_1, such that L_1 is equidistant from lines AB and AC. (2 marks)
   (c) Draw the locus L_2 such that L_2 is equidistant from parts A and B. (2 marks)
   (d) Draw the locus of point P on the same side of C such that ∠APB = 90^0. Let L_1 meet P at X and L_2 meet at Y. measure XY. (3 marks)

23. The figure below is a right pyramid VEFGH with a square base of 8 cm and a slant edge of 20cm. points A, B, C and D lie on the slant edges of the pyramid such that VA = VB = VC = VD = 10cm and plane ABCD is parallel to the base EFGH.

a) Find the length of AB. (2 marks)
b) Calculate, correct to 2 decimal places:
i. The length of CA (2 marks)
ii. The perpendicular height of the pyramid VABCD. (2 marks)
c) The pyramid VABCD was cut off. Find the volume of the frustum ABCDEFGH correct to 2 decimal places. (4 marks)

24. Kamau has at least 50 acres of land on which he plans to plant potatoes and cabbages. Each acre of potatoes requires 6 men and each acre of cabbages requires 2 men. The farmer has 240 men available and he must plant at least 10 acres of potatoes. The profit on potatoes is Ksh. 1,000 per acre and on cabbages is Ksh. 1,200 per acre. If he plants x acres of potatoes and y acres of cabbages.
a) Write down 3 inequalities in X and Y to describe the information above. (3 mks)
b) Represent these inequalities graphically (use a scale of 1:10 for both axes). (4 mks
c) Use your graph to determine the number of acres for each vegetable which will give maximum profit and find the maximum profit. (3 mks)

KIRINYAGA WEST FORM 4 SCHOOL BASED EXAMINATIONS 2023
**Kenya Certificate of Secondary Education**
121/1
MATHEMATICS
Paper 1
$2^1/_2$ hours

SECTION 1: (50 Marks)
Answer all the questions in this section.

1. The product of two factors $(12x + 5)$ and $(2 – 5x)$ is -11. Find the two factors. (4 marks)

2. Four businessmen shared their profits as follows:
   Mr. White got a quarter of the profit while Mr. Green got a half of what remained. The rest was shared equally between Mr. Black and Mr. Brown. If the difference between Mr. White and Mr. Black was Sh 7,500, how much did Mr. Green get? (4marks)

3. Solve the inequalities $5^{x-2} < 25^x \leq 125^{\left(\frac{1}{2}x+1\right)}$ and represent your solution on a number line. (3 marks)

4. Two athletes were running 10,000m. Mboga was running at a constant speed of 200m per minute while Sukuma was running at a constant speed of 150m in half a minute. For how long did Sukuma wait for mboga also to finish? (3 marks)

5. Simplify completely $\dfrac{x^2 - 16}{x^3 + 4x - 2x^2 - 8}$ (3 marks)

6. Find the area of the quadrilateral ABCD below, correct to 1 decimal place. (3 marks)
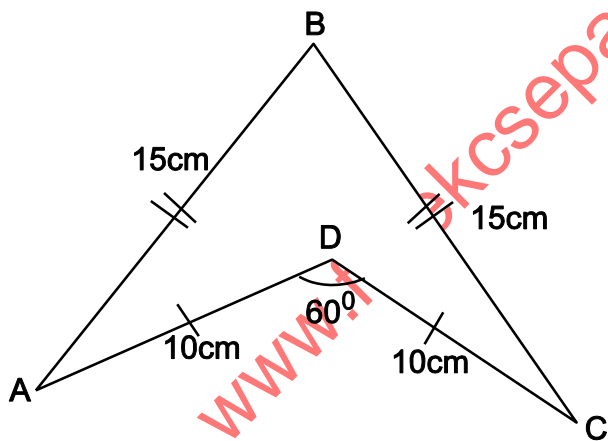
7. A watch gains 10 seconds every hour. It was set right at 0950 hrs on Monday. Determine the time, in a 12 – hrs system, the watch will show on the following Monday when the correct time is 1150 hrs, to the nearest minute, (3 marks)

8. Jack and Dan both drive a distance of 10 km but Dan's average speed is 10km/hr slower than Jack's and consequently he takes 30 minutes longer to complete the journey. Calculate Jack's average speed. (3 marks)

9. Three towns A, B and C are such that B is 5km and on a bearing of 050^0 from A. C is due south of B and on a bearing of S 65^0E from A. Using a scale of 1cm represents 1 km, draw a scale diagram to show the relative positions of the three towns, hence state the distance between towns A and C. (4 marks)

10. Two interior angles of an irregular polygon are right angles, the rest are 144^0 each. Determine the number of sides of the polygon, (3 marks)

11. A trader converted Ksh 500 000 to sterling pounds. He then spent a total of 1,000. He proceeds to exchange the balance to Euros and bought goods worth 100 Euros. Calculate his balance to the nearest Kenya shillings.

(3 marks)

Currency	Buying	Selling
1 Sterling pound	130.14	130.50
1 Euro	84.25	84.28

12. Joan has some money in two denominations only: twenty-shilling coins and one hundred – shilling notes. She has four times as many twenty – shilling coins as one hundred-shilling notes. Altogether she has sh 2160. How many one hundred-shilling notes does she have? (3marks)

13. Given that $A = \begin{pmatrix} 2 & 1 \\ 3 & 4 \end{pmatrix}$, find matrix B such that $A^2 = A + B$ (3 marks)

14. The heights of two similar containers are 21cm and 28cm respectively. If the larger container holds 3.1 litres, find the capacity of the smaller one. (3 Marks)

15. The table below shows the shoe sizes of 20 students in a class.

Shoe size	4	5	6	7	8	9
No. of students	1	4	5	7	2	1

Determine the median shoe size. (2 marks)

16. The base ABCD of a right pyramid is a square of side 2cm. Point V is the vertex of the pyramid and the length of the slanting edges is 3 cm. Draw a labelled net of the pyramid. (3 marks)

SECTION II: (50 Marks)

Answer only **FIVE** questions in this section in the spaces provide,

17. Mwajuma and Mwangi entered a partnership. They contributed Ksh 120,000 and Ksh 150,000 respectively. After 18 months of business, Njambi joined the partnership and contributed Ksh 90,000.
   a) Determine the ratio of their contribution after three years of business. (3 marks)
   b) After the three years, they realized a profit of Ksh 510,000. They agreed to set aside 30% of the profit to cater for the cost of running the business and share the rest as per their contributions. Determine the difference in Mwangi's and Njambi's share of the profit. (4 marks)
   c) Njambi then invested back her share into the business. Determine their new ratio of contributions at the end of the fourth year. (3 marks)

18. A solid frustum has a base radius of 21 cm and a top radius of 14cm. The frustum is 22.5 cm high and is made of a metal whose density is 3g/cm³. (Take $\square = {}^{22}/_7$)
   a) Calculate
   i) The volume of the metal in the Frustum. (5 marks)
   ii) The mass of the Frustum in kg. (2 marks)
   b) The Frustum is melted down and recast into a solid cube. In the process 20% of the metal is lost. Calculate to 2 decimal places the length of each side of cube. (3 marks)

19. A rhombus has vertices at A (-1, 1), B (0,8), C (5, 3) and D (x, y). T is the intersection of the diagonals of the rhombus.
   a) Find the coordinates of D and T. (2 marks)
   b) Given the < CBT = a, express < BAD in term of a. (2 marks)
   c) Calculate the lengths of diagonals AC and BD, to one decimal place. (4 marks)
   d) Calculate the area of the rhombus. (2 marks)

20. a) Using a ruler and a pair of compasses only, construct a parallelogram ABCD such that AB = 8cm, diagonal AC = 12cm and < BAC = 22.5⁰. (4 marks)
   b) Measure: i) The diagonal BD (1 mark)
              ii) The angle ABC. (1 mark)
   c) Draw the circumcircle of triangle ABC. (2 marks)
   d) Calculate the area of the circle drawn. (2 marks)

21. The table below shows marks scored by a group of students in a Mathematics test.

Marks	No. of Students	X	fX	Cf
10-24	6			
25-39	8			
40-54	11			
55-69	12			
70-84	9			
85-99	4			

   a) State the modal class. (1 mark)
   b) Calculate the mean mark. (3 marks)
   c) Draw a histogram to represent the information above. (3 marks)
   d) Use the histogram to determine the median amount of money spent. (3 marks)

22. a) Sketch the curve $y = x(5 – x)$ and the line $y = x$. (5 marks)
    b) Use integration method to determine the area bound by the curve $y = x(5 – x)$ and the line $y = x$.
                                                                                                    (5 marks)

23. A room measuring 2.5m long, 2m wide and 3m high is to be renovated by covering all the four walls and floor with tiles. The room has one door measuring 2m high and 90cm wide and a 1.2m high window on the opposite wall measuring 1.5m long and 40cm wide. The walls are to be covered with tiles to a height of 1.2m. The remaining part of the walls (except door and window) and ceiling are to be painted. Each tile measures 12 cm by 5cm.
   (a) Calculate;
   (i) Number of tiles to be bought. (4 marks)
   (ii) The area to be painted. (3marks)
   b) 1 tile cost sh. 25 and one litre of paint covers 3m² and costs sh, 2450. Determine the cost of the materials needed to renovate the room. (3 marks)

24. A quadrilateral ABCD has vertices A(4, -4), B(2,-4), C(6,-6) and D(4, -2).
   (a) On a grid draw quadrilateral ABCD (1 mark)
   b) A¹B¹C¹D¹ is the image of ABCD under positive quarter turn about the origin on the same grid draw the image A¹B¹C¹D¹ and state its coordinates. (3 marks)
   c) A¹¹B¹¹C¹¹D¹¹ is the image of A¹B¹C¹D¹ under transformation given by the matrix

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

   i) Determine the coordinates of A¹¹B¹¹C¹¹D¹¹ . (2 marks)
   ii) On the same grid draw the quadrilateral   A¹¹B¹¹C¹¹D¹¹ (1 mark)
   d) Determine a single matrix that maps ABCD onto A¹¹B¹¹C¹¹D¹¹ (3 marks)
   e) At what time of the day did the Nissan catch up with the bus? (2 marks)
   f) At what time did the bus reach Cheptiret? (3 marks)

Kenya Certificate of Secondary Education
121/2
MATHEMATICS
Paper 2
$2\frac{1}{2}$ hours

SECTION 1: (50 Marks)
Answer all the questions in this section.

1. Quantities P and Q are 5.34 cm and 2.0cm respectively to the nearest mm. Find the percentage error in calculating $\frac{p}{q}$ to 4 s.f. (3 marks)

2. Make R the subject of the formula.
   A = ∏(R + r) (R – r) (3marks)

3. Draw line MN = 8cm. On one side of MN, draw the locus of a point P such that the area of triangle MPN is 12cm^2. On the locus of P, locate two points T and R such that <MTN = <MRN = 90^0.
   Measure TR. (4 marks)

4. A financial institution gives a loan at 12% per annum compounded quarterly. Calculate the time it would take certain borrowed amount to double. Give your answer to one decimal place. (3 marks)

5. a) Expand $(1 + 2x)^5$ to the fourth term. (1 mark)
   b) Hence evaluate $(1.02)^5$ correct to 3 d.p. (2 marks)

6. A uniform distributor is required to supply two sizes of skirts to a school; medium and large sizes, she was given the following conditions by the school.
   i) The total number of skirts must not exceed 600.
   ii) The number of medium size skirts must be more than the number of large size skirts.
   iii) The number of medium size skirts must not be more than 350 and the number of large size skirts must not be less than 150.
   If the distributor supplied x medium size and y large size skirts. Write down in terms of x and y all the linear inequalities representing the conditions above. (4 marks)

7. Given that $Tan 15^0 = 2 - \sqrt{3}$. Find without using Mathematical tables or calculator Tan 75^0. (3 marks)

8. The position vectors of A and B are a = 3i + 7j – 8k and b = 6i – 5j + 3k. Given that x divides lines AB in
   the ratio 2 : -3. Determine the co-ordinates of point x. (3 marks)

9. Determine the quartile deviation for the following set of numbers.
   6, 10, 7, 6, 9, 8, 3, 2, 9, 8, 5, 4, 5 (3 marks)

12. The points (5, 5) and (-3, -1) are ends of diameter of a circle centre A.
    Determine:-
    a) The co-ordinates of A. (1 mark)
    b) The equation of the circle expressing it in the form $x^2 + y^2 + ax + by + C = 0$. (2 marks)

13. In the figure below BT is a tangent to the circle at B. AXCT and BXD are straight lines XC = 4cm, CT = 8cm, BX = 9.6cm and XD = 2.5cm.
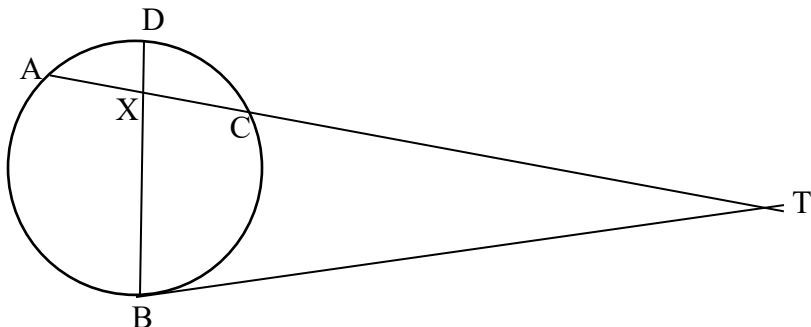
Find the length of:
a) AX (1 mark)

b) BT (2 marks)

14. Tap A can fill a bath in 4 min. Tap B can fill the same bath in 6 min and Tap C can empty the bath in 8 min.
   a) Calculate how long it would take to fill the bath if all the taps were left running. (1 mark)
   b) Calculate how long it would take to fill the bath if all taps were left running for 2 min after which tap C was closed. (2 marks)

14. A transformation whose matrix is $\begin{pmatrix} 2 & 6 \\ 4 & -3 \end{pmatrix}$ maps quadrilateral ABCD of area 18cm^2 onto another

quadrilateral PQRS, what is the area of PQRS? (3 marks)

14. Given that $y = \dfrac{x(x^2 - 1)}{(x + 1)}$ is the equation of a curve, find the gradient of the tangent to the curve at the point

(2, 4). (2 marks)

16. A two-digit number is made by combining cards labeled with the digits 1, 4, 6 and 9 at random.
   The cards are picked at random with replacement.
   a) Make a table of possible numbers that can be made. (1 mark)
   b) Find the probability that the number formed is a prime number or even number. (2 marks)

17. The table below shows the rate of cooling of a liquid with respect to time.

Time (Min)	0	2	4	6	8	10	12	14	16
Temp (^{0}C)	80	60	46	35	26	20	16	14	12

   a) Draw the temperature – time graph. (2 marks)
   b) Use the graph to determine the average rate of cooling of the liquid between the 5th and 13th minutes. (2 marks)

SECTION II: (50 Marks)
Answer only **FIVE** questions in this section.

19. The table below shows income tax rates for the year 2018.

Monthly taxable income KSh.	Percentage rate of tax Per shilling
Upto 9680	10
From 9681 to 18800	15
From 18801 to 27920	20
From 27921 to 37040	25
From 37041 and above	30

   In May 2018 Christine's basic salary was Sh 18000. She was also paid a house allowance of Sh 5000, a commuter allowance of Sh 3800 and a medical allowance of Sh 2600. In June that year her basic salary was increased by 3%.
   a) Calculate her June's
   i) basic salary (2 marks)
   ii) total taxable income (2 marks)
   b) If the monthly personal relief was Ksh 1056. Calculate the net tax that Christine paid in June. (4 marks)
   c) In addition to income tax the following deductions were also made from her salary every month.
   NHIF   Sh 2000
   Loan recovery   Sh 3500
   Calculate her monthly net income. (2 marks)

20. The figure below is a square based pyramid ABCDV with AD = DC = 6cm and height VO = 10cm.
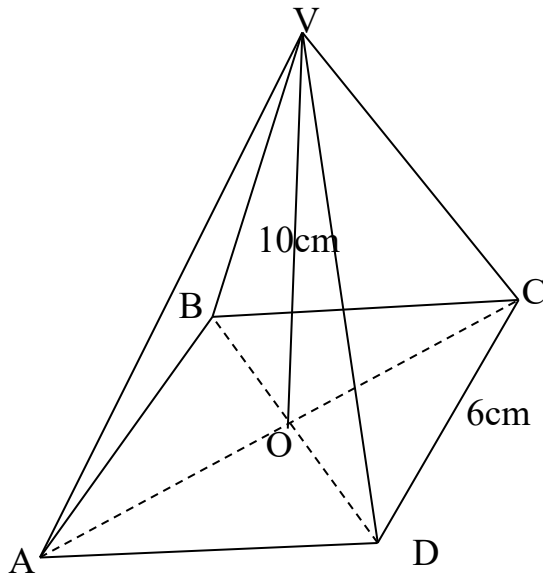
a) State the projection of VA on the base ABCD. (1 mark)
b) Find;
   i) The length of VA. (3 marks)
   ii) The angle between VA and ABCD. (2 marks)
   iii) The angle between the planes VDC and ABCD. (2 marks)
   iv) Volume of the pyramid. (2 marks)

19. a) Complete the table below given $y = x^3 - 4x^2 + x + 6$.
   For $-2 \leq x \leq 4$ (2 marks)

x	-2	-1	0	1	2	3	4
y			6		0		

b) On the gird provided draw the graph of $y = x^3 - 4x^2 + x + 6$ for $-2 \leq x \leq 4$.
   Use the scale of 1 cm represent 5 units on the y- axis and 2 cm represent 1 unit on the x axis.
   (3 marks)
c) Use your graph to solve the equation $x^3 - 4x^2 + x = -6$ (2 marks)
d) By drawing a suitable straight line on the same axis solve the equation $x^3 - 4x^2 - 5x + 7 = 0$.
   (3 marks)

20. The following table shows the distribution of marks obtained by 50 students in a maths test.

Marks	45-49	50-54	55-59	60-64	65-69	70-74	75-79
Frequency	3	15	13	9	4	1	5

Calculate:
i) Mean (4 marks)
ii) Variance (4 marks)
iii) Standard deviation (2 marks)

21. An aircraft leaves town P(30^0S, 17^0E) and moves directly northwards to Q (60^0N, 17^0E).
It then moved at an average speed of 300 knots for 8 hours westwards to town R.
Determine
a) The distance PQ in nautical miles. (3 marks)
b) The position of town R. (3 marks)
c) The local time at R if local time at Q is 3.12 pm. (2 marks)
d) The total distance moved from P to R in KM.
Take 1 nautical mile = 1.853 Km (2 marks)

22. a) Complete the table below, giving the values correct to 2 decimal places. (2 marks)

x	0	30	60	90	120	150	180	210	240	270	300	330	360
Sin 2x	0				-0.87								0
3 Cos x – 2	1				-3.5			-4.60					

c) On the grid provided draw the graph of y = Sin 2x and y = 3 Cos x – 2 for $0^0 < x \leq 360^0$, on the same axes. Use the scale of 1cm to represent 30^0 on the x-axis and 2cm to represent 1 unit on the y-axis.
(5 marks)

c) Use to graph in (b) above to solve the equation 3 Cos x – Sin 2x = 2. (2 marks)

d) State the amplitude of y = 3 Cos x -2. (1 mark)

23. a) An arithmetric progression is such that first term is -5, the last term is 135 and the sum of the progression is 975. Calculate:

i) The number of terms in the progression. (3 marks)

ii) The common difference of the progression. (3 marks)

b) The sum of the first two terms of an increasing Geometric Progression (G.P) is 20. The sum of the second term and third term of the same GP is 30. Determine the common ratio of the GP. (4 marks)

24. 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

i) the area of the region in (a) above by integration. (3 marks)

ii) the percentage error of the estimated area to the actual area of the region correct to 2 d.p. (2 marks)

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MECS II
*Kenya Certificate of Secondary Education*
121/1
MATHEMATICS
PAPER 1
2 ½ HOURS

SECTION I (50 marks)
Answer all the questions in this section

1. Without using a calculator evaluate. (3marks)

    $$\dfrac{2\,\frac{1}{3} - 1\,\frac{1}{5}\ of\ 4}{\frac{1}{4} - \left(-\frac{1}{3}\right)^2}$$

2. A piece of rectangular plot measuring 27m by 16m is to be divided into smaller rectangular units leaving no remainder. Calculate the highest number of smaller units whose dimensions are each greater than 1m that can be obtained from the plot. (3marks)

3. Given that $x = 1.\dot{3}1\dot{3}$, find the **exact** value of . (3 marks)

4. Using the grid provided below, solve the simultaneous equation (3 marks)

    $3x - 4y = 10$

    $5x + 7y = 3$
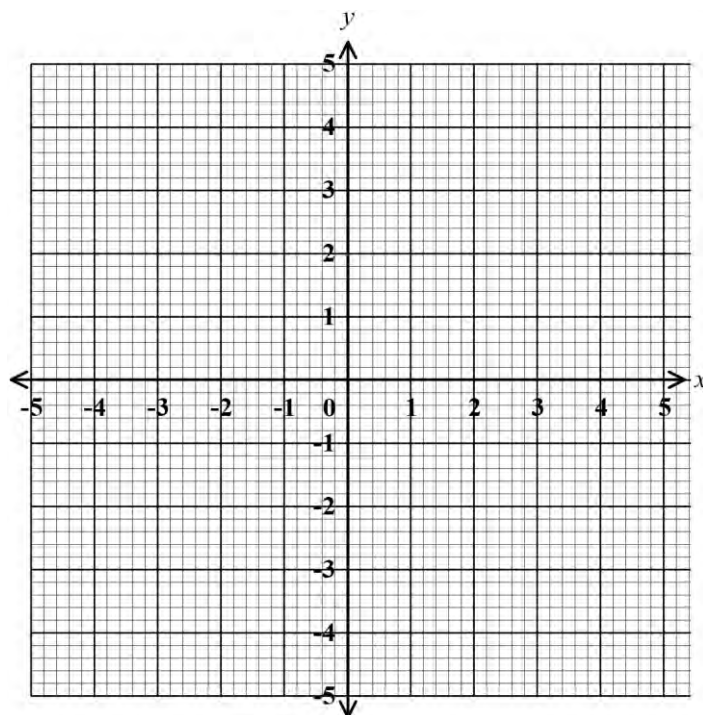
5. Write the following ratios in ascending order $2:3$, $15:16$, $7:6$, $13:15$ (3 marks)

6. Under an enlargement, the image of the points $A(3,1)$ and $B(1,2)$ are $A'(3,7)$ and $B'(7,5)$. Find the centre and scale factor of enlargement. (4 marks)

7. A Kenyan businessman intended to buy goods worth US dollar 20,000 from South Africa. Calculate the value of the goods to the nearest south Africa (S.A) Rand given that 1 US dollar = Ksh 101.9378 and 1 S.A Rand = Ksh 7.6326. (3marks)

8. Solve for x in the following equation. (3marks)

    $4^x (8^{x-1}) = \dfrac{sin45^0}{cos45^0}$

9. From a viewing tower 40 metres above the ground, the angle of depression of an object on the ground is 36° and the angle of elevation of an aircraft vertically above the object is 48°. Calculate the height of the aircraft above the objet on the ground. (3marks)

10. Solve the equation $2x^2 + 3x = 5$ by completing the square method. (3marks)

11. The mean of five numbers is 20. The mean of the first three numbers is 16. The fifth number is greater than the fourth by 8. Find the fifth number. (3marks)
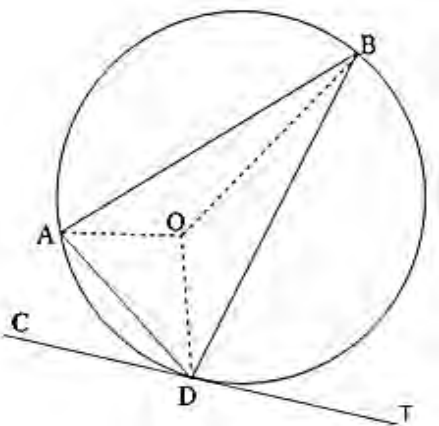
12. Simplify: (3 marks)

$$\left[\frac{x^3 - xy^2}{x^4 - y^4}\right]^{-1}$$

13. The figure below ABCDE is a cross-section of a solid ABCDEPDRST. The solid has a uniform cross-section. Given that AP is an edge of the solid, complete the sketch showing the hidden edges with a broken line. (3 marks)
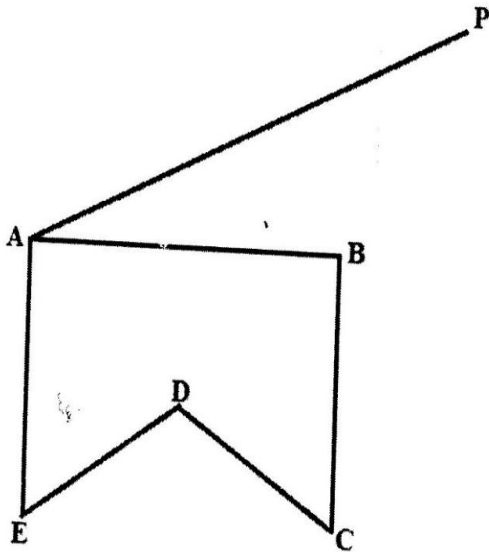
14. In the circle below, O is the centre, angle DAB = 87^0 and acute angle AOD=62^0. CD is a tangent to the circle at D.

Calculate the size of;
(i)   Angle ABD. (2marks)
(ii) Angle ADC (1mark)
(iii) Angle ADB (1mark)

15. Given that log a = 0.30 and log b = 0.48 find the value of $\log \frac{b^2}{a}$. (3marks)

16. The area of a rhombus is 60cm^2. Given that one of its diagonals is 15cm long. Calculate the perimeter of the rhombus. (3marks)

SECTION II (50 marks)
Answer 5 questions only in this section

17. Three business partners Abila, Bwire and Chirchir contributed Ksh120,000, Ksh 180,000 and Ksh 240,000 respectively to boost their business. They agreed to put 20% of the profit accrued back into the business and to use 35% of the profits for running the business. The remainder was to be shared among the business partners in the ratio of their contribution. At the end of the year, a gross profit of Ksh225,000 was realised.

a.   Calculate the amount.
(i) Put back into the business. (2marks)
(ii) Used for official operations. (1mark)
b.   Calculate the amount of profit each partner got. (4marks)

c. If the amount put back into the business was added to individual's shares proportionately of their initial contributions, find the amount of Chirchir's new shares. (3marks)

18. One day Mr. Makori bought some oranges worth Ksh 45, on another day of the same week his wife Mrs.Makori spent the same amount of Money but bought the oranges at a discount of 75 cents per orange
a) If Mr.Makori bought an orange at Kshs x, write down and simplify an expression for the total number of oranges bought by the two in the week. (3marks)
b) If Mrs.Makori bought 2 oranges more than her husband, find how much each spent on an orange.
(5 marks)
c) Find the number of oranges bought by the two. (2 marks)

19. Two lines $L_1: 2y - 3x - 6 = 0$ and $L_2 = 3y + x - 20 = 0$ intersect at a point A.
a) Find the coordinates of A (3 marks)
b) A third line L_4 is perpendicular to L_2 at point A. Find the equation of L_3 in the form $y = mx + c$, where m and c are constants. (3 marks)
c) Another line L4 is parallel to L_1 and passes through (-2, 3). Find the x and y intercepts of L_4 (4 marks)

20. The mases to the nearest kilogram of some student were recorded in table below

Mass (kg)	41-50	51-55	56-65	66-70	71-85
Frequency	8	12	16	10	6
Height of rectangle					0.2

a). Complete the table above to 1 decimal (2 marks)
b) On a grid, draw a histogram to represent the above information (3 marks)
c) Use the histogram to
i) State the class in which the median mark lies. (1 mark)
ii) Estimate the median mark (2 marks)
iii) The percentage number of students with masses of at least 74kg. (2marks)

21. Use a ruler and compass only for all the constructions in this question.
a) Construct a triangle XYZ in which XY= 6cm, YZ =5cm and angle XYZ= 120^0. (2marks)
b) Measure XZ and angle YXZ. (2 marks)
c) Construct the perpendicular bisector of XZ and let it meet XZ at M. (1 mark)
d) Locate a point W on the opposite of XZ as Y and that XW = ZW and YW =9cm and hence complete triangle XZW. (2 marks)
e) Measure WM and hence calculate the area of triangle XZW. (3 marks)

22. The diagram below shows the speed time graph for a bus travelling between two stations, the bus starts from rest and accelerates uniformly for 75 seconds. It then travels at constant speed for 150 seconds and finally decelerates uniformly for 100 seconds.
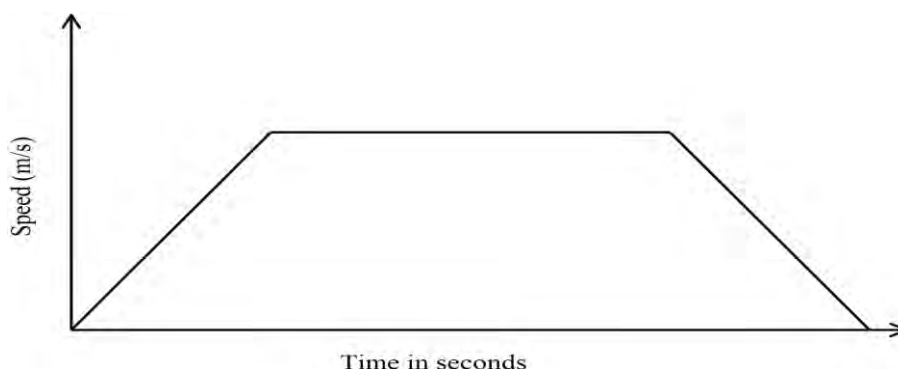
(a)   Given that the distance between the two stations is   5225 m . Calculate

(i)   maximum speed in   km/h attained by the bus.   (3 marks)

(ii)   the acceleration of the bus   (2 marks)

(b)   A van left Nairobi at 8.00 a.m and travelled towards Mombasa at an average speed of 80 km/h . At 8.30 am a car left Nairobi and travelled along the same road at an average speed of 120km/h.

(i)   Calculate the distance covered by the car to catch up with the van.   (4 marks)

(ii)   Find the time of the day when the car caught up with van.   (1 mark)

23.   While designing the water circulation system, planners of an estate used assumption that each housing unit in the estate will require at least 0.32m^3 of water per day. To satisfy this need, they are to use a water pipe of radius 8cm to distribute the water. The water will be flowing in the pipe for only 14 hours a day at the rate of 24cm/s.

a)   Determine the amount of water to the nearest litres, supplied in one hour.   (3marks)

b)   What is the maximum number of housing units that can be supported by the water circulation system? (Assume that a housing unit requires at most 0.32m^3 of water per day).   (2marks)

c)   Each housing unit will pay a flat rate of sh. 280 per month for the supply of water. If the number of housing units in the estate is to be maximum and all end up being occupied, calculate the amount of money that will be collected in a month.   (2 marks)

d)   The maximum number of housing units were constructed and all got occupied. The estate ended up using on average 0.35m^3 of water per housing unit per day. How much longer was the water pumped per day to satisfy the estate's water demand?   (3marks)

24.   The equation of the curve is $y = x^3 - 2x^2 - 1$

(a)   Determine

(i)   the stationary points   (4marks)

(ii)   the nature of the stationary points in (a) (i) above   (2 marks)

(b)   Determine

(i)   the equation of the tangent to the curve at $x = 1$ (2marks)

(ii)   the equation of the normal to the curve at $x = 1$ (2marks)

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MECS II
Kenya Certificate of Secondary Education
**121/2**
MATHEMATICS
PAPER 2
2 ½ HOURS

<u>SECTION I: 50 MARKS</u>
<u>Answer all questions in this section</u>

1.   Solve for x in the equation
     $2Sin^2x - 1 = Cos^2x + Sinx$ for $0 \le x \le 360$ (3 Marks)

2.   (a)   Expand $\left(1 + \frac{3}{x}\right)^5$ upto the fifth term   (2 Marks)

     (b)   Hence use your expansion to evaluate the value of $(2.5)^5$ to 3 d.p.   (2 Marks)

3.   Make p the subject of the formula   (3 Marks)

     $$E + m = m + \sqrt{\frac{p - 3u}{y - 3mp}}$$

4.   A object A of area 10cm^2 is mapped onto its image B of area 60cm^2 by a transformation whose matrix is given by

     $P = \begin{Bmatrix} x & 4 \\ 3 & x + 3 \end{Bmatrix}$. Find the possible value of   (3 Marks)

5.   A variable Z varies directly as the square of X and inversely as the square root of Y. Find the percentage change in Z if X increased by 20% and Y decreased by 19%   (3 Marks)

6.   A circle whose equation is $(x - 1)^2 + (y - k)^2 = 10$ passes through point (2,5). Find the coordinates of the two possible centres of the circle.   (3marks)

7.   Juma deposited Sh. 45 000 in a bank which paid interest at 12% p.a compounded monthly. Calculate the amount of interest after 3 years.   (3 Marks)

8.   (a)   Find the inverse of the matrix $\begin{pmatrix} 4 & 3 \\ 3 & 5 \end{pmatrix}$ (1 Mark)

     (b)   Hence solve the simultaneous equation below using matrix method   (3 Marks)
           4x + 3y = 6
           5y + 3x - 5 = 0

9.   Given that $P = 4 + \sqrt{2}$ and $Q = 2 + \sqrt{2}$ and that $\frac{P}{Q} = a + b\sqrt{c}$, where a, b and c are constants, find the values of a, b and c.   (3 marks)

10. Find the value of x that satisfies the equation:
     $log_3(x + 24) - 2 = log_3(9 - 2x)$ (3 marks)

11. Under a shear with x-axis invariant the point (3,2) is mapped onto (-2,2). Find the image of point (4,4) under the same transformation.   (3marks)

12. The data below shows the marks obtained by ten students in a test.
     71, 55, 69, 45, 65, 57, 71, 82, 55, 50
     Find the quartile deviations.   (3 marks)

13. A bag contains 4 green, 9 purple and 18 blue balls. The balls are identical except for the colour. Two balls are picked at random, one at a time without replacement, find the probability that, a blue ball and a green ball are picked.   (3 marks)

14. Find the equation of the tangent to the curve $y = x^2 + 2x + 3$ at the point where the gradient is equal to 4.   (3 marks)

15. The radius of a spherical ball is 2.5cm correct to one decimal place. Calculate the percentage error in calculating the surface area of the ball.   (3 marks)
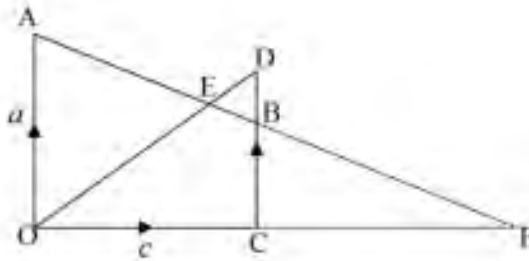
16.
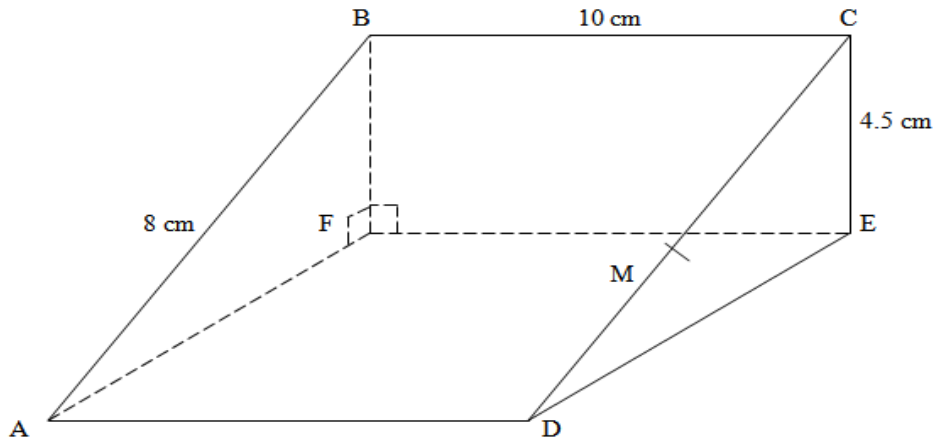
The above diagram represents a wooden prism. ABCD is a rectangle. Points E and F are directly below C and B respectively. M is the mid-point of CD. AB = 8 cm, BC = 10 cm and CE = 4.5 cm. Calculate the Angle CAE makes with the plane ADEF (3marks)

SECTION II: 50 MARKS
ANSWER ANY 5 QUESTIONS IN THIS SECTION

17.

In the figure below, $OA = \tilde{a}$ and $OC = \tilde{c}$. $CB = \frac{2}{3}OA$ and B divides CD in the ratio 3:1

(a)   Express the following vectors in terms of **a** and **c** only:

(i)   **AB**   (1 mark)

(ii)   **OD**   (2 marks)

(b)   Given that **OE** = h**OD** and **AE** = k**AB** where h and k are scalars express OE in two different ways hence find the scalars h and k.   (5 marks)

(c)   If OC produced meets AB produced at F, find **OF**.   (3 marks)

18.   (a)   The 5th term of an AP is 82 and the 12th term is 103. find:

        (i)   the first term and common difference.   (3marks)

        (ii)   the sum of the 21 terms.   (2 marks)

        (b)   A stair case was built such that each subsequent stair has a uniform difference in height. The height of the 6th stair from the horizontal floor was 85 cm and the height of the 10th stair was 145. Calculate the height of the 1st stair and the uniform difference in height of the stairs.   (3 marks)

        (c)   During the construction of the staircase, each step was supported by a vertical piece of timber. If the staircase has 11 stairs, calculate the total length of timber used.   (2 marks)

19.   (a)   Complete the table below given that $y = -x^2 + x + 12$ for $-4 \leq x \leq 5$.   (2 marks)

| x	-4	-3	-2	-1	0	1	2	3	4	5
y	8				12	12				

        (b)   On the grid provided below, draw the graph of $y = -x^2 + x + 12$ for $-4 \leq x \leq 5$
                Scale: 1 cm represents 1 unit on the x – axis and 1 cm represent 2 units on the y – axis.   (4 marks)

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(c) i)   Using your graph, to Solve the equation $x^2 - 3x - 10 = 0$ (2 marks)

     ii)   State the range of values of x for which $-x^2 + x + 12 \geq 0$ (1 mark)

(d) Estimate the coordinates of the turning point of the curve $y = -x^2 + x + 12$.   (1 mark)

20. An aircraft leaves town $P(30°S, 17°E)$ and moves directly to town $Q(60°N, 17°E)$. It then moved at an average speed of 300 knots for 8 hours westwards to town R. Determine;

(a) The distance PQ in nautical miles.   (3 marks)

(b) The position of town R.   (3 marks)

(c) The local time at R if the local time at Q is 3:15 p.m   (2 marks)

(d) The total distance moved from P to R in km. Take 1nm=1.853 km.   (2 marks)

21. Using a ruler and compasses only.

(i)   Construct a parallelogram ABCD such that AB = 10cm, BC = 7cm and angle ABC = 105º. (3 marks)

(ii)   Construct the loci of P and Q within the parallelogram such that 6cm. $AP \leq 4cm$ and $BQ \leq 6cm$
                                                                                          (3 marks)

(iii) Calculate the area within the parallelogram but outside regions bounded by the loci of P and Q. (4 marks)

22. Below is the histogram representing marks obtained in Mathematics test
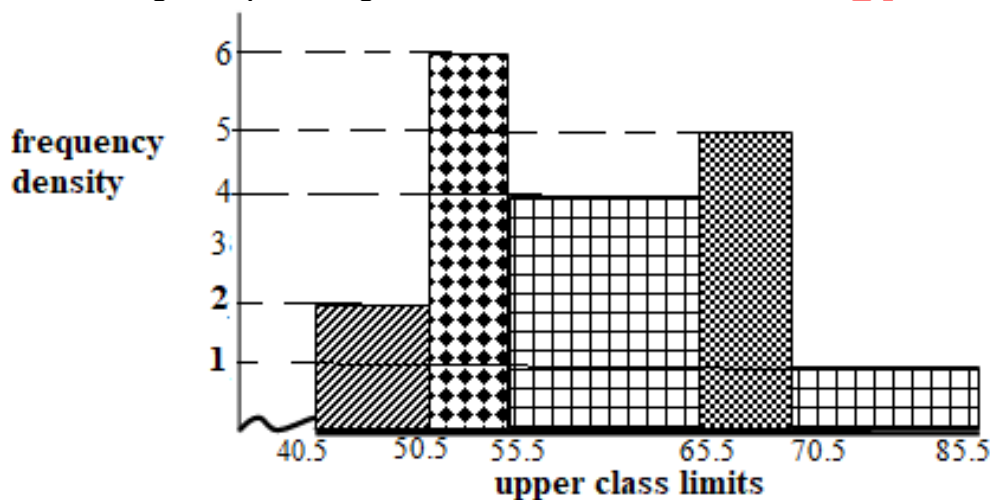
(a) Develop a frequency distribution table for the data   (3 Marks)

(b) Using an assumed mean of 60.5 find the mean.   (3 marks)

(c) Calculate Standard deviation.   (4 marks)

23. (a)   Use the mid ordinate rule with 5 strips to estimate the area bounded by the curve
            $y = x^2 - 3x - 4, x = -2, x = 3$ and $x - axis$ (3 marks)

     (b)   Calculate the exact area above   (5 marks)

     (c)   Find the percentage error involve in using the mid-ordinate role.   (2 marks)

24. Eldoret Airport is planning to build a fire fighting plant on a space of 250m². Two types of machines are to be installed, machine x which occupies a space of 5m² and machine Y which occupies 10m². The airport can have a maximum of 40 machines at a time. At most 15 machines of type Y are used at any given time.

a)   Write down three inequalities other than x > 0, and y > 0.   (3marks)

b)   On the grid below, show the region satisfying the given conditions.   (4marks)

c)   The profit from a type x machine is Ksh 1000 and that of type y is Ksh 4000. Use the graph to obtain the number of machines of each type that should be installed to obtain maximum profit. Calculate the maximum profit.   (3marks)

SECTION I (50MKS)
**ANSWER ALL THE QUESTIONS IN THE SECTION**

1. Two similar solids have surface areas $48cm^2$ and $108cm^2$ respectively. Find the smaller solid if the bigger one has a volume of $162cm^3$ (3mks)

2. An electrician made a loss of 30% by selling a multi plug at sh. 1400 what profit would have made if he sold the multi plug at sh. 2300. (3mks)

3. Find the exact value of $2.3\overset{..}{4}-1.9\overset{..}{1}$ (4mks)

4. The graph below (not drawn to scale) is a plot for the function $y=ax^2 +bx +k$ where a,b and k are constant
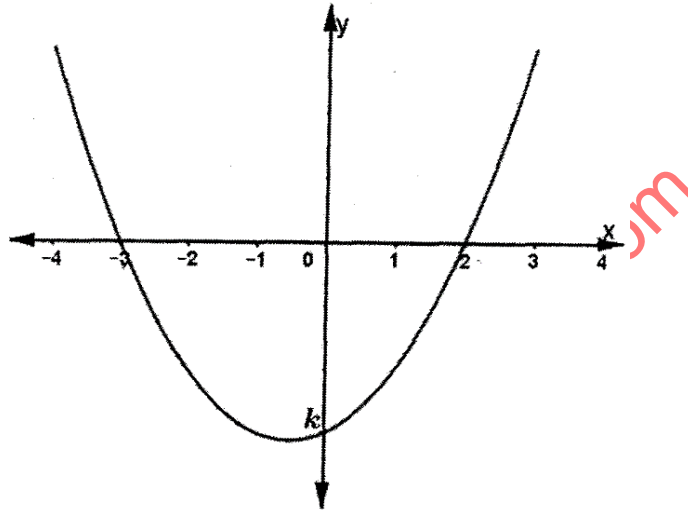
   Determine the values of a,b and k. (3mks)

5. Solve the following inequalities and represent the solutions on a number line x+1<4x-5<3x+2 (3mks)

6. Dr.June needs to import a car from Japan that costs US dollars (USD) 5000 outside Kenya. He intends to buy the car through an agent who deals in Japanese Yen (JPY). The agent charges a 20% commission on the price of the car and a further 80 325 JPY for shipping the car to Kenya. Find the amount in Kenya shillings that Dr. June need to sent to the agent to get the car given that: (3mks)
   1 USD = Ksh 120
   1USD = 135 JPY

7. For x in the equation. (3mks)
   $9^{x+1}+3^{2x}=810$

8. A lampshade is the shape of a cone such that its slanting height is 30cm white the top and bottom radii of the lampshade are 10cm and 17.5cm respectively. Calculate the surface area of the material used to make the lampshade. (4mks)

9. Simplify $\dfrac{6x^2 + x -1}{2-18x^2}$ (2mk)

10. A translation vector $\begin{pmatrix} x-y \\ 2-y \end{pmatrix}$ maps a point A (4,6) onto A^1(9,12). Find the value of x and y. (3mks)

11. In the figure below <A= 62º < = 42º, bc = 8.4 cm and CN is a bisector of angle ACB. Calculate to 1dp the length of CN. (3mks)
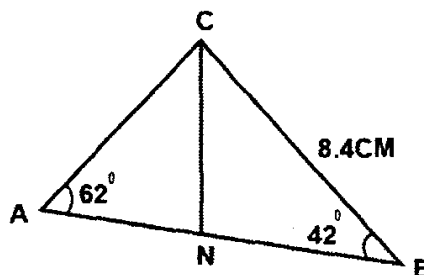
12. The figure below show a triangular prism whose cross-section is an equilateral triangle.
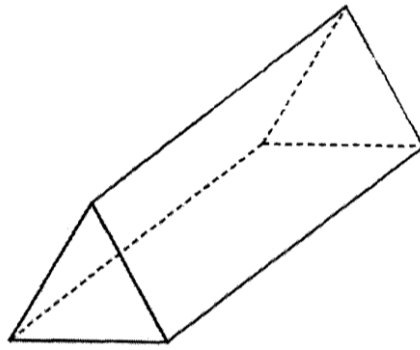
a) On the prism, show the positions of the lines of symmetry. (1mk)

b) Draw the net of the prism. (1mk)

13. In Boresha Bank customers may withdraw cash through one of the three tellers at the counter. On average, one teller takes 3minutes, the others take 5 minutes and 6minutes respectively to serve a customer. If the three tellers start to serve the customers at the same time, find the shortest time it takes to serve 210 customers. (4mks)

14. An arc length of 11cm subtends an angle of 140º at the center of the circle. Find the area of the enclosed sector. (4mks)

15. It would take 15men 8days to dig a trench of 240m long. Find how many days it would take 18men to dig trench 360 meters long working at the same rate. (3mks)

16. Determine the quartile deviation for the following distribution. (3mks)
3,4,9,5,4,7,6,2,1,6,7,8,9

SECTION II (50MARKS)
Answer any five questions in this section.

17. A straight line L_1 has a gradient $-\dfrac{1}{2}$ and passes through the p(-1,3). Another line l_2 Passes through the points Q(1,-3) and R(4,5)

Find:

a) (i) The equation of l_1 in the form y=mx +c, where m and c are constants. (2mks)

   (ii) Hence find k given that S (0,k) (1mk)

b) i) The gradient of l_2 (1mk)

   ii) The equation of l_2 in the form ax +by=c, where a, b and c are integral values. (2mks)

c) The equation of a line l_3 makes with the x-axis. (1mk)

d) Calculate the acute angle l_3 makes with the x-axis. (1mk)

18. The triangle ABC with coordinates A(2,3),B(4,2) and C (1,1) is mapped onto triangle $A^1B^1C^1$ by a reflection in the line y+ x=0

a) i) Draw triangle ABC and its image $A^1B^1C^1$ on the same plane. (3mks)

   ii) Triangle $A^1B^1C^1$ is mapped onto $A^{11}B^{11}C^{11}$ and describe felly a single transformation that maps triangle ABC onto triangle $A^{11}B^{11}C^{11}$. (4mks)

b) Triangle ABC is mapped onto xyz with A being mapped onto x, B onto Y and C onto Z. given that the coordinates of x is (-4,3) Y is (0,2) and z is (-1,1) find the matrix representing the transformation. (3mks)

19. A bus left Nairobi at 7.00am and traveled towards Eldoret at an average speed of 80km/hr. A t 7.45am a car left Eldoret towards Nairobi at an average speed of 120km/hr.
The distance between Nairobi is 300km. Calculate

a) The time the bus arrived at Eldoret. (2mks)

b) The time of the day two met. (4mks)

c) The distance of the bus from Eldoret when the car arrived in Nairobi (2mks)

d) The distance from Nairobi when two met. (2mks)

20. Two equal circles with centres P and Q and radius 8cm intersects at point A and B as shown   below.
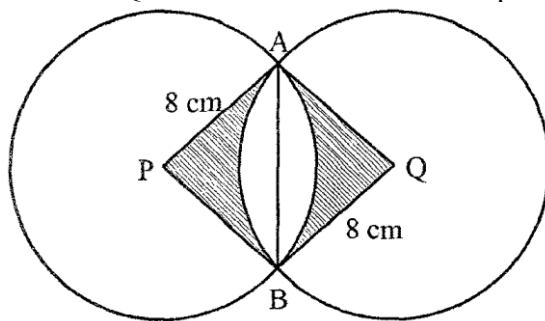

Given that the distance between their centres is 12 cm, find, correct to 4 significant figures;

(a)   The length of chord AB.   (2mks)
(b)   The length of shaded region. Use π=3.142.   (8mks)

21.   The figure below shows a triangle OAB with as the origin. OA=<u>a</u> OB=b, OM 2/5a and ON =2/3<u>b</u>.
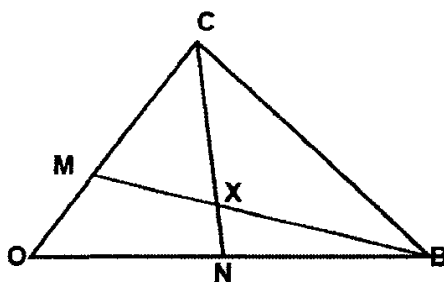
a)   Express in terms of <u>a</u> and <u>b</u> the vectors.
      i)   BM.   (1mk)
      ii) AN.   (1mk)
b)   Vector OX can be expressed in two ways: OB+ Kbm or +Han, where k and h are
      constants. Express OX in term of:
      i)   <u>a</u> <u>b</u> and k.   (2mks)
      ii) <u>a</u> <u>b</u> and h.   (2mks)
c)   Find the values of k and h.   (4mks)

22.   In the figure below P,Q,R,S and T lie the circumference of a circle centre O. Line UPV Is a   tangent to
       the circle at P. Chord ST of the circle is produced to intersect with the tangent at U. Angle UPT,RST and
       ORQ ARE 28º,100º AND 50º respectively.
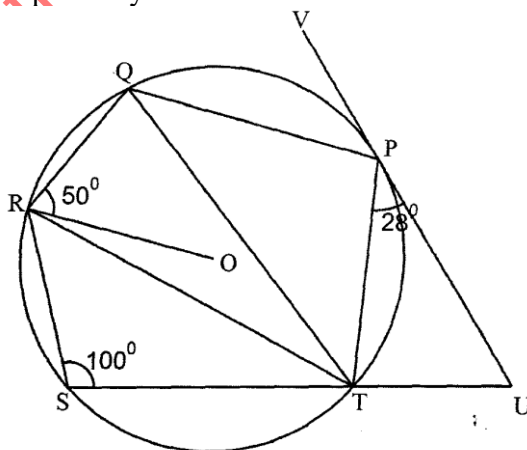
a)   Determine the sizes of the following angles;   (3mks)
      i)   RTP
      ii) QTP.   (3mks)
b)   Given that PQ= 6cm, calculate correct to 1 decimal place, the circle.   (4mks)

23. a) Complete the table below y=2x^2+ 5x-7 for the range -4 $\leq$ x $\leq$ 2. (2mks)

x-4	-3.5	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
y5			-7		-10	-10		-7			5	11

b) On the grid provided draw the graph of y=2x^2+ 5x-7 for the range -4 $\leq$ x $\leq$ 2. (3mks)
Use the scale : 1cm represent 0.5 units on the x-axis
1cm represent 2 units on the y- axis

c) Use your graph to solve;
i) 2x^2 _ 5x -7=0. (2mks)
ii) 2x^2 + 5x -7=4x+3. (3mks)

24. The figure below shows triangular garden XZY, xz = 6cm, xy = 4cm and angle xzy = 40º
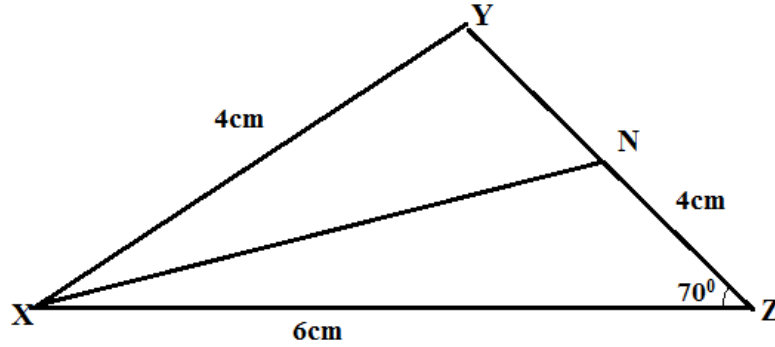
A point N lies on the line ZY such that ZN =4cm. find correct to 2 decimal place.
a) <ZNX. (3mks)
b) Length of NY. (4mks)
c) Length of ZY. (1mk)
d) Area of the garden. (2mks)

CEKENAS PREMOCK EXAMINATION, 2023
Kenya Certificate of Secondary Education. (K.C.S.E)
121/2
MATHEMATICS ALT. A
Paper 2
Time: 2½ Hours

SECTION I: (50MKS)
ATTEMPT ALL THE QUESTIONS FROM THIS SECTION

1   Solve for n in $(\log_2 n)^2 = \log_2 n^4 - \log_2 8$ (3marks)

2   Make x the subject of the formula   (3marks)

$$\sqrt[n]{\frac{2x^n + r}{4}} = \frac{x}{r}$$

3   In the expansion of $(a - \frac{b}{9^2})^6$, the tern independent of a is 735. Find the value of b.   (3marks)

4   The absolute errors of the radius and height of a cylinder are 3mm and 2mm respectively. If the actual radius and height are 8cm and 9.5cm respectively. Calculate the percentage error in the volume of the cylinder   (3marks)

5   A point (a,b) undergoes a transformation represented by the matrix $\begin{pmatrix} 0 & 1 \\ -1 & 4 \end{pmatrix}$ followed by another

transformation represented by the matrix N $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$. Determine the value of $\begin{pmatrix} a & b \end{pmatrix}$ if the final image is

(4, 5)   (3marks)

6   Solve for x in the internal $-\pi \leq x \leq \pi^c$ for which $2 \cos^2 x - \sin x = 1$ (3marks)

7   The cash price of an iPhone 12 pro is kshs.125, 000. Ngeti bought the iPhone on hire purchase terms by paying a deposit of ksh 70,000 and the balance by 24 equal monthly instalments of ksh 3000. Find the rate of interest charged per annum to 4 significant figure   (3marks)

8   Without using calculators or mathematical tables express $\frac{\sqrt{48}}{2 - \cos 750}$ (3marks)

9   The table below represents a relationship between 2 variables Q and R connected by the equation
Q = aR +b. where a and b are constant

R	0.1	0.2	0.3	0.4	0.5	0.6
Q	2.7	3.4	4.0	4.8	5.6	6.2

(a)   On the grid provided draw the line of best fit for the data.   (3marks)
(b)   Use your graph to find the value of b.   (1marks)

10   Mr. Ngetich a police constable in the police service pays a net tax of ksh. 5,499 after a relief of ksh. 2,256 in a month. Using the below of income tax rates in Kenya in a certain year. Calculate Ngetichs gross salary during the month if he enjoys a non- taxable travel allowance of ksh 15,000.   (4marks)

Monthly taxable income (ksh)	Taxable
Up to 16680	10%
16681- 28900	15%
28901- 51920	20%

11   Given that y is inversely proportional to x^n and k is constant proportional and that x=2 when y = 4 ½ and x = 3 when y = 1⅓. Find the values of n and k.   (3marks)

12   The position vectors of A, B and C are *a , b* and *c* respectively. Point C divides AB externally in the ratio 5:2. Express *c* in terms of *a* and *b*   (3marks)

13   A right angled triangle has the length of its shorter sides as (2x +4) and (8x + 8). If the length of the hypotenuse is 10x, find its area   (4marks)

14.   In what ratio should grade A tea costing sh 180 per kg be mixed with grade B tea costing sh 300 per kg to produce mixture which when sold at sh 270 per a profit of 20% is realized.   (3mks)

15.   Draw a line PQ Of length 7cm. On one side of the line PQ, construct the locus of point R such that the area of triangle PRQ is 10.5 cm² on this locus locate two position of R, R_1 and R_2 such that <PRQ=PR_2Q =90⁰ . Measure $R_1 R_2$.   (3mks)

16. The diagram below shows a sketch of a circle drawn on a Cartesian place such that it cuts the axes or x=-1.5,x=6.5,y=-2.5 and y=5.5.
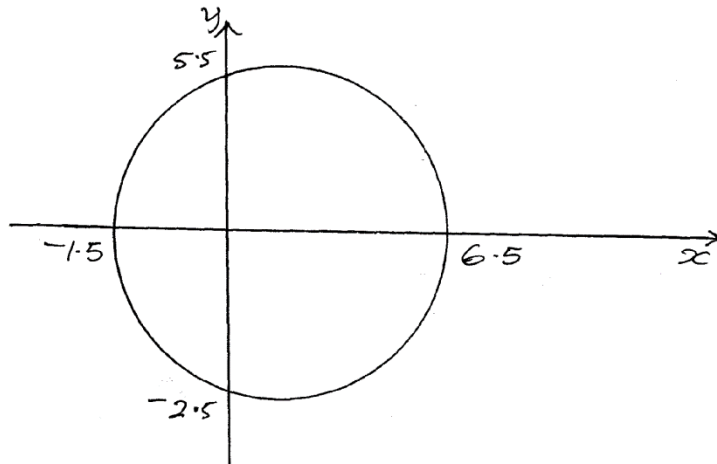

a) Find the co-ordinate of the centre of the circle. (1mk)
b) Find the radius of the circle in sued form. (1mk)

c) Find the equation of the circle in the form $ax^2 + ay^2 + bx + y + d$. (2mks)

17. a) A sequence is formed by adding corresponding terms of an AP and GP. The first second and third term of the sequence formed after adding the first three terms of the sequence are 14, 34 and 78 respectively. Given that the first term of the AP is a and the first term of the GP is b and that the common difference of the AP. (5mks)

b) The second and third terms of a geometric progression are 24 and 12(x+1) respectively. Given that the sum of the first three terms of the progression is 76,find the whole number value of x and hence the first term. (5mks)

18. a) Complete the table below. (2mks)

x	-180^0	-150^0	-120^0	-90^0	-60^0	-30^0	0^0	60^0	90^0	120^0	150^0	180^0
2cos x	-2.0	-1.73	1.00				2.00					
sin (2x-30⁰⁾)			1.00		-0.5				1.00			

b) On the graph provided below on the same axis draw the graph of y=2cox and
y = sin (2x−30⁰) for −180⁰ ≤ x≤ (take the scale 1cm for30⁰ on the x axis and 2cm for 1unit on the y=axis. (5mks)

c) Use your graph to estimate the value of x for which Cos x−½ Sin (2x−30⁰) = 0 (2mks)

d) Use your graph to state the amplitude and period of the function y = sin(2x−30⁰). (2mks)

19. A pentahedron with faces marked 6,5,1,2 and 7 is biased so that when rolled, the probability of a number t showing up, is given by P (t) = K (t) where K is a constant. If the pentahedron is rolled twice, find the probability that the total score is 8. (4marks)
b) The probability of the three horses X, Y and Z jumping over a fence are 0.5., 0.2 and 0.3 respectively
i) Draw a tree diagram to represent the information (1mark)
ii) Find the probability that all the horses jump successfully (1mark)
iii) Find the probability that only one horse jumps successfully (2marks)
iv) Find the probability that at most one horse misses to jump over the fence (2marks)

20. The position of three cities P, Q, and Rare (15⁰N 20⁰W) ,(50⁰N , 20⁰W) and (50⁰N 60⁰E) respectively.
a) Find the distance in nautical miles between
i) Cities P and Q (2marks)
ii) Cities P and R, via city Q (3marks)
b) A plane left city P at 0250h and flew to city Q where it stopped for 3 hours then flew to city R, maintaining a speed of 900 knots throughout .Find.

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i) The local time in city R when the plane left city P (3marks)
ii) The local time (to the nearest minute) at city R when the plane landed at R (2marks)

21. The marks scored by 40 Mathematics students were shown in the table below.

Marks	42-46	47-57	52-56	57-61	62-66	67-71
Number of students	3	4	10	12	8	3

a) State the upper class limit of the modal class (1mark)
b) Estimate the standard deviation. (3marks)
c) If the pass mark is 55% how many students passed? (3marks)
d) Find the range of marks scored by the middle 50% of the students (3marks)

22. Karuku, Jaoko and Ezra contributed a total of Ksh.3, 579,000 to purchase a van. The ratio of Karuku's contribution to Jaoko's contribution was 4:3 while Ezra's contribution to Karuku's contribution was 5:7
a) Determine the amount each contributed towards the project (4marks)
b) The van purchased had a capacity of 14 seats including the driver's seat and charges Ksh. 650 from Migori to Kisumu. The van operates from Migori to Kisumu and back to Migori on a daily basis for six days per week .On a daily basis, Ksh 10,000 collected is used in fencing the van, 31% of the remainder is set aside for maintenance and drivers salary and the rest is saved for the owners which will be divided in the ratio of their contribution. Determine:
i) The amount saved for the maintenance of the van after 56 weeks if the driver was paid a total of Ksh 268,800 (3marks)
ii) The amount each received after 56 weeks (3marks)

23. Use the line below to construct triangle ABC such that BC= 5.3cm and angle ABC=75^0. (2marks)
Locate point M that is equidistance from points A, B and C (2marks)
Construct the locus of P such that angle APC + Angle ABC=180^0 (2marks)
Construct the locus of Q to meet the locus of P at R such that angle ABQ=CBQ (1mark)
Measure MR (1mark)
Shade the region S inside the triangle such that angle ABS≤ angle CBS and AS≥CS (2marks)

A ————————————————————————— B
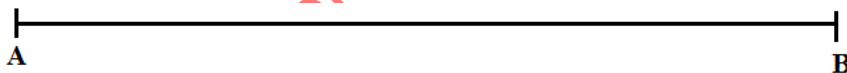
24. A school has to take 560 people for a tour .There are two types of buses available. Type X and type Y. Type X can carry 70 passengers and type Y can carry 40 passengers. They have to use at least 10 buses of each type must not be less than 3.
a) Form all linear inequalities to represent the above equation (3marks)
b) On the grid provided draw the inequalities and shade the unwanted region (3marks)
c) If the charges for hiring the buses are;
Type X; Shs 40,000
Type Y: Shs 30,000
i) Use your graph to determine the number of buses of each type that should be hired to minimize the cost (3marks)
ii) Find the minimum cost

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IMENTI SOUTH EXAMINATIONS, 2023
121/1
MATHEMATICS
Paper 1
TIME: 2½ HRS

SECTION I (50 marks)
Answer all the questions in this section

1. Evaluate
$$\frac{\frac{1}{2} + 2\frac{4}{5} \text{ of } 8 \div 6(2 \times 4\frac{2}{5})}{\frac{1}{2} \text{ of } 6 (8 \div 3\frac{1}{3})}$$
(3 marks)

2. Arrange all prime numbers between 10 and 20 in ascending order to form a number. State the total value of fourth digit from the left of the number that is formed. (2 marks)

3. The volume of water in a measuring cylinder is 25.2cm^3. After a solid metal sphere is immersed into it, the measuring cylinder reads 29.4cm^3. Calculate the radius of the sphere. (Use $\pi = \frac{22}{7}$) (3 marks)

4. Mary and Jane working together can cultivate a piece of land in 6 days. Mary alone can complete the work in 15 days. After the two had worked together for 4 days Mary withdrew the services. Find the time taken by Jane to complete the work alone. (4 marks)

5. Solve the simultaneous equation
   $2p + 7q = -19$
   $\frac{1}{2} p - 3q = 7$
   (3 marks)

6. The angles of a quadrilateral are in the ratio $6 : 4 : 3 : 2$. Calculate the sizes of the angles. (3 marks)

7. EFGH is rhombus and triangle DEF is equilateral. Calculate $\angle HDG$ given that $\angle HED = 18^o$. (2 marks)
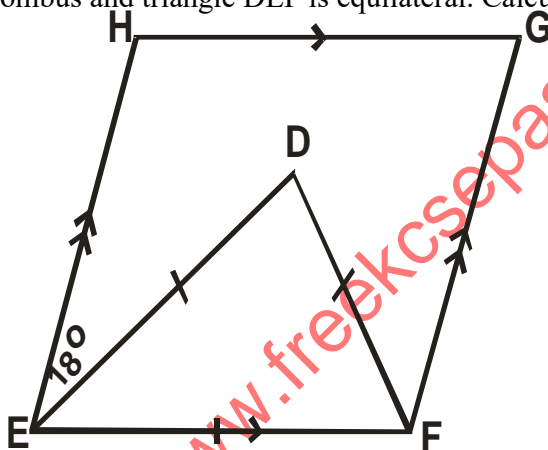
8. Express $\frac{x+y}{3} - \frac{2x-y}{2}$ as a single fraction (3 marks)

9. Evaluate using logarithm tables. (4 marks)
   $$\frac{5 \cos 62.3}{3.5 \sin 44.5}$$

10. List all the integral values of x which satisfy the inequality
    $$\frac{4+x}{-3} > 3x + 2 > -13$$
    (3 marks)

11. A class has 18 boys and 12 girls. Three pupils are chosen at random from the class.
    What is the probability of choosing all three girls? (3 marks)

12. If OP = 5i – 3j and OQ = 3i + 5j, find the magnitude of PQ to two significant figures. (3 marks)

13. Simplify $\frac{16k^2-9}{12k^2+7k-12}$ (3 marks)

14. A car and a bus were moving in the same direction at an average speed of 92km/h and 77km/h respectively. The car was at point P at 10.30am. If it overtook the bus at 10.35a.m, determine the distance that was between the two vehicles at 10.30 am. (4 marks)

15. A straight line *l* passes through a point (2 -1) and is perpendicular to a line whose equation is
    $2y + 3x = 5$. Find the equation of *l* in the form $y = mx + c$ where m and c are constants. (3 marks)

16. Mercy bought the following goods from supermarket
    3kgs of sugar @ Ksh 160.00, 2 loaves of bread @ Ksh 120.00, 6 packets of milk @ Ksh 65.00

a) How much did she pay for the goods (2 marks)

b) How much money did she receive in change if she gave a note of a thousand and a note of five hundred
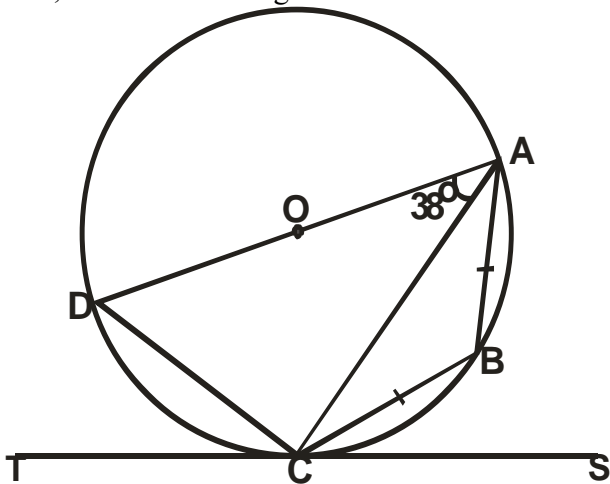
(2 marks)

SECTION II (50 marks)

Answer any FIVE questions in this section

17. a) Fill the table below for function $y = x^2 - 4x + 2$ for $-1 \leq x \leq 5$ (2 marks)

x	−1	0	1	2	3	4	5
y							

   b) i)   Draw the graph of the function $y = x^2 - 4x + 2$ for $-1 \leq x \leq 5$ (4 marks)

   ii)   On the same axes draw a line $y = x - 1$ (2 marks)

   c) Determine the values of x at the points of intersection between the curves $y = x^2 - 4x + 2$ and $y = x - 1$ (2 marks)

18. In the figure below DA is a diameter of the circle ABCD centre O, radius 10cm. TCS is a tangent to the circle at C, AB = BC and angle DAC = 38°.

   a)   Find the size of angle

   i)   ACS (2 marks)

   ii)   BCA (2 marks)

   b)   Calculate the length of

   i)   AC (3 marks)

   ii)   AB (3 marks)

19. Two circles of radii 3.5cm and 4.2 cm with centres O_1 and O_2 respectively intersect at points A and B as shown in the figure below. The distance between the two centres is 6cm.
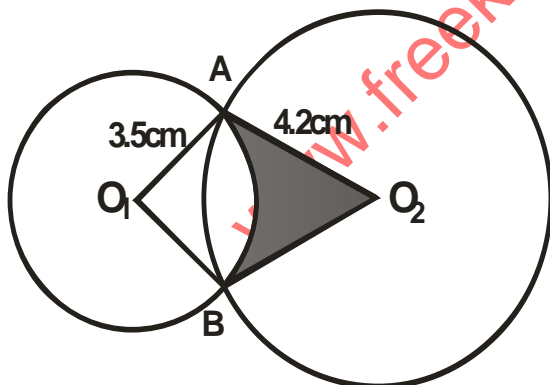
   Calculate:

   a)   The size of $\angle AO_1B$ (3 marks)

   b)   The size of $\angle AO_2B$ (3 marks)

   c)   The area of quadrilateral O_1AO_2B to 2 dp (2 marks)

   d)   The area of the shaded region to 2 s.f (2 marks)

20. In the figure below OY : YA = 1 : 3, AX : XB = 1 : 2, OA = a and OB = b. N is a point of intersection of BY and OX
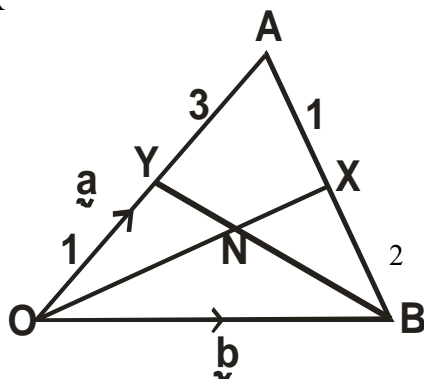
Determine:

a) i) OX (2 marks)

  ii) BY (1 mark)

b) Given that BN = mBY and ON = nOX, express ON in two ways in terms of a, b, m and n (3 marks)

c) Find the values of m and n (4 marks)

21. a) Use a ruler and a compass only. Construct triangle ABC where AB = 7cm, angle CBA = 75° and BC = 5cm. (4 marks)

b) i) Locate a point T inside the triangle which is equidistant from points A and B and also equidistant from line AB and AC (3 marks)

  ii) Measure TB (1 mark)

c) By shading the wanted region P inside the triangle if its nearer to point B than to point A and also nearer to the line AB than AC. (2 marks)

22. The diagram below shows the speed – time graph for a lorry travelling between two stations. The lorry starts from rest and accelerated uniformly for 150 seconds. It then travels at a constant speed for 300 seconds and finally decelerates uniformly for 200 seconds.
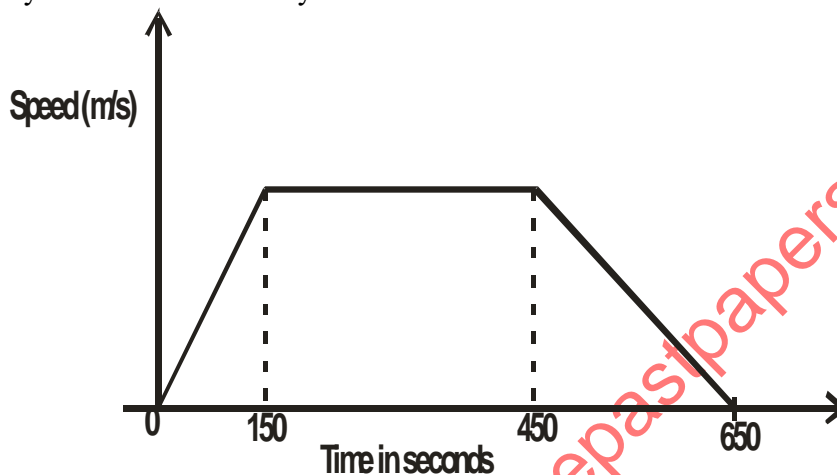
Given that the distant between the two stations is 10450m, calculate the

a) Maximum speed in m/s attained by the lorry (2 marks)

b) Acceleration (2 marks)

c) Distance the lorry travelled during the last 100 seconds. (3 marks)

d) Time the lorry takes to travel first half of the journey. (3 marks)

23. Three quantities A, B and C are such that A varies directly as square of B and inversely as the square root of C.

a) Given that A = 20 when B = 5 and C = 9,

i) Find the equation connecting A, B and C (3 marks)

ii) Find A when B = 7 and C = 25 (2 marks)

b) If B increases by 20% and C reduces by 36%; find the percentage increase in A (5 marks)

24. a) The ratio of Juma's and Akinyi's earnings was 5 : 3. Juma's earnings rose to Ksh. 8400 after an increase of 12%. Calculate the percentage increase in Akinyi's earnings given that the sum of their new earnings was Ksh. 14,100 (6 marks)

b) Juma and Akinyi contributed all the new earnings to buy beans at Ksh 1175 per bag. The beans were then sold at Ksh 1762.50 per bag. The two shared all the money from the sale of beans in the ratio of their contributions. Calculate the amount that Akinyi got. (4 marks)

SECTION I (50 marks)
Answer all the questions in this section
1. Make u the subject of the formula
    $z = w \sqrt{u^2 - v^2}$ (3 marks)
2. Betty withdrew sh 84,528 from a financial institution which included both the principal and compound interest that had accrued within two and half years. If the compound interest rate was 18% per annum calculate the principal (3 marks)
3. Expand $(1 + 3x)^9$ in ascending powers of x up to the term x^4 and use your expansion to estimate 0.94^9 correct to three decimal places. (3 marks)
4. Given that $X = \begin{pmatrix} 1 & 5 \\ 2 & 5 \end{pmatrix}, Y = \begin{pmatrix} 5 & 1 \\ 2 & -1 \end{pmatrix}$ and $Z = \begin{pmatrix} m & n \\ p & q \end{pmatrix}$ and XY = YZ, determine the values m, n, p, q and z. (4 marks)
5. A quantity E is partly constant and partly varies as the square root of F.
a) Using constants k and c, write down an equation connecting E and F (1 mark)
b) If F = 25 when E = 22 and F = 49 when E = 28, Find the values of k and C (2 marks)
6. The base and height of a right angles triangle are 5.4cm and 3.5cm respectively.
    Calculate the relative error in the area of the triangle. (3 marks)
7. Determine the quartile deviation for the following set of numbers
    6, 10, 7, 6, 9, 8, 3, 2, 9, 8, 5, 4, 5 (3 marks)
8. In the figure below O is the centre of the circle. ABC and CD is a tangent to the circle at C.
    If angle CDB = 24º, determine the size of ∠BCD (3 marks)
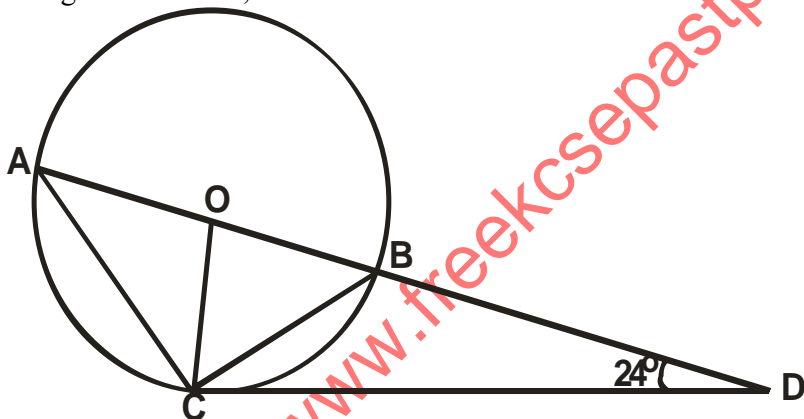
9. Show that number 1. 5̇2̇3̇ consist of a whole number and a fraction. (2 marks)
10. Solve the equation $4\cos^2 \theta = 5 - 4 \sin \theta$ for $0º \leq \theta \leq 360º$. (3 marks)
11. The equation of a circle is given by $4x^2 + 4y^2 + 56x - 20y - 35 = 0$. Find the co-ordinates of the centre of the circle and the circumference of the circle. (Take $\pi = 3.142$) (4 marks)
12. Cosmas mixed types A, B and C of rice in the ratio 2 : 3 : 7 respectively. Type A costs sh 72 per kg, type B costs sh 96 per kg and type C costs sh 120 per kg
a) Find the costs of one kg of the mixture (2 marks)
b) If she sold the mixture at a profit of 25.5% per kg, determine to the nearest shilling the selling price of 7kg of the mixture. (2 marks)
13. If $\frac{\sqrt{6}}{\sqrt{3} - \sqrt{2}} - \frac{\sqrt{6}}{\sqrt{3} + \sqrt{2}} = a \sqrt{b}$ where $a \sqrt{b}$ is in its simplest form, Find the values of a and b. (3 marks)
14. The GCD of two numbers is 12 and their LCM is 240. If one of the numbers is 60, Find the other number (3 marks)
15. If x : y = 9 : 11, find the ratio (5x – 3y) : (2x + 3y) (3 marks)
16. Solve $\log_{10}(7x - 1) - 1 = \log_{10}(x - 1)$ (3 marks)

SECTION II (50 marks)
*Answer any FIVE questions in this section*
17. The table below shows the income tax rates that were used in 2019.

Monthly taxable pay (Ksh)	Rate %
1 – 10,164	10
10165 – 19, 740	15
19741 – 29316	20
29317 – 38892	25
Over 38,892	30

Mwango earned a basic monthly salary of sh 23,500 and had a house allowance of sh 4000 per month. He paid a premium of sh 18,000 p.a towards his life insurance policy and claimed relief. The amount of the life insurance relief was 15% of the premiums paid. He also claimed a personal tax relief of sh 1162 per month.

a) Find
i) His monthly taxable income. (1 mark)
ii) The gross tax (4 marks)
iii) The net tax (2 marks)
b) The following other monthly salary deductions were made on his income:
   A service charge of sh 150
   Health insurance fund 250
i) Find the total monthly deductions made on Mwango's income (2 marks)
ii) Mwango's net income (1 mark)

18. The probabilities that a cow and a goat will be alive 25 years from now are 0.7 and 0.9 respectively. Find the probability that in 25 years' time
a) Both will be alive (2 marks)
b) Neither will be alive (2 marks)
c) One will be alive (3 marks)
d) At least one will be alive (3 marks)

19. a) In a geometrical progression the sum of the second and third and fourth term is -36.
      Find the first term and the common ratio. (4 marks)
    b) In an arithmetic progression the 12th term is 25 and the 7th term is three times the second term. Find
    i) The first term and the common difference (4 marks)
    ii) The sum of the first 10 terms of the arithmetic progression (2 marks)

20. Triangle MNP on the grid below has vertices M(1, 4), N (3, 1) and P(4, 3)
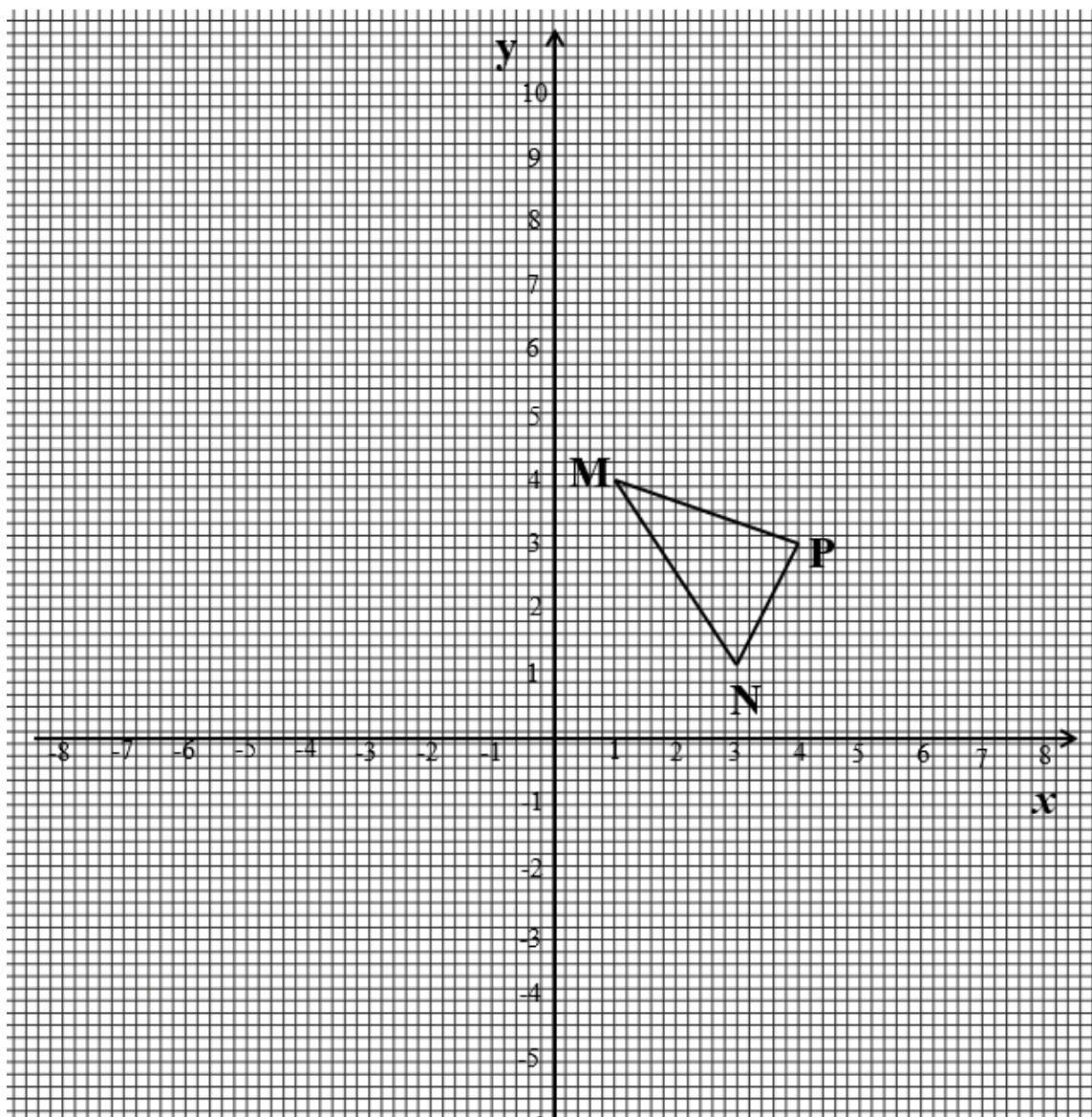
a) Draw triangle $M^IN^IP^I$ the image of ΔMNP under a negative quarter turn about the origin   (2 marks)
b) Triangle $M^IN^IP^I$ is reflected on the line x = y onto $ΔM^{II}N^{II}P^{II}$. Draw triangle $M^{II}N^{II}P^{II}$.   (2 marks)
c) Triangle $M^{III}N^{III}P^{III}$ is the image of Δ $M^{II}N^{II}P^{II}$ under a rotation of +90° about the origin.
   Draw $M^{III}N^{III}P^{III}$.   (3 marks)
d) A single transformation T maps ΔMNP onto $M^{III}N^{III}P^{III}$. Find matrix of transformation.   (3 marks)

21. In an agricultural research centre, 100 carrots were harvested a few months after application of a new type of fertilizer to a carrot garden.
    Their masses to the nearest gram were measured and recorded as shown below.

mass	70 - 74	75 - 79	80 - 84	85 - 89	90 - 94	95 - 99	100 - 104	105 - 109	110 - 114	115 - 119
Frequency	3	7	8	15	19	16	14	9	6	3

a) State the modal class   (1 mark)
b) Calculate the mean mark   (4 marks)
c) Find the
i) Mean squared deviation   (4 marks)
ii) Standard deviation   (1 mark)

22. The diagram below represents a pyramid standing on a rectangular base ABCO. V is the vertex of the pyramid and VA = VB = VC = VD = 26cm. M and N are the midpoints of BC and AC respectively. AB = 24cm and BC = 18cm.
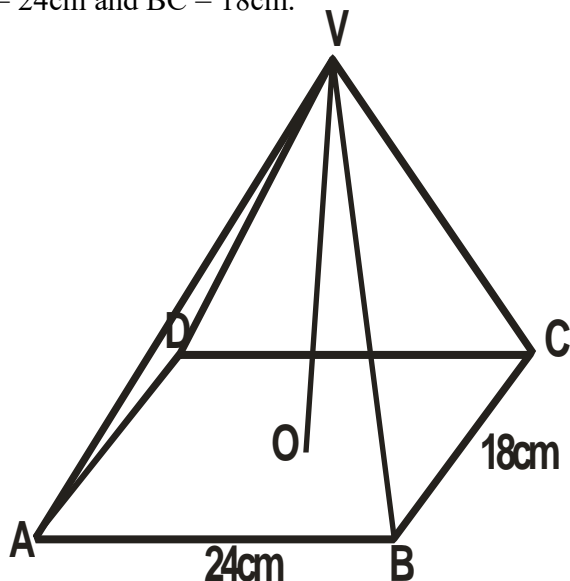
Calculate

a) The length of line AC   (2 marks)
b) The length of projection of VA on the plane ABCD   (1 mark)
c) The angle between line VA and the plane ABCD   (2 marks)
d) The vertical height of the pyramid   (2 marks)
e) The size of the angle between the plane VBC and ABCD   (3 marks)

23. a) Complete the table below for the functions y = 3 sin (2x + 30°) and y = cos 2x for x values in the range 0 ≤ x ≤ 180°.

x	0	15	30	45	60	75	90	105	120	135	150	165	180
y = 3 sin (2x + 30°)	1.5		3		1.5		-1.5			-2.60	-1.50		1.5
y = cos 2x	1			0		-0.866		-0.866	-0.5			0.866	1

b) Using the scale horizontal axis 1cm represent 15° vertical axis 1cm represent 1 unit, draw the graphs of y = 3 sin (2x + 30) and y = cos 2x   (6 marks)
c) Use your graph to solve the equation 3 sin (2x + 30) = cos 2x   (1 mark)
d) Determine the following from your graph
i) Amplitude of y = 3 sin (2x + 30°)   (1 mark)
ii) Period of y = 3 sin (2x + 30°)   (1 mark)
iii) Period of y = cos 2x   (1 mark)

24. Two inlet taps P and Q opened at the same time can fill a tank in 2 ½ hours. The two taps were opened together at the same time and after 1 hour 10 minutes tap Q was closed and P continued alone and filled the tank after a further 4 hours. Find;

a) The fractions of the tank filled by both taps for 1 hour.   (1 mark)
b) The fraction of the tank filled by tap P after Q was closed.   (2 marks)
c) The time which each tap working alone would have taken to fill the tank.   (7 marks)

MURANG'A SOUTH PREMOCK EXAMINATION
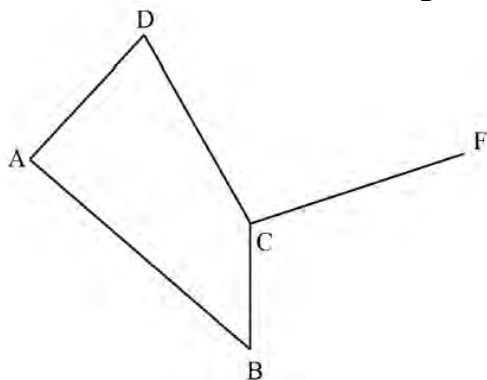**Kenya Certificate of Secondary Education, 2023**
121/1
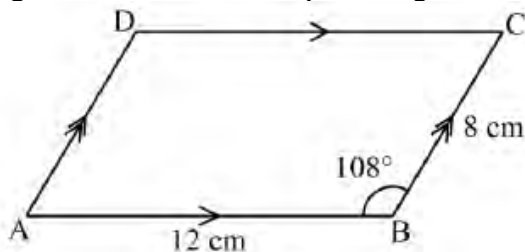MATHEMATICS
PAPER 1
TIME: 2½ HOURS

SECTION I (50 Marks)
Answer all the questions in this section

1. A man withdrew some money from a bank. He spent $\frac{3}{10}$ of the money on his daughter's school fees and $\frac{3}{5}$ of the remainder on his son's school fees. If he remained with Ksh 10 500, calculate the amount of money he spent on son's school fees. (3 marks)

2. Solve for x (3 marks)
$9^{(x+1)} + 3^{(2x+1)} = 108$

3. The volume of two similar solid spheres are 4752 cm³ and 1408 cm³. If the surface area of the smaller sphere is 352 cm², find the surface area of the larger sphere. (3 marks)

4. The figure below represents a sketch of the cross – section of a solid ABCDEFGH and its edge CF. Complete the sketch of the solid showing the hidden edges using dotted lines. (3 marks)

5. When a given length of a piece of wire is divided into pieces measuring 20 cm or 24 cm or 26 cm or 28 cm, a piece of wire 7cm always remained. Find the length of wire. (4 marks)

6. Solve the equation $6x^2 - 13x + 6 = 0$ using the completing the square method. (3 marks)

7. Using a ruler and a pair of compasses only, construct a trapezium ABCD in which $AB = 5\ cm, AD = 6\ cm, DC = 10\ cm, \angle BAD = 105°$ and AB is parallel to DC. Draw a perpendicular from B to DC hence measure the height of the trapezium. (4 marks)

8. Given that $\tilde{a} = 2p - ¾ q$ where $p = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ and $q = \begin{pmatrix} 16 \\ 4 \end{pmatrix}$ Find column vector $\tilde{a}$. (2 marks)

9. Two friends Ojwang and David live 40 km apart. One day Ojwang left his house at 9.00 a.m. and cycled towards David's house at an average speed of 15 km/h. David left his house at 10.30 a.m. on the same day and cycled towards Ojwang's house at an average speed of 25 km/h. Determine;
   i. The time taken before the two friends met. (3 marks)
   ii. The time they met. (1 mark)

10. In the figure below, ABCD is a parallelogram in which AB = 12 cm, BC = 8 cm and angle ABC = 108°.

   Calculate the area of the parallelogram correct to 3 significant figures. (3 marks)

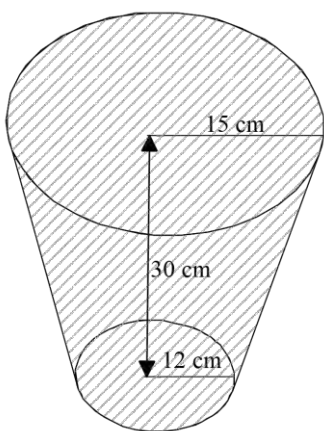11. Without using mathematical tables or a calculator evaluate. (3 marks)
$$\frac{\tan 30^o \ \tan 60^o}{\sin 60^o \cos 30°}$$

12. Given that $M = \begin{pmatrix} 4 & 5 \\ 2 & 3 \end{pmatrix}$ and $N = \begin{pmatrix} -2 & 3 \\ 1 & -1 \end{pmatrix}$, find $M^{-1}N$ (3 marks)

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13. Simplify completely; $\dfrac{(m+5n)^2+(m-5n)^2}{3m^2+75n^2}$ (3 marks)

14. Use logarithms to evaluate. (3 marks)
$\dfrac{39.51 \times 614}{0.758}$

15. Dr. June needs to import a car from Japan that costs US dollars (USD) 5 000 outside Kenya. He intends to buy the car through an agent who deals in Japanese Yen (JPY). The agent charges a 20% commission on the price of the car and a further 80 325 JPY for shipping the car to Kenya. Find the amount in Kenya shillings that Dr. June will need to send to the agent to get the car given that 1 USD = Ksh. 120 and 1USD = 135 JPY (3 marks)

16. In a right angled triangle, the two sides enclosing the right angle measure $(3x - 2)$cm and $(x + 2)$ cm. If the area of the triangle is $17.5 \ cm^2$, find the length of these two sides. (3 marks)

SECTION II (50 Marks)
Answer any five questions only in this section

17. The diagram below shows a frustum which represents a bucket with an open end diameter of 30 cm and bottom diameter 24 cm.

The bucket is 30cm deep. (Use $\pi = 3.142$)
(a) Calculate the capacity of the tank in litres. (5 marks)
(b) The bucket is used to fill an empty cylindrical tank of diameter 1.4m and height 1.2m.
i. Calculate the capacity of the tank in litres. (3 marks)
ii. Determine the number of buckets that must be drawn in order to fill the tank. (2 marks)

18. Three islands P, Q, R and S are on an ocean such that island Q is 400Km on a bearing of $030°$ from island P. Island R is 520 km and a bearing of $120°$ from island Q. A port S is sighted 750 km due South of island Q.
a) Taking a scale of 1cm to represent 100Km, give a scale drawing showing the relative positions of $P, Q, R \ and \ S$. (4 marks)
b) Use the scale drawing to find the bearing of:
(i) Island R from island P (1 mark)
(ii) Port S from island R (1 mark)
c) Find the distance between island P and R (2 marks)
d) A warship T is such that it is equidistant from the islands P, S and R. by construction locate the position of T. (2 marks)

19. The vertices of a triangle ABC are A(1,1), B(4,1) and C(6,4)
a) On the grid below, draw the triangles.
i. ABC. (1 mark)
ii. $A'B'C'$, the image of triangle ABC under a negative quarter turn about the origin. (2 marks)
iii. $A''B''C''$, the image of triangle $A'B'C'$, under reflection in the line $y = x$. (2 marks)
b) Triangle $A'''B'''C'''$, with vertices $A'''(-1,-5) \ B'''(-4,-5) \ and \ C'''(-6,-2)$, is the image of , triangle $A''B''C''$, under a transformation **T**.
i. Draw the triangle $A'''B'''C'''$, (1 mark)
ii. Describe fully the transformation **T**. (2 marks)

c)   State **any** pair of triangles which are:
i.   Directly congruent.   (1 mark)
ii. Oppositely congruent.   (1 mark)

20.   The figure below shows a triangle inside a circle. $AB = 8\ cm, BC = 10\ cm$ and $AC = 13cm$

Calculate
(a)   The area of triangle ABC.   (3 marks)
(b)   Angle BAC   (2 marks)
(c)   The radius of the circle.   (2 marks)
(d)   Area of the shaded region.   (3 marks)

21.   (a)   Complete the table below for the function $y = x^3 - 5x^2 + 2x + 9$ for $-2 \leq x \leq 5$ (2 marks)

x	-2	-1	0	1	2	3	4	5
y			9					

(b)   On the grid provided, draw the graph of $y = x^3 - 5x^2 + 2x + 9$ for $-2 \leq x \leq 5$ (3 marks)
(c)   Use the graph in (b) above to find the roots of the following equations:
i. $x^3 - 5x^2 + 2x + 9 = 0$ (2 marks)
ii. $x^3 - 5x^2 + 6x = -5$ (3 marks)

22.   A construction company makes concrete by mixing cement, sand and ballast such that the ratio of cement to sand is 1:2 and that of sand to ballast is 3:4.
a)   Determine:
(i)   The ratio of cement to ballast in the concrete.   (2 marks)
(ii) The number of bags of ballast required to make a concrete with 27 bags of sand.   (2 marks)
b)   The cost of a bag of cement, sand and ballast is Ksh 680, Ksh 136 and Ksh 102 respectively.
      Calculate the cost of one bag of concrete.   (2 marks)
c)   The construction company requires to transport 30 tonnes of sand to a site using a tractor. The tractor carries a maximum of 3 600 kg of sand and costs Ksh 8 000 per trip. Calculate the least amount of money required to transport the sand to the site.   (4 marks)

23.   A trader bought 8 cows and 12 goats for a total of Ksh 294,000. If he had bought 1 more cow and 3 more goats he would have spent Ksh 337,500
a)   Form two equations to represent the above information.   (2 marks)
b)   Use matrix method to determine the cost of a cow and that of a goat.   (4 marks)
c)   The trader sold the animals he had bought making a profit of 40% per cow and 45% per goat. Calculate the total amount of money he received.   (2 marks)
d)   Determine his profit in Kenya shillings.   (2 marks)

24.   A straight line l_1 has a gradient $-\frac{1}{2}$ and passes through the point $(-1, 3)$. Another line l_2 passes through the points $Q\ (1, -3)$ and $R\ (4, 5)$ Find:
a)   (i)   The equation of l_1 in the form $y = mx + c$, where m and c are constants.   (2 marks)
      (ii) Hence find the y intercept of line l_1 (1 mark)
b)   (i)   The gradient of l_2 (1 mark)
      (ii) The equation of l_2 in the form $ax + by = c$, where a, b and c are integral values. (2 marks)
c)   The equation of a line passing through a point $(0, 5)$ and perpendicular to l_2.   (3 marks)
d)   Calculate the acute angle that l_3 makes with the x-axis.   (1 mark)

MURANG'A SOUTH PREMOCK EXAMINATION
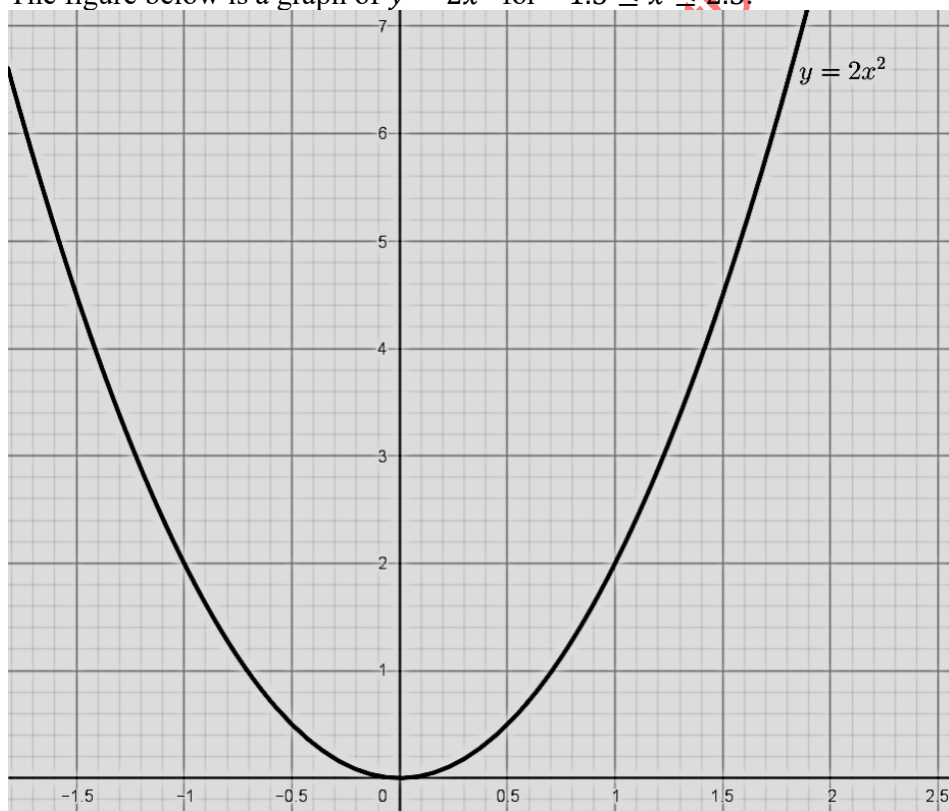**Kenya Certificate of Secondary Education, 2023**
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MATHEMATICS
PAPER 1
TIME: 2½ HOURS
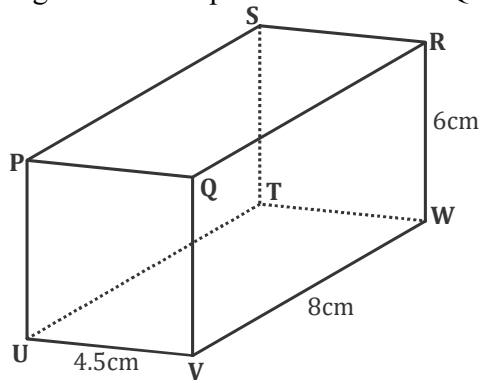**SECTION I (50 Marks)**
Answer all questions in this section.

1. Without using mathematical tables or a calculator, evaluate:
   $2\log 5 - \frac{1}{2}\log 16 + 2\log 40$. (3 marks)

2. a) Expand and simplify the binomial expression $(2 + x)^5$ upto the term in x^3. (2 marks)
   b) Use your expression to estimate the value of $(1.97)^5$ (2 marks)

3. Find the interest on Ksh. 200,000 for 2 years at 14% per annum compounded semi-annually. (3 marks)

4. At point A, Grace observed the top of a flag post at an angle of 30°. After walking 25 m towards the foot of the flag post, she stopped at point B where she observed it again at angle of 60°. Find the height of the flag post. (3 marks)

5. Simplify $\frac{\sqrt{5}}{\sqrt{7}-\sqrt{2}}$ (2 marks)

6. (a) Find the range of values of x which satisfies the following inequalities simultaneously (3 marks)
   $4x - 9 \leq x + 6$
   $4 + x \geq 8 - 3x$
   (b) Represent the range of values of x in (a) above on a number line. (1 mark)

7. Make t the subject of the formula; $s = ut + \frac{1}{2}at^2$ (3 marks)

8. A trader mixes 350 kg of beans type A costing Sh. 84 per Kg with 140 kg of beans type B costing Sh. 105 per Kg. Calculate the selling price per kg of the mixture if the trader makes a profit of 25% (3 marks)

9. The figure below is a graph of $y = 2x^2$ for $-1.5 \leq x \leq 2.5$.

Use the graph to find the gradient at:
   (i) $x = 1.5$ (2 marks)
   (ii) $x = -0.8$ (2 marks)

10. Given the function $y = 2\cos(x + 30°)$ for $0° \leq x \leq 540°$, state:
    i. The period (1 mark)
    ii. The phase angle (1 mark)

11. Determine the interquartile range for the following set of numbers (2 marks)
    10, 15, 14, 17, 12, 13

12. The diagram below represents a cuboid PQRSTUVW in which UV = 4.5cm, VW = 8cm and WR = 6cm

   Calculate the size of the angle between the lines UR and UW (3 marks)

13. Given that $r = i + 2j - k, s = 4i - j + 2k, t = 2i + 3k$ and O is the origin, determine the coordinates of P if $OP = r - 3s + t$. (3 marks)

14. Bag contains 14 beads of which x are red and the remainder blue. When 4 Red beads are removed, the probability of selecting a red bead is $\frac{2}{5}$. Find the value of x (3 marks)

15. Calculate the area of the unshaded region given that AC is an arc of a circle centre B. Given that AB = BC = 14cm, CD = 8cm and angle $ABD = 75°$ (3 marks)

16. If $A = 2.3, B = 8.7$ and $C = 2.2$, find the percentage error in $\frac{A+B}{C}$ (4 marks)

SECTION B (50 Marks)

17. The mass, m, grams of a cylinder varies jointly as the square of its radius, r, and its height, h.
a) Find the percentage change in the mass if the radius is tripled and the height is halved. (3 marks)
b) Given that $m = 990g$ when $r = 3cm$ and $h = 7cm$;
i. Find the equation connecting m, r and h. (3 marks)
ii. Calculate the value of m when r =3.5cm and h =5cm. (2 marks)
c) Taking $\pi = \frac{22}{7}$ calculate the density of the cylinder (2 marks)

18. The table below shows the distribution of marks scored by 60 students in a test.

Marks	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Frequency	2	5	6	10	14	11	9	3

a) On the grid provided draw a cumulative frequency curve of the data. (3 marks)
   (Take 1cm to represent 5 students on the vertical scale and 1 cm to represent 10 marks on the horizontal scale).
b) From the curve in (a) above
i. Estimate the median mark (1 mark)
ii. Determine the quartile deviation. (2 marks)
iii. Determine the 10th and 90th percentile range. (2 marks)
c) It is given that students who score over 45 marks pass the test. Use your graph in (a) above to estimate the percentage of students that pass. (2 marks)

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19. Seats in the theatre area arranged in rows. The number of seats in this theatre form the terms of an arithmetic series.

The sixth row has 23 seats and the fifteenth row has 50 seats. The theatre has 20 rows in total. Find:
i. The number of seats in the first row. (4 marks)
ii. The number of seats in the eleventh row. (2 marks)
iii. The number of seats in this theatre. (4 marks)

20. The figure below represents a model of a solid structure in the shape of a frustum of a cone with a hemispherical top. The diameter of the hemispherical part is 70cm and is equal to the diameter of the top of the frustum. The frustum has a base diameter of 30 cm and slant height of 60 cm (use $\pi = 3.142$)

Calculate
a) The area of the hemispherical surface. (2 marks)
b) The slant height of cone from which the frustum was cut. (2 marks)
c) The surface area of the frustum. (2 marks)
d) The area of the base (2 marks)
e) The total surface area of the model. (2 marks)

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

Taxable Income (Ksh per month)	Tax Rate (%)
0 – 13 450	10
13 451 – 26 350	15
26 351 – 39 250	20
39 251 – 52 150	25
52 151 *and above*	30

In that year, the monthly earnings for Amilo were as follows: basic salary Ksh 35 500, House allowance Ksh 12 600 and other allowances that amount to Ksh. 5 872 were exempted from taxation. Amilo contributes 12.5% of her basic salary to a pension scheme. She is entitled to a personal tax relief of Ksh 1 845 per month. Calculate:

(a) Amilo's taxable income in Ksh per month. (2 marks)
(b) Amilo's P.A.Y.E that month. (5 marks)
(c) Amilo's net pay that month, given that the following are deducted monthly from her salary; (3 marks)
NHIF – Ksh 1000,
Union dues – Kshs 455
BBF – Ksh 200.

22. Machine K makes 45% of the biscuits. Machine J makes 30% of the biscuits. The rest of the biscuits are made by machine L. It is known that 2% of the biscuits made by machine J are broken, 3% of the biscuits made by machine K are broken and 5% of the biscuits made by machine L are broken. A biscuit is selected at random.
a. Draw a tree diagram to illustrate all the possible outcomes and associated probabilities. (2 marks)
b. Using the tree diagram, calculate the probability that the biscuit is:
i. Made by machine J and is not broken. (3 marks)
ii. Broken. (3 marks)
iii. Broken but not made by machine K. (2 marks)

23. The diagram below shows a circle center **O.** BF is a tangent to the circle at **B.** Angle $DAC = 20^0$ and angle $FBD = 50^0$

Giving reasons in each case, find;
a) Angle AEC (2 marks)
b) Angle CAB (2 marks)
c) Angle ADB (2 marks)
d) Angle BCD (2 marks)
e) Angle AOB (**reflex**) (2 marks)

24. The figure below shows two circles centres A and B and radii 6 cm and 8 cm respectively. The circles intersect at P and Q. Angle PAB = 42^0 and angle ABQ = 30^0.

(a) Find the size of angle PAQ and angle PBQ. (2 marks)
(b) Calculate, to one decimal place the area of:
i. Sector APQ and PBQ. (2 marks)
ii. Triangle APQ and PBQ. (2 marks)
iii. The shaded area (Take $\pi = \frac{22}{7}$) (4 marks)

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MURANG'A SOUTH PREMOCK EXAMINATION
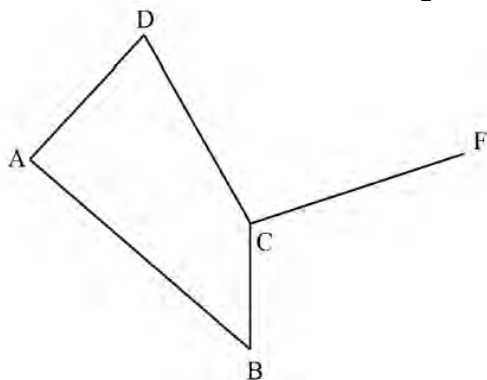Kenya Certificate of Secondary Education, 2023
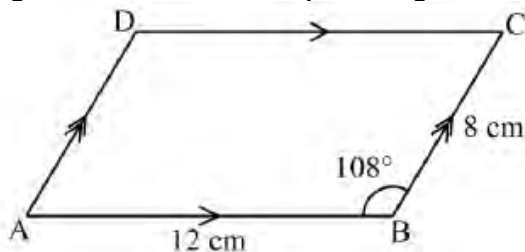121/1
MATHEMATICS
PAPER 1
TIME: 2½ HOURS

SECTION I (50 Marks)
Answer all the questions in this section

1. A man withdrew some money from a bank. He spent $\frac{3}{10}$ of the money on his daughter's school fees and $\frac{3}{5}$ of the remainder on his son's school fees. If he remained with Ksh 10 500, calculate the amount of money he spent on son's school fees. (3 marks)

2. Solve for x (3 marks)
$9^{(x+1)} + 3^{(2x+1)} = 108$

3. The volume of two similar solid spheres are 4752 cm³ and 1408 cm³. If the surface area of the smaller sphere is 352 cm², find the surface area of the larger sphere. (3 marks)

4. The figure below represents a sketch of the cross – section of a solid ABCDEFGH and its edge CF. Complete the sketch of the solid showing the hidden edges using dotted lines. (3 marks)

5. When a given length of a piece of wire is divided into pieces measuring 20 cm or 24 cm or 26 cm or 28 cm, a piece of wire 7cm always remained. Find the length of wire. (4 marks)

6. Solve the equation $6x^2 - 13x + 6 = 0$ using the completing the square method. (3 marks)

7. Using a ruler and a pair of compasses only, construct a trapezium ABCD in which $AB = 5\ cm$, $AD = 6\ cm$, $DC = 10\ cm$, $\angle BAD = 105°$ and AB is parallel to DC. Draw a perpendicular from B to DC hence measure the height of the trapezium. (4 marks)

8. Given that $\tilde{a} = 2p - \frac{3}{4}q$ where $p = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ and $q = \begin{pmatrix} 16 \\ 4 \end{pmatrix}$ Find column vector $\tilde{a}$. (2 marks)

9. Two friends Ojwang and David live 40 km apart. One day Ojwang left his house at 9.00 a.m. and cycled towards David's house at an average speed of 15 km/h. David left his house at 10.30 a.m. on the same day and cycled towards Ojwang's house at an average speed of 25 km/h. Determine;

i. The time taken before the two friends met. (3 marks)
ii. The time they met. (1 mark)

10. In the figure below, ABCD is a parallelogram in which AB = 12 cm, BC = 8 cm and angle ABC = 108°.

Calculate the area of the parallelogram correct to 3 significant figures. (3 marks)

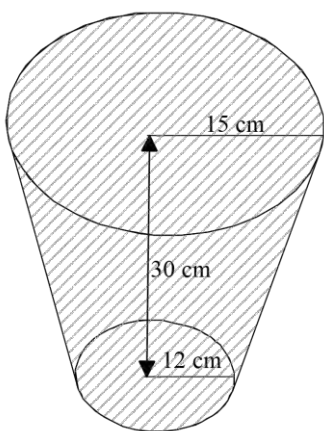11. Without using mathematical tables or a calculator evaluate. (3 marks)
$$\frac{\tan 30°\ \tan 60°}{\sin 60°\ \cos 30°}$$

12. Given that $M = \begin{pmatrix} 4 & 5 \\ 2 & 3 \end{pmatrix}$ and $N = \begin{pmatrix} -2 & 3 \\ 1 & -1 \end{pmatrix}$, find $M^{-1}N$ (3 marks)

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13. Simplify completely; $\dfrac{(m+5n)^2+(m-5n)^2}{3m^2+75n^2}$ (3 marks)

14. Use logarithms to evaluate. (3 marks)
    $\dfrac{39.51 \times 614}{0.758}$

15. Dr. June needs to import a car from Japan that costs US dollars (USD) 5 000 outside Kenya. He intends to buy the car through an agent who deals in Japanese Yen (JPY). The agent charges a 20% commission on the price of the car and a further 80 325 JPY for shipping the car to Kenya. Find the amount in Kenya shillings that Dr. June will need to send to the agent to get the car given that 1 USD = Ksh. 120 and 1USD = 135 JPY (3 marks)

16. In a right angled triangle, the two sides enclosing the right angle measure $(3x - 2)$cm and $(x + 2)$ cm. If the area of the triangle is $17.5 \, cm^2$, find the length of these two sides. (3 marks)

SECTION II (50 Marks)
Answer any five questions only in this section

17. The diagram below shows a frustum which represents a bucket with an open end diameter of 30 cm and bottom diameter 24 cm.

15 cm

30 cm

12 cm

The bucket is 30cm deep. (Use $\pi = 3.142$)
(a) Calculate the capacity of the tank in litres. (5 marks)
(b) The bucket is used to fill an empty cylindrical tank of diameter 1.4m and height 1.2m.
i. Calculate the capacity of the tank in litres. (3 marks)
ii. Determine the number of buckets that must be drawn in order to fill the tank. (2 marks)

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a) Taking a scale of 1cm to represent 100Km, give a scale drawing showing the relative positions of P, Q, R and S. (4 marks)
b) Use the scale drawing to find the bearing of:
(i) Island R from island P (1 mark)
(ii) Port S from island R (1 mark)
c) Find the distance between island P and R (2 marks)
d) A warship T is such that it is equidistant from the islands P, S and R. by construction locate the position of T. (2 marks)

19. The vertices of a triangle ABC are A(1,1), B(4,1) and C(6,4)
a) On the grid below, draw the triangles.
i. ABC. (1 mark)
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b) Triangle $A'''B'''C'''$, with vertices $A'''(-1, -5)$ $B'''(-4, -5)$ and $C'''(-6, -2)$, is the image of , triangle $A''B''C''$, under a transformation **T**.
i. Draw the triangle $A'''B'''C'''$, (1 mark)
ii. Describe fully the transformation **T**. (2 marks)

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c) State **any** pair of triangles which are:
i. Directly congruent. (1 mark)
ii. Oppositely congruent. (1 mark)

20. The figure below shows a triangle inside a circle. $AB = 8\ cm, BC = 10\ cm$ and $AC = 13cm$

Calculate
(a) The area of triangle ABC. (3 marks)
(b) Angle BAC (2 marks)
(c) The radius of the circle. (2 marks)
(d) Area of the shaded region. (3 marks)

21. (a) Complete the table below for the function $y = x^3 - 5x^2 + 2x + 9$ for $-2 \le x \le 5$ (2 marks)

x	-2	-1	0	1	2	3	4	5
y			9					

(b) On the grid provided, draw the graph of $y = x^3 - 5x^2 + 2x + 9$ for $-2 \le x \le 5$ (3 marks)
(c) Use the graph in (b) above to find the roots of the following equations:
i. $x^3 - 5x^2 + 2x + 9 = 0$ (2 marks)
ii. $x^3 - 5x^2 + 6x = -5$ (3 marks)

22. A construction company makes concrete by mixing cement, sand and ballast such that the ratio of cement to sand is 1:2 and that of sand to ballast is 3:4.
a) Determine:
(i) The ratio of cement to ballast in the concrete. (2 marks)
(ii) The number of bags of ballast required to make a concrete with 27 bags of sand. (2 marks)
b) The cost of a bag of cement, sand and ballast is Ksh 680, Ksh 136 and Ksh 102 respectively. Calculate the cost of one bag of concrete. (2 marks)
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b) Use matrix method to determine the cost of a cow and that of a goat. (4 marks)
c) The trader sold the animals he had bought making a profit of 40% per cow and 45% per goat. Calculate the total amount of money he received. (2 marks)
d) Determine his profit in Kenya shillings. (2 marks)

24. A straight line l_1 has a gradient $-\frac{1}{2}$ and passes through the point $(-1, 3)$. Another line l_2 passes through the points $Q\ (1, -3)$ and $R\ (4, 5)$ Find:
a) (i) The equation of l_1 in the form $y = mx + c$, where m and c are constants. (2 marks)
(ii) Hence find the y intercept of line l_1 (1 mark)
b) (i) The gradient of l_2 (1 mark)
(ii) The equation of l_2 in the form $ax + by = c$, where a, b and c are integral values. (2 marks)
c) The equation of a line passing through a point $(0, 5)$ and perpendicular to l_2. (3 marks)
d) Calculate the acute angle that l_3 makes with the x-axis. (1 mark)

MURANG'A SOUTH PREMOCK EXAMINATION
Kenya Certificate of Secondary Education, 2023
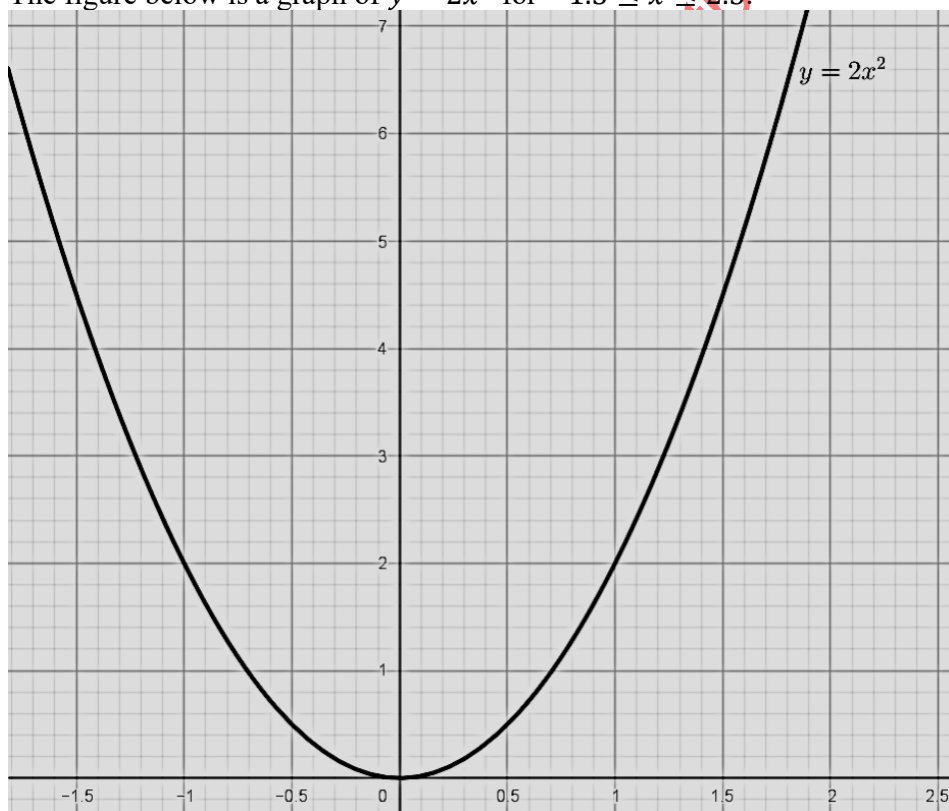121/1
MATHEMATICS
PAPER 1
TIME: 2½ HOURS
SECTION I (50 Marks)
Answer all questions in this section.

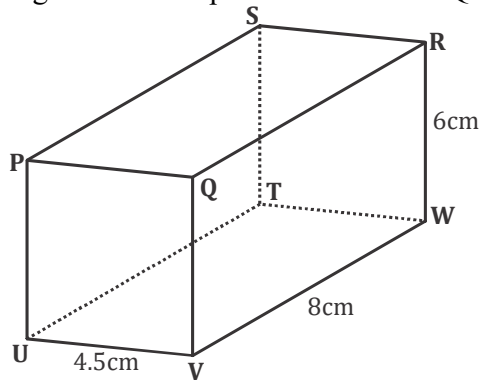1. Without using mathematical tables or a calculator, evaluate:
   $2\log 5 - \frac{1}{2}\log 16 + 2\log 40$.   (3 marks)

2. a)   Expand and simplify the binomial expression $(2 + x)^5$ upto the term in x^3.   (2 marks)
   b)   Use your expression to estimate the value of $(1.97)^5$ (2 marks)

3. Find the interest on Ksh. 200,000 for 2 years at 14% per annum compounded semi-annually.   (3 marks)

4. At point A, Grace observed the top of a flag post at an angle of 30°. After walking 25 m towards the foot of the flag post, she stopped at point B where she observed it again at angle of 60°. Find the height of the flag post.   (3 marks)

5. Simplify $\frac{\sqrt{5}}{\sqrt{7}-\sqrt{2}}$ (2 marks)

6. (a)   Find the range of values of x which satisfies the following inequalities simultaneously   (3 marks)
       $4x - 9 \leq x + 6$
       $4 + x \geq 8 - 3x$
   (b)   Represent the range of values of x in (a) above on a number line.   (1 mark)

7. Make t the subject of the formula; $s = ut + \frac{1}{2}at^2$ (3 marks)

8. A trader mixes 350 kg of beans type A costing Sh. 84 per Kg with 140 kg of beans type B costing Sh. 105 per Kg. Calculate the selling price per kg of the mixture if the trader makes a profit of 25%   (3 marks)

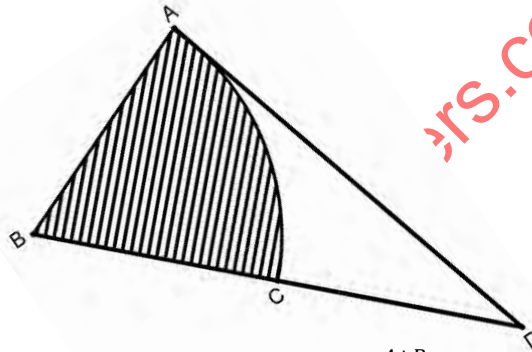9. The figure below is a graph of $y = 2x^2$ for $-1.5 \leq x \leq 2.5$.

$y = 2x^2$

   Use the graph to find the gradient at:
   (i) $x = 1.5$ (2 marks)
   (ii) $x = -0.8$ (2 marks)

10. Given the function $y = 2\cos(x + 30°)$ for $0° \leq x \leq 540°$, state:
    i.   The period   (1 mark)
    ii.   The phase angle   (1 mark)

11. Determine the interquartile range for the following set of numbers   (2 marks)
    10,15,14,17,12,13

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12. The diagram below represents a cuboid PQRSTUVW in which UV = 4.5cm, VW = 8cm and WR = 6cm

Calculate the size of the angle between the lines UR and UW (3 marks)

13. Given that $r = i + 2j - k, s = 4i - j + 2k, t = 2i + 3k$ and O is the origin, determine the coordinates of P if $OP = r - 3s + t$. (3 marks)

14. Bag contains 14 beads of which x are red and the remainder blue .When 4 Red beads are removed ,the probability of selecting a red bead is $\frac{2}{5}$ .Find the value of x (3 marks)

15. Calculate the area of the unshaded region given that AC is an arc of a circle centre B. Given that AB = BC = 14cm, CD = 8cm and angle $ABD = 75°$ (3 marks)

16. If $A = 2.3, B = 8.7 \ and \ C = 2.2$, find the percentage error in $\frac{A+B}{C}$ (4 marks)

SECTION B (50 Marks)

17. The mass, m, grams of a cylinder varies jointly as the square of its radius, r, and its height, h.
a) Find the percentage change in the mass if the radius is tripled and the height is halved. (3 marks)
b) Given that $m = 990g$ when $r = 3cm$ and $h = 7cm$;
i. Find the equation connecting m, r and h. (3 marks)
ii. Calculate the value of m when r =3.5cm and h =5cm. (2 marks)
c) Taking $\pi = \frac{22}{7}$ calculate the density of the cylinder (2 marks)

18. The table below shows the distribution of marks scored by 60 students in a test.

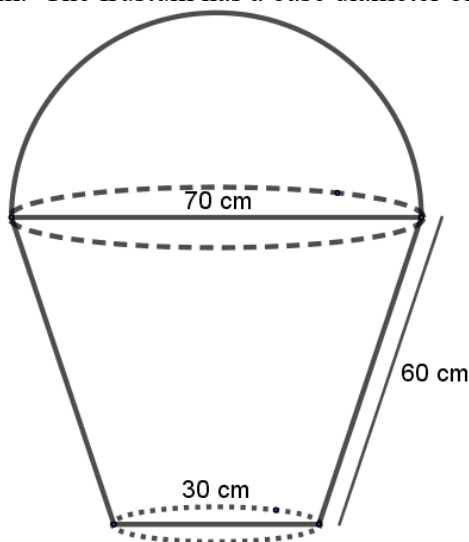| Marks	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Frequency	2	5	6	10	14	11	9	3

a) On the grid provided draw a cumulative frequency curve of the data. (3 marks)
(Take 1cm to represent 5 students on the vertical scale and 1 cm to represent 10 marks on the horizontal scale).
b) From the curve in (a) above
i. Estimate the median mark (1 mark)
ii. Determine the quartile deviation. (2 marks)
iii. Determine the 10th and 90th percentile range. (2 marks)
c) It is given that students who score over 45 marks pass the test. Use your graph in (a) above to estimate the percentage of students that pass. (2 marks)

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19. Seats in the theatre area arranged in rows. The number of seats in this theatre form the terms of an arithmetic series.

The sixth row has 23 seats and the fifteenth row has 50 seats. The theatre has 20 rows in total. Find:
i.   The number of seats in the first row.   (4 marks)
ii. The number of seats in the eleventh row.   (2 marks)
iii. The number of seats in this theatre.   (4 marks)

20. The figure below represents a model of a solid structure in the shape of a frustum of a cone with a hemispherical top. The diameter of the hemispherical part is 70cm and is equal to the diameter of the top of the frustum. The frustum has a base diameter of 30 cm and slant height of 60 cm (use $\pi = 3.142$)

Calculate
a) The area of the hemispherical surface.   (2 marks)
b) The slant height of cone from which the frustum was cut.   (2 marks)
c) The surface area of the frustum.   (2 marks)
d) The area of the base   (2 marks)
e) The total surface area of the model.   (2 marks)

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

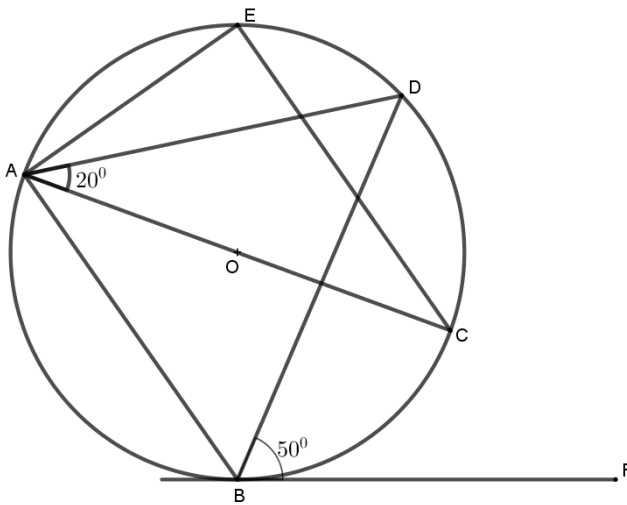| Taxable Income (Ksh per month)	Tax Rate (%)
0 – 13 450	10
13 451 – 26 350	15
26 351 – 39 250	20
39 251 – 52 150	25
52 151 *and above*	30

In that year, the monthly earnings for Amilo were as follows: basic salary Ksh 35 500, House allowance Ksh 12 600 and other allowances that amount to Ksh. 5 872 were exempted from taxation. Amilo contributes 12.5% of her basic salary to a pension scheme. She is entitled to a personal tax relief of Ksh 1 845 per month. Calculate:

(a) Amilo's taxable income in Ksh per month. (2 marks)

(b) Amilo's P.A.Y.E that month. (5 marks)

(c) Amilo's net pay that month, given that the following are deducted monthly from her salary; (3 marks)
NHIF – Ksh 1000,
Union dues – Kshs 455
BBF – Ksh 200.

22. Machine K makes 45% of the biscuits. Machine J makes 30% of the biscuits. The rest of the biscuits are made by machine L. It is known that 2% of the biscuits made by machine J are broken, 3% of the biscuits made by machine K are broken and 5% of the biscuits made by machine L are broken. A biscuit is selected at random.

a. Draw a tree diagram to illustrate all the possible outcomes and associated probabilities. (2 marks)

b. Using the tree diagram, calculate the probability that the biscuit is:

i. Made by machine J and is not broken. (3 marks)

ii. Broken. (3 marks)

iii. Broken but not made by machine K. (2 marks)

23. The diagram below shows a circle center **O.** BF is a tangent to the circle at **B.** Angle $DAC = 20^0$ and angle $FBD = 50^0$

Giving reasons in each case, find;

a) Angle AEC (2 marks)

b) Angle CAB (2 marks)

c) Angle ADB (2 marks)

d) Angle BCD (2 marks)

e) Angle AOB (**reflex**) (2 marks)

24. The figure below shows two circles centres A and B and radii 6 cm and 8 cm respectively. The circles intersect at P and Q. Angle PAB = 42^0 and angle ABQ = 30^0.

(a) Find the size of angle PAQ and angle PBQ. (2 marks)

(b) Calculate, to one decimal place the area of:

i. Sector APQ and PBQ. (2 marks)

ii. Triangle APQ and PBQ. (2 marks)

iii. The shaded area (Take $\pi = \frac{22}{7}$) (4 marks)

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12. Use reciprocal, square and square root tables to evaluate, to 4 significant figures, the expression.

$$\sqrt{\frac{1}{24.56} + 4.346^2}$$
 (3 mks)

13. Two similar cans have different heights 8cm and the other one 10cm. If the surface area of the larger can is 480cm^2, find the surface area of the smaller can. (3 marks)

14. Given that cos A = $^5/_{13}$ and angle A is acute, find the value of:-

   2 tan A + 3 sin A (3 mks)

15. Two circles of radii 4cm and 6cm intersect as shown below. If angle XBY = 30º and angle XAY = 97.2º. Find the area of the shaded part. (4 mks)

   (Take $\pi = \frac{22}{7}$)
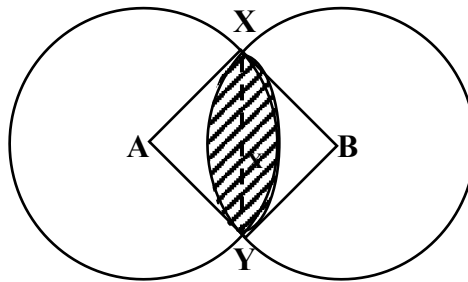
16. Find scalars **m** and **n** such that

   $$m \begin{pmatrix} 4 \\ 3 \end{pmatrix} + n \begin{pmatrix} -3 \\ 2 \end{pmatrix} = \begin{pmatrix} 5 \\ 8 \end{pmatrix}$$

   ## SECTION 2
   ## (Answer only five questions in this section – 50 MARKS)

17. The examination marks in a mathematics test for 60 students were as follows; -

60	54	34	83	52	74	61	27	65	22
70	71	47	60	63	59	58	46	39	35
69	42	53	74	92	27	39	41	49	54
25	51	71	59	68	73	90	88	93	85
46	82	58	85	61	69	24	40	88	34
30	26	17	15	80	90	65	55	69	89

| Class	Tally	Frequency	Upper class limit
10-29			
30-39			
40-69			
70-74			
75-89			
90-99			

From the table;

(a) State the modal class

(b) On the grid provided, draw a histogram to represent the above information

18. The table below gives the values of x and y for the curve $y = x^2 + 1$

x	0	1	2	3	4	5	6	7	8	9	10
y	1	2		10	17		37	50		82	

a) Complete the table (2 mks)

b) Use the mid- ordinate rule to estimate the area enclosed by the curve $y = x^2 + 1$. Use five coordinates. (3 mks)

c) Using integration, calculate the actual area in (a) above (3 mks)

d) Calculate the percentage error in the estimated area. (2 mks)

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19. a) Find the angle θ in degrees from the figure below
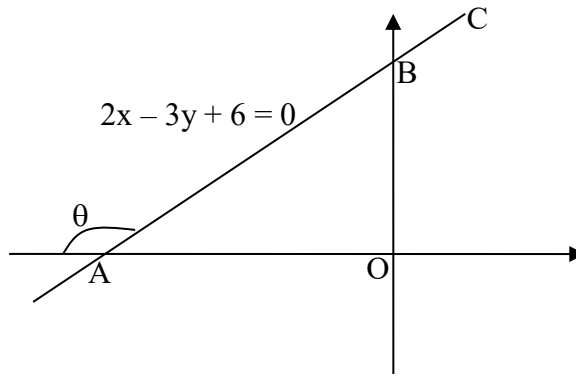
b) In the diagram below, determine the equation of the line **XY** in the form **y = mx + c**
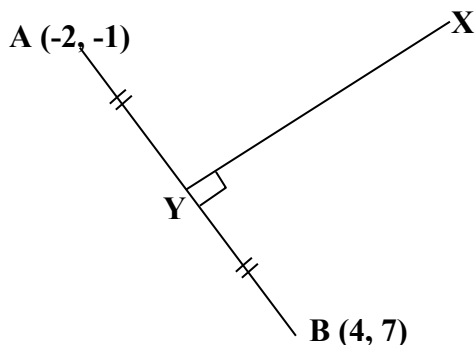
c) Find the equation of a line which passes through the point (2, 3) and is parallel to y – 3x+ 1 = 0, giving your answer in the form $\frac{x}{a} + \frac{y}{b} = 1$.

20. Four towns P, R, T and S are such that R is 80km directly to the north of P and T on a bearing of 290^0 from P at a distance of 65km. S is on a bearing of 330^0 from T and a distance of 30km. Using a scale of 1 cm to represent 10km, make an accurate scale drawing to show the relative position of the towns. (4mks)
Find:
a) The distance and the bearing of R from T (3mks)
b) The distance and the bearing of S from R (2mks)
c) The bearing of P from S (2mks)

21. A cylindrical water tank is of diameter 14 metres and height 3.5 metres.
    (a) Find the capacity of the water tank in litres. (3mks)
    (b) Six members of a family use 20 litres each per day. Each day 80 litre are used for cooking and washing. A further 50 litres is wasted daily. Find the number of complete days a full tank would last the family. (3mks)
    (c) Two members of the family were absent for 90 days. During this time, wasting was reduced by 20% as cooking and washing remained the same. Calculate the number of days a full tank would now last the family. (4mks)

22. A bus and a matatu left Nairobi for Meru, 240 km away at 8.00 A.M. They travelled at 90km/h and 120km/h respectively. After 20 minutes the matatu had a puncture which took 30 minutes to mend. It then continued with the journey.
    a) How far from Nairobi did the matatu catch up with the bus? (6mks)
    b) At what time did the matatu catch up with the bus (2mks)
    c) At what time did the bus reach Moi's Bridge? (2mks)

23. Wanjiku is standing at a point P, 160m south of a hill H on a level ground. From point P she observes the angle of elevation of the top of the hill to be 67^0

    (a)   Calculate the height of the hill (3 mks)

    (b)   After walking 420m due east to the point Q, Wanjiku proceeds to point R due east of Q, where the angle of elevation of the top of the hill is 35^0. Calculate the angle of elevation of the top of the hill from Q (3 mks)

    (c)   Calculate the distance from P to R (4 mks)

24.   (a)   Find the inverse of the matrix. (2 mks)

$$\begin{bmatrix} 2 & 5 \\ 4 & 3 \end{bmatrix}$$

    (b)   A transport company has two types of vehicles for hire: Lorries and buses. The vehicles are hired per day. The cost of hiring two lorries and five buses is Sh. 156,000 and that of hiring 4 lorries and three buses is Sh. 137,000.

    (i)   Form two equations to represent the above information. (2 mks)

    (ii)   Use matrix method to determine the cost of hiring a lorry and that of hiring a bus. (3 mks)

    (c)   Find the value of x given that $\begin{bmatrix} 2x - 1 & 1 \\ x^2 & 1 \end{bmatrix}$ is a singular matrix (3 mks)

GATUNDU SOUTH EXAMINATIONS, 2023
KENYA CERTIFICATE OF SECONDARY EDUCATION
121/2
MATHEMATICS
PAPER 2
TIME: 2½ HOURS

SECTION A (50 MARKS)

1. Evaluate using reciprocals, square and square root tables only.

$$\sqrt{\frac{(445.1 \times 10^{-1})^2 + 1}{0.07245}}$$ (3mks)

2. Solve the simultaneous equation (4mks)
   $$2x - y = 3$$
   $$x^2 - xy = -4$$

3. The product of a and $\sqrt[3]{b}$ is 31.59. Given that logarithm of a is 2.6182. Find using logarithm the value of b. to 4 significant figures. (4mks)

4. If $\tan \theta = {}^8/_{15}$, find the value of $\dfrac{\textbf{Sinθ} - \textbf{Cosθ}}{\textbf{Cosθ} + \textbf{Sinθ}}$ without using a calculator or table (3mks)

5. Given that $25x^2 - 20x + k$ is a perfect square. Find the value of k. (2 mks)

6. Given the points P(-6, -3), Q(-2, -1) and R(6, 3) express PQ and QR as column vectors. Hence show that the points P, Q and R are collinear. (3mks)

7. The length and breadth f a rectangular room are 15cm and 12 cm respectively. If each of these measurements is liable to 1.5% error, calculate the absolute error in the perimeter of the room (3 mks)

8. Find the value of **y** which satisfies the equation
   $\text{Log }_{10} 5 - 2 + \log_{10} (2y + 10) = \log_{10} (y - 4)$ (4 mks)

9. In the figure below not drawn to scale. DC is a tangent to the circle. DC = 6cm, AB = 5cm. Calculate BC. (3mks)
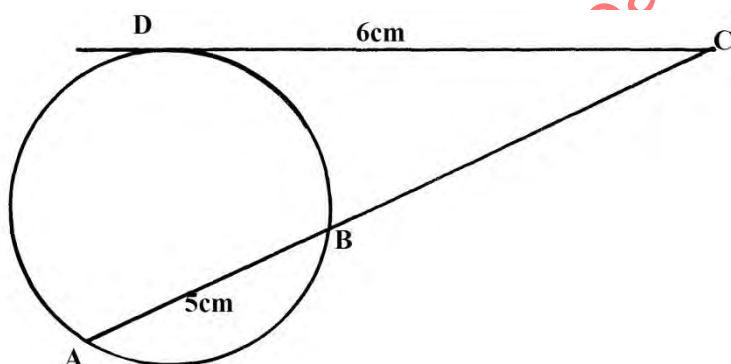
10. Make **b** the subject of the formula. 3mks
    $$a = \frac{bd}{\sqrt{b^2 + d}}$$

11. a) Using binomial expansion, determine the first five terms of the expansion: $\left(2 - {}^1\!/_x\right)^8$ (2mks)

    b) Use the expansion above to evaluate $(1.75)^8$ (2mks)

12. A globe representing the earth has a radius of 0.2m. Points P (60^0N, 140^0E) and Q (60^0N, 120^0W) are marked on the globe. If O is the centre of the latitude 60^0N, find the area of the minor sector OPQ (3 mks)

13. Show that $4y^2 + 4x^2 = 12x - 12y + 7$ is the equation of a circle, hence find the co-ordinates of the centre and the radius. 3mks

14. A quantity V is partly constant and partly varies as U. If U = 1 when V = 12 and U = 3 when r = 22. Find the V when U = 5. (3 marks)

15. The surface area of two similar bottles are 12cm² and 108cm² respectively. If the larger one has a volume of 810cm³. Find the volume of the smaller one 2mks

16. A two-digit number is formed from the first four prime numbers.
    a) Draw the table to show the possible outcomes, if each number can be used only once. (1mk)
    b) Calculate the probability that a number chosen from the digit numbers is an even number (2mks)

SECTION II (50 marks)
*Answer only **five** questions from this section.*

17. John bought 3 brands of tea A, B and C. The cost price of the three brands were Sh. 25, Sh. 30 and Sh. 45 per kilogram respectively. He mixed the three brands in the ratio 5:2:1 respectively. After selling the mixture he made a profit of 20%.
    (a) How much profit did he make per kilogram of the mixture?   (4 marks)
    (b) After one year the cost price of each brand was increased by 12%.
    (i) For how much did he sell one kilogram of the mixture to make 20% profit? Give your answer to the nearest 5cts   (3 marks)
    (ii) What would have been his percentage profit if he sold one kilogram of the mixture at Sh. 40.25?   (3mks)

18. (a) Fill in the table below for the function $y = -6 + x + 4x^2 + x^3$ for $-4 \leq x \leq 2$ **2mks**

x	-4	-3	-2	-1	0	1	2
-6	-6	-6	-6	-6	-6	-6	-6
x	-4	-3	-2	-1	0	1	2
$4x^2$			16			4	
x^3							
y							

(b) Using the grid provided draw the graph for $y = -6 + x + 4x^2 + x^3$ for $-4 \leq x \leq 2$ **3mks**
(c) (i) Use the graph to solve the equations: -
    (i) $x^3 + 4x^2 + x - 4 = 0$ 2mks
    (ii) $-6 + x + 4x^2 + x^3 = 0$ 1mk
    (iii) $-2 + 4x^2 + x^3 = 0$ 2mk

19. On the grid provided, draw triangle PQR with P(2,3), Q(1,2) and R(4,1). On the same axes draw triangle $P^{11}Q^{11}R^{11}$ with vertices $P^{11}(-2,3)$, $Q^{11}(-1,2)$ and $R^{11}(-4,1)$.   (2mks)
    (a) Describe fully a single transformation which will map triangle PQR onto triangle $P^{11}Q^{11}R^{11}$.   (1mk)
    (b) On the same plane, draw triangle $P^1Q^1R^1$ the image of triangle PQR under reflection in the line y = -x.   (2mks)
    (c) Describe fully a single transformation which maps triangle $P^1Q^1R^1$ onto triangle $P^{11}Q^{11}R^{11}$.   (2mks)
    (d) Draw triangle $P^{111}Q^{111}R^{111}$ such that it can be mapped onto triangle PQR by a position quarter about (0,0)   (2mks)
    (e) State all pairs of triangles that are oppositely congruent.   (1mk)

20. 40 form four students sat for a mathematics test and their marks were distributed as follows:

Marks	1 – 10	11- 20	21- 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80	81 – 90	91 - 100
No. of students	1	3	4	7	12	9	2	1	0	1

a) Using 45.6 as the working mean, calculate;
i) The actual mean.   4mks
ii) The standard deviation.   3mks
b) When ranked from first to last, what mark was scored by the 30th student? (Give your answer correct to 3 s.f.)   3mks

21. Use ruler and a pair of compasses only in this question.
    (a) Construct triangle ABC in which AB = 7 cm, BC = 8 cm and $\angle ABC = 60^0$.   3mks
    (b) Measure (i) side AC (ii) $\angle$ ACB   2mks
    (c) Construct a circle passing through the three points A, B and C. Measure the radius of the circle.   2mks
    (d) Construct Δ PBC such that P is on the same side of BC as point A and $\angle$ PCB = ½ $\angle$ ACB, $\angle$ BPC = $\angle$ BAC measure $\angle$ PBC.   3mks

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22. The figure below is a pyramid of a rectangular base PQRS of length 12cm and width 9cm. The slanting edge has a length of 19.5cm
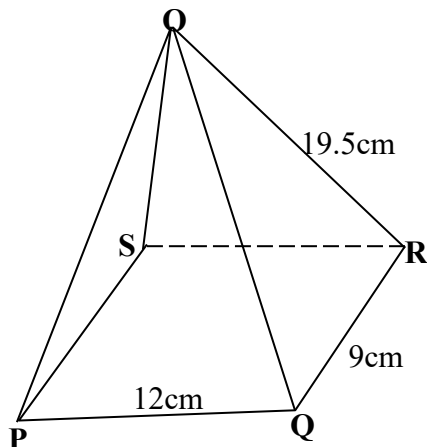
   (a) Determine the height of the pyramid   2mks
   (b) The angle PO makes with base PQRS   3mks
   (c) The angle POS makes with QOR   3mks
   (d) The volume of the pyramid   2mks

23. A company produces shirts and jerseys using two types of machines. Every shirt made requires 2 hours on machine **A** and 2 hours on machine **B**. Every Jersey made requires 3 hours on machine **A** and I hour on machine **B**. In one day, the time limit on machine **A** is 24hours but that on machine **B** is 12hrs. The number of Jerseys produced must not be more than the shirts produced in one day. The company makes a profit of shs.200 on each shirt and shs.200 on each Jersey. The company produces x shirts and **y** jerseys per day
   (a) Write down four inequalities which must be satisfied by **x** and **y**   **4mks**
   (b) Represent these inequalities on a grid   4mks
   (c) Find the values of **x** and **y** which will give the company maximum daily profit and also state the maximum profit   2mks

24. A particle **P** moves in a straight line so that its velocity, Vm/s at time t seconds where $t \geq 0$ is given by $v = 28 + t - 2t^2$
   Find;
   (a) the time when **P** is instantaneously at rest   2mks
   (b) the speed of **P** at the instant when the acceleration of **P** is zero   2mks
   (c) Find the acceleration of **P** when the article is instantaneously at rest 3mks
   (d) Find the distance covered by the particle during the 3rd second, when at t = 0 D = 5M 3mks

GATUNDU SOUTH EXAMINATIONS, 2023
KENYA CERTIFICATE OF SECONDARY EDUCATION
121/1
MATHEMATICS
PAPER 1
TIME: 2½ HOURS
SECTION 1
(Answer all the questions – 50 marks)

1. Evaluate $\dfrac{-12 \div (-3) \times 4 - (-15)}{-5 \times 6 \div 2 + (-5)}$ (3 marks)

2. Simplify $\dfrac{2y^2 - xy - x^2}{2x^2 - 2y^2}$ (3mks)

3. A watch which loses a half-minute every hour was set to read the correct time at 0445h on Monday. Determine the time in 12-hour system, the watch will show on the following Friday at 1845h (3mks)

4. Three angles of a polygon are 125,140 and 160. The remaining angles are 145^0 each. Calculate the sum of the interior angles of the polygon. (3 mks)

5. Find the integral values of the inequalities $x \leq 2x + 7 \leq {}^{-1}/_3 x + 14$ hence represent the solution on a number line. (3mks)

6. Evaluate without using a calculator. (3mks)

$$\dfrac{\left(1\frac{3}{7} - \frac{5}{8}\right) \times \frac{2}{3}}{\frac{3}{4} + 1\frac{5}{7} \div \frac{4}{7} \, of \, 2\frac{1}{3}}$$

7. Find the value of y in the equation. (4mks)

$$\dfrac{243 \times 3^{2y}}{729 \times 3^y \div 2^{(2y-1)}} = 81$$

8. The position vectors of A and B are given as $\mathbf{a} = 2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$ and $\mathbf{b} = -2\mathbf{i} - \mathbf{j} + 2\mathbf{k}$ respectively. Find to 2 decimal places, the length of vector **AB**. (3 Marks)

9. Foreign exchange on 27/5/2010 was given as follows:

Currency	Buying (Kshs)	Selling (Kshs)
1 Euro	84.15	84.26
1 Sterling pound	118.35	121.47

A tourist came to Kenya from London with 6000 Euros which he converted to Kenya shillings at a bank. While in Kenya he spent a total of Kshs.300,000 then converted the balance into sterling pounds at the Same bank. Calculate the amount in sterling pounds he received. (3 mks)

10. Use ruler and a pair of compasses only in this question.
    (a) Construct triangle ABC in which AB = 7 cm, BC = 8 cm and ∠ABC = 60^0. (2 mks)
    (b) Measure side AC (1 mk)

11. In the figure below ABCD is a trapezium with DC parallel to AB. DC = 5cm, CB = 4cm, BD = 8cm and AB = 10cm
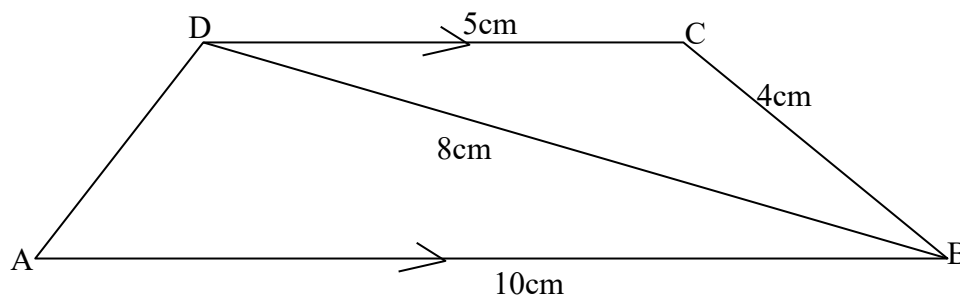
Calculate:
    (a) the size of angle BDC (2 mks)
    (b) the area of triangle ABD (1 mk)

MECS I JOINT EXAMINATIONS, 2023
Kenya Certificate of Secondary Education
121/1
**MATHEMATICS**
PAPER 1
2½ HOURS
TERM ONE

SECTION I(50marks)
*Answer all the questions in this section*

1. The sum of four consecutive odd integers is less than 64. Determine the first four such integers. (3 marks)

2. Solve the equation (3marks)
$$\frac{2}{t-1} - \frac{1}{t+2} = \frac{1}{t}$$

3. Moses has twenty shillings more than Jane. After he spends a quarter of his money and Jane ⅕ of hers, they find that Jane has 10 shillings more than Moses. How much money did both have? (4 marks)

4. The sum of interior angles of two regular polygons of side n-1 and n are in the ratio 4:5. Calculate;
   (i) The size of interior angle of the polygon with side (n-1) (2 marks)
   (ii) The size of exterior angle of the polygon with side (n-1) (1 mark)

5. The figure below is a rhombus ABCD of sides 4cm. BD is an arc of circle center C. Given that ∠ABC = 138^0. Find the area of shaded region correct to 3 significant figures. (Take $\pi=\frac{22}{7}$) (3 marks)
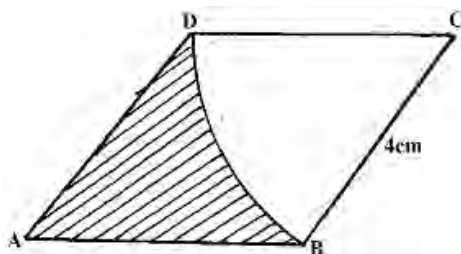
6. Find the greatest common factor of x^3y^2 and $4xy^4$. Hence factorise completely the expression $x^3y^2 - 4xy^4$
   . (3 marks)

7. The figure below is a part of the sketch of a triangular prism ABCDEF.
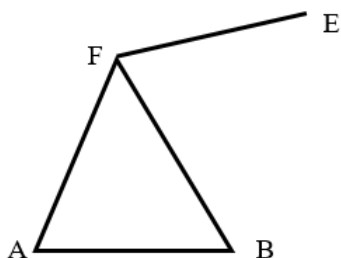
   Complete the sketch by drawing the hidden edges using broken lines. (3 marks)

8. Without using calculator, solve for n in the equation $1 - \left(\frac{1}{3}\right)^n = \frac{242}{243}$ (3marks)

9. Given that $OA = \begin{pmatrix} -2 \\ 10 \end{pmatrix}$ and $OB = \begin{pmatrix} x \\ -2 \end{pmatrix}$ and that the magnitude of AB is 13 units, find the possible values of x. (3marks)

10. Ali travelled a distance of 5km from village A to village B in direction of N60^0E. He then changed direction and travelled a distance of 4km in the direction of 135^0 to village C.
a) Using a scale of 1cm to represent 1.0 km represent the information on an accurate diagram. (2marks)
b) Using scale drawing in (a) above determine
(i) The distance between A and C (1mk)
(ii) The bearing of A from C (1mk)

11. Three numbers p, q and r are such that p³ × q² × r = 2250. Find p, q and r. (3 marks)

12. A bus starts off from Kitale at 9.00 a.m and travels towards Kakamega at a speed of 60km/hr. At 9.50 a.m, a matatu leaves Kakamega and travels towards Kitale at a speed of 60Km/h. If the distance between the two towns is 150km, how far from Kitale will the two vehicles meet? (3marks)

13. Find the inequalities that satisfy the region R shown in the figure below. (3 marks)
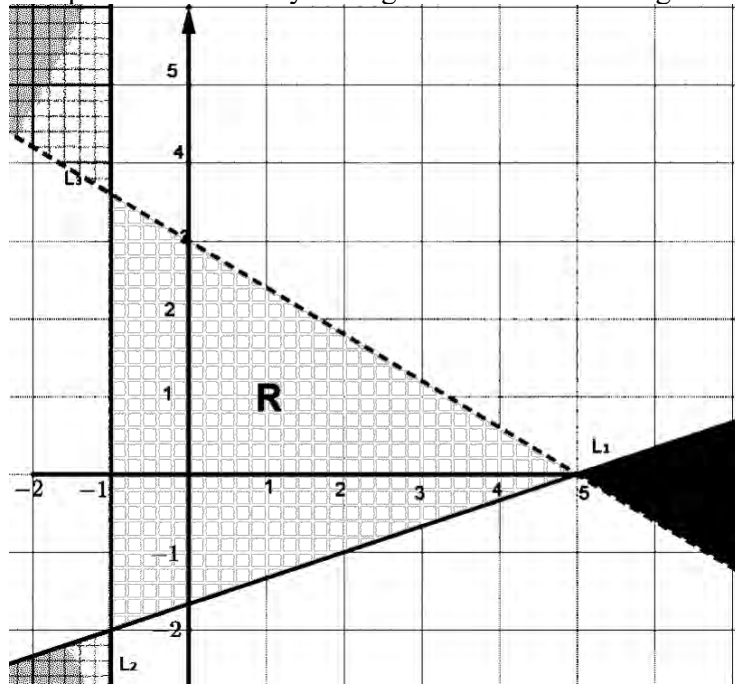
14. A dealer sells a certain spare part for Kshs 650, making a profit of 30%. The manufacturer reduces the price to the dealer by Kshs 50 and the dealer reduces his selling price by the same amount. Find the dealer's new percentage profit. (3marks)

15. A taxi travelling at 20m/s accelerates uniformly and in 4 seconds, its velocity is 30m/s. it maintains this velocity for another 5 seconds before decelerating uniformly to rest after 3 seconds. Calculate the total distance travelled by the taxi during the journey. (3marks)

16. The length of a rectangle is $(x + 3)$ cm. If the width of the rectangle is two thirds its length and the perimeter is 40 cm, find its width. (3 marks)

SECTION II
Answer only five questions in this section

17. A sales agents earns a basic salary of Kshs. 20,000 per month. In addition, he is entitled for a commission for sales in excess of Kshs. 200,000 as follows:

Sales	Commission
0-200,000	0%
200,001-300,000	1.5%
300,001-400,000	3.0%
400,001-500,000	4.5%
Above 500,000	6.0%

(a) On the month of April 2019, her total sales were Kshs. 558,200. Determine his total earnings that month. (4marks)

(b) On the month of May 2020, his sales increase in the ratio 6:5, Calculate his total earnings on May 2020 to the nearest shilling. (3marks)

(c) On the month of June 2020 his total earnings were Kshs. 39,800. Calculate the difference in his total sales in months of May and June. (3marks)

18. (a) A man standing 20m away from a building notices that the angles of elevation of the top and bottom of a flagpole mounted at the top of the building are 64^0 and 62^0 respectively. Calculate to 1d.p. the height of the flagpole. (4marks)

   b) The angles of elevation of the top of a tree from P and Q which are 30m apart are 22^0 and 32^0 respectively. Given that the two points are on the same side of the tree and on a straight line, determine the height of the tree. (6marks)

19. Two security personnel were together at a road junction. Each had a walkie talkie. The maximum distance at which one could communicate with the other was 2.5km. One of the personnel walked due East at 3.2km/h while the other walked due North at 2.4km/h. The personnel who headed east travelled for x km while the one who headed North travelled for y km before they were unable to communicate.

(a) Draw a sketch to represent the relative positions of the policemen. (1 mark)

(b) (i) From the information above form two simultaneous equations in form of x and y. (2 marks)

(ii) Find the value of x and y. (5 marks)

(iii) Calculate the time in minutes taken before the security personnel were unable to communicate.
(2 marks)

20. ABCD is a rectangle with A as the point (-3,1).
(a) If AB is parallel to the line $3y - x = 4$, find the equation of line AB. (2 marks)
(b) Find the equation of line AD. (2marks)
(d) If C has coordinates (2,6), find the equations of the line BC and CD in the form
$\frac{x}{a} + \frac{y}{b} = 1$ (4marks)
(e) Find the coordinates of B (2marks)

21. The figure below shows a rectangular sheet of metal whose length is twice its width.
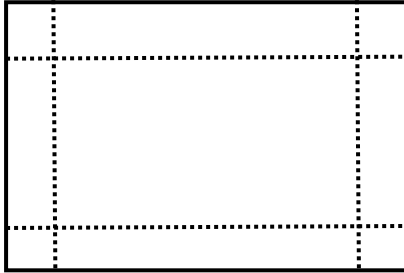
An open rectangular tank is made by cutting equal squares of length 60 cm from each of its four corners and folding along the dotted lines shown in the figure above. Given that the capacity of the tank so formed is 1920 litres and the width of the metal sheet used was x cm;

a) (i) Express the volume of the tank formed in terms of **x** cm. (3 marks)

(ii) Hence or otherwise obtain the length and width of the sheet of metal that was used. (3 marks)

b) If the cost of the metal sheet per m² is Kshs 1000 and labour cost for making the tank is 300 per hour. Find the selling price of the tank in order to make a 30% profit if it took 6 hours to make the tank. (4 marks)

22. a) The ratio of Juma's and Akinyi's earnings was 5: 3. Juma's earnings rose to Ksh 8 400 after an increase of 12%. Calculate the percentage increase in Akinyi's earnings given that the sum of their earnings was Ksh. 14 100 (6 marks)

(b) Juma and Akinyi contributed all the new earnings to buy maize at Ksh 1 175 per bag. The maize was then sold at ksh 1 762.50 per bag. The two shared all the money from the sales of the maize in the ratio of their contributions. Calculate the amount that Akinyi got. (4 marks)

23. a) Given that $\mathbf{A} = \begin{pmatrix} 3 & 4 \\ 2 & 3 \end{pmatrix}$ find inverse of **A** (1mark)

b) Two colleges, Utalii and Huduma purchased beans and rice . Utalii bought 90 bags of beans and 120 bags of rice for a total of sh 360 000 . Huduma bought 200 bags of beans and 300 bags of rice for a total of sh 850 000. Use the inverse of **A** obtained in (a) above to find the price of one bag of each item. (6marks)

c) The price of beans later decreased in the ratio 4: 5 while that of rice increased by 20 %. A businessman bought 20 bags of beans and 30 bags 0f rice. How much did he pay? (3marks)

24. The figure below shows a model of a solid in the shape of a frustum of a cone with a hemispherical top.
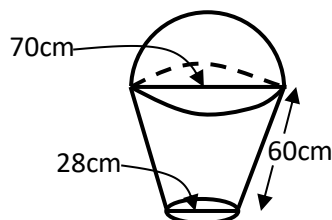

The diameter of the hemispherical top is 70cm and is equal to the diameter of the top of the frustum.
The frustum has a base diameter of 28cm and a slant height of 60cm.

(a) Calculate the area of the hemispherical surface. (1mark)
(b) Calculate the slant height of the cone from which the frustum was cut. (4marks)
(c) Calculate the total surface area of the model. (5 marks)

TERM 1 2023
121/2
MATHEMATICS
PAPER 2
TIME: 2 HOURS 30 MINUTES
Section I (50 Marks)
Answer ALL questions in this section.

1. Solve for x

   $(\log_3 x)^2 - \frac{1}{2}\log_3 x = \frac{3}{2}$ [4 *marks*]

2. In the figure below PT is a tangent to the circle from an external point P. $PT = 24\ cm$ and $OP = 25\ cm$.
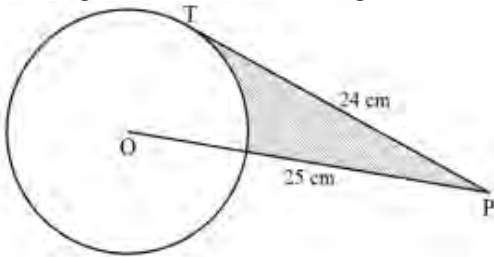
   Calculate the area of the shaded region correct to 2 decimal places [4 *marks*]

3. Find the value of w in the expression $wx^2 - \frac{3}{2}x + \frac{1}{16}$ is a perfect square , given that w is a constant

   [2 *marks*]

4. Simplify $\dfrac{4}{\sqrt{5}+\sqrt{2}} - \dfrac{3}{\sqrt{5}-\sqrt{2}}$ (3 marks)

5. The cost C of hiring a conference facility for one day consists of two parts, one which is fixed and the other varies as the number of participants n attending the conference. If Kshs 45000 is charged for hiring the facility for 100 participants and Kshs 40000 for 60 participants, Find the number of participants if 63000 is used to hire the facility. [3 *marks*]

6. Juma a form 2 student was told to pick two number x and y from a set of digits 0, 1, 2, 3, 4, 5 and 6. Find the probability that $|x - y|$ is atleast 3. [3 *marks*]

7. Given that the matrix $\begin{pmatrix} 3x & x \\ x-6 & -3 \end{pmatrix}$ maps a triangle A(0,0), B(2, 1) and c(3, 5) on to a straight line. Find the possible values of x. [3 *marks*]

8. The points with co-ordinates A(13,3) and B(-3,-9) are the end of diameter of a circle centre O. Determine ;
   (i) The coordinates of O [1 *mark*]
   (ii) The equation of the circle expressing it in the form
   $x^2 + y^2 + ax + by + c = 0$ [3 *marks*]

9. Two containers have base areas of 750cm² and 120cm² respectively. Calculate the volume of the larger container in litres given that the volume of the smaller container is 400cm³. (3 marks)

10. The cash price of a laptop is 4800. Wambui bought it on hire purchase by making a deposit of kshs. 10000 followed by 24 monthly instalments of kshs 2000 each. Calculate the monthly rate at which compund interest was charged [3 *marks*]

11. A merchant blends 350kg of KAKUZI tea costing shs. 84 per kg with 140 kg of KETEPA tea costing sh.105 per kg. calculate the price at which he must sell 1kg of the mixture to attain 20 % profit. [3 *marks*]

12. The graph below is part of the straight line graph obtained from the initial equation $V = aP^n$
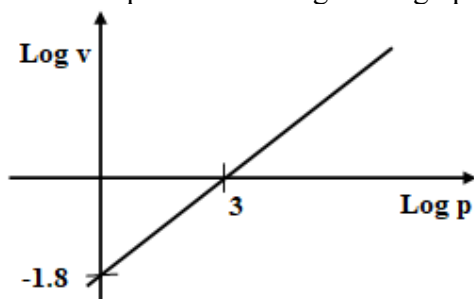
   Write down the equation of a straight line in the form of $y = mx + c$ hence use the graph to find the of $\boldsymbol{a}$ and $\boldsymbol{n}$ [3 *marks*]

13. State the amplitude, period and phase angle of $y = 2\sin\left(\frac{1}{2}x + 30^0\right)$
    (i) Amplitude (1 mark)
    (ii) Period (1 mark)
    (iii)Phase angle (1 mark)
14. Given the position vectors $\overrightarrow{OA} = 4i + 8j - 2k$ and $\overrightarrow{OB} = 3k - i - 2j$. Point C divides vector AB in the ratio of 3:-1. Find the magnitude of $\overrightarrow{OC}$. Give your answer to 2dp [3marks]
15. The table below shows income tax rates in a certain year.

Monthly income in Kshs	Tax rate in each Kshs
$1 \leq x < 9681$	10%
$9681 \leq x < 18801$	15%
$18801 \leq x < 27921$	20%
$27921 \leq x < 37040$	25%
Over 37040	30%

In a certain month of the year Mr. Mogaka had a total deduction of ksh 5,000, he got a personal tax relief of kshs.1056 and paid kshs.3944 for NHIF, WCPS and sacco loan repayment. Calculate
(i) P.A.Y.E. (1 mark)
(ii) Monthly income/salary (3 marks)
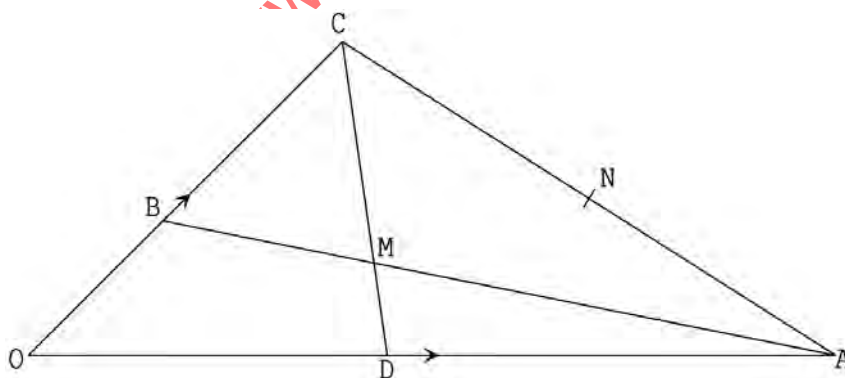16. In the figure given below, O is the centre of circle. If $\angle BCA = 80^0$ and $\angle CBO = 10^0$.
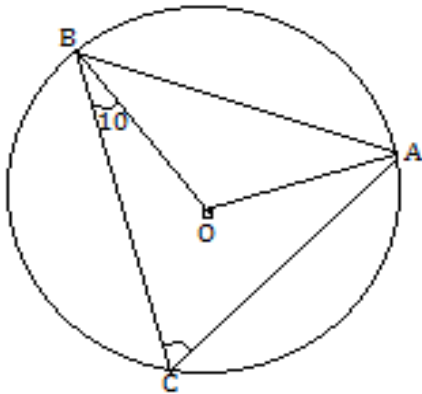
Determine the size of $\angle CAB$. (3 marks)

Section II (50 Marks)
Answer ONLY FIVE questions in the section.
17. In the figure below $\overrightarrow{OB} = \underset{\sim}{b}; OC = 3\overrightarrow{OB}$ and $OA = \underset{\sim}{a}$

a) Given that $\overrightarrow{OD} = \frac{1}{3}\overrightarrow{OA}$ and $\overrightarrow{AN} = \frac{1}{2}\overrightarrow{AC}$, $\overrightarrow{CD}$ and $\overrightarrow{AB}$ meet at M. Determine in terms $\underset{\sim}{a}$ and $\underset{\sim}{b}$.

i) $\overrightarrow{AB}$ (1 mark)

ii) $\overrightarrow{CD}$ (1 mark)

b) Given that $\overrightarrow{CM} = k\overrightarrow{CD}$ and $\overrightarrow{AM} = h\overrightarrow{AB}$. Determine the values of the scalars k and h. (5 marks)
c) Show that O, M and N are collinear. (3 marks)

EASTERN CLUSTER, 2023
Kenya Certificate of Secondary Education
121/1
MATHEMATICS
PAPER 1
TIME: 2½ HOURS

Section 1

1. Evaluate $\dfrac{-4 \ of\ (-4 + -15 \div 5 + -3 - 4 \div 2)}{84 \div -7 + 3 - -5}$ (3 marks)

2. Simplify $\dfrac{9x^2 - 1}{3x^2 - 2x - 1}$ (3 marks)

3. Solve the following inequality and state the integral solutions. (3 marks)
   $2^{2x-1} \leq 8^x < 32^{(-1/5x + 6)}$

4. The position vector of P is **OP = 2i – 3j** and M is the mid – point of PQ. Given **OM = i + 4j**, Obtain the vector **PQ.** (3 marks)

5. Use tables of reciprocals only to work out. (3 marks)

   $$\frac{5}{0.0396} + \frac{12}{0.593}$$

6. A straight line passes through points A (-2,6) and B (4, 2).
   (a) M is the midpoint of line AB. Find the coordinate of M. (2 marks)
   (b) Determine the equation of a straight line passing through point M and is perpendicular to AB. (2 marks)

7. An open right circular cone has radius of 5cm and a perpendicular height of 12cm. Calculate the surface area of the cone. (take π =3.142). (3 marks)

8. The lengths of three wires were 9 M, 27 M and 108 M. Pieces of wire of equal length were cut from the three wires. Calculate the least number of pieces obtained. (3marks)

9. A farmer has 100 M of wire-mesh to fence a rectangular enclosure. What is the greatest area he can enclose with the wire-mesh? (3 marks)

10. In a bookstore, books packed in cartons are arranged in rows such that there are 50 cartons in the first row, 48 cartons in the next row, 46 cartons in next row and so on.
    (a) How many cartons will be there in 8th row? (2 marks)
    (b) If there are 20 rows in total, find the total number of cartons in the books store. (2 marks)

11. Find the value of x if. (3 marks)

    $$\left(\frac{27}{8}\right)^{x+7} = \left(\frac{4}{9}\right)^{-3x}$$

12. The mean ages of a group of ten boys in a Math's club is 15. The ages of nine of the boys are 14, 15, 14, 16, 17, 14, 16, 15 and 13. What is the age of the remaining boy? (3 marks)

13. The figure below is a velocity time graph for a car.

Time in
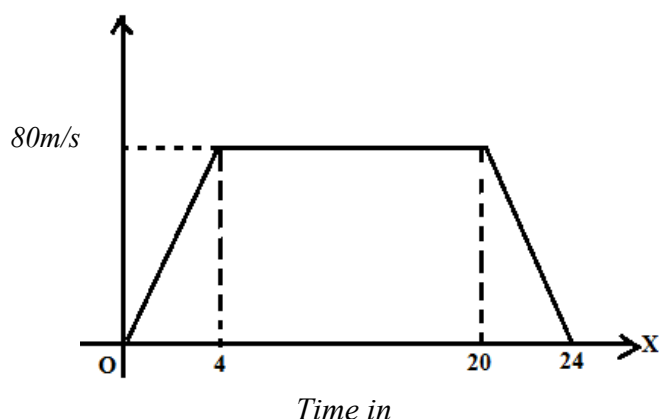
   (a) Find the total distance travelled by the car (2 marks)
   (b) Calculate the deceleration of the car. (1 marks)

14. Security light poles have been erected along both sides of a street in Bahati town. The poles are 50m apart along the left-hand side of the road while they are 80m apart along the right-hand side. At one end of the road the poles are directly opposite each other. How many poles will be erected by time the poles are directly opposite each other at end of the road? (3 marks)

15. The exterior angle of a regular polygon is equal to one third of the interior angle. Calculate the number of sides of the polygon. (3 marks)

16. Write down the inequalities that define the unshaded region marked R in the figure, below. (3 marks)
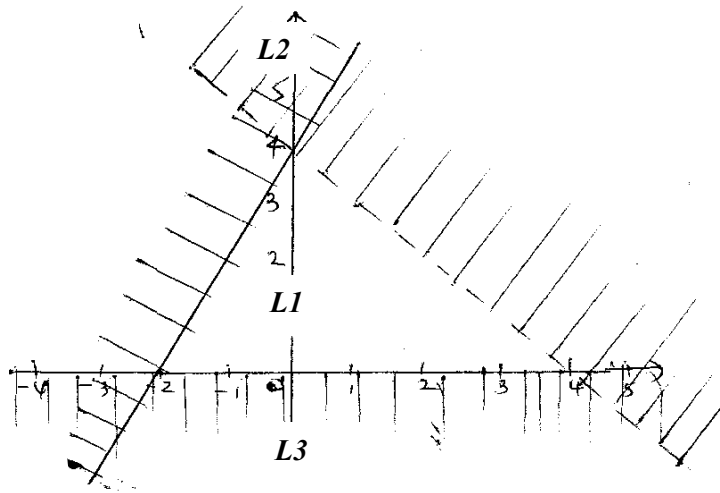
Section II.
Choose any five questions from this section

17. Nakuru county government is to construct a floor of an open wholesale market whose area is 800m^2. The floor is to be covered with a slab of uniform thickness of 200mm. In order to make the slab, sand, cement and ballast are to be mixed such that their masses are in the ratio 3:2:3 respectively. The mass of dry slab of volume 1m^3 is 2000kg.
   (a) Calculate
   (i) The volume of the slab. (2 marks)
   (ii) The mass of the dry slab. (2 marks)
   (iii) The mass of cement to be used. (2 marks)
   (b) If one bag of cement is 50kg, find the number of bags to be purchased. (1 mark)
   (c) If a lorry carries 10 tonnes of ballast, calculate the number of Lories of ballast to be purchased. (3 marks)

18. Paul is a sale executive earning sh 20,000 and a commission of 8% for the sales in excess of 100,000. In January 2014 he earned a total of 48000 in salaries and commissions.
(a) Determine the amount of sales he made in that month. (4 marks)
(b) If the total sales in the month of February and March increased by 18% and then dropped by 25% respectively. Calculate.
(i) Paul`s commission in the month of February. (3 marks)
(ii) His total earnings in the month of March. (3 marks)

19. Two tanks are similar in shape. The capacity of the tanks are 1,000,000 litres and 512,000 litres respectively.
   (a) Find the height of the smaller tank if the larger one is 300cm tall. (5 marks)
   (b) Calculate the surface area of the tank if the smaller one has a surface area of 768cm^2 (3 marks)
   (c) Calculate the mass of the larger tank if the mass of the smaller one is 800kg. (2 marks)

20. The equation of a curve is given by y=x^3 - x^2 - 8x + 3
(a) Find the value of y when x=1. (1 mark)
(b) Determine the stationary points of the curve. (5 marks)
(c) Find the equation of the normal to the curve at x=1 in the form ax + by = c (4 marks)

21. Peter owns a farm that is triangular in shape as shown below
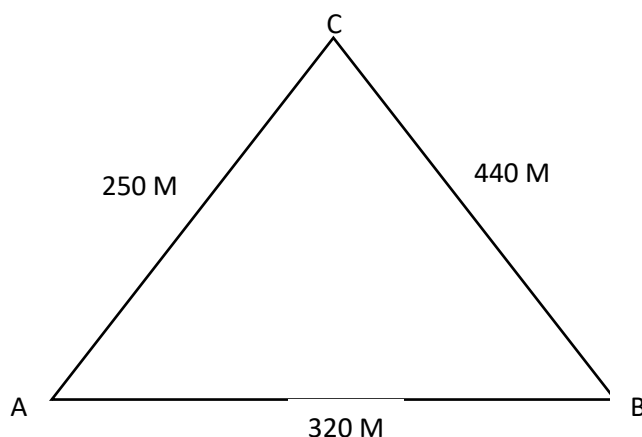
(a) Calculate the size of angle BAC. (2 marks)
(b) Find the area of the farm in hectares. (3 marks)
(c) Peter wishes to irrigate his farm using a sprinkler machine in the farm such that it is equidistant from points A. B and C.
The sprinkler rotates in a circular motion so that the maximum point reached by the water jets is the vertices A, B and C. Calculate the area outside the farm that will be irrigated. (5 marks)

22. Transline bus left Nairobi at 8.00 am and travelled to Nakuru at an average speed of 80km/h. A car left Nakuru at 3.30 am and travelled to Nairobi at an average speed of 120km/h. Given that the distance between Nairobi and Nakuru is 400km, calculate:
(a) The time the car arrived in Nairobi. (3 marks)
(b) The time the two vehicles met. (4 marks)
(c) The distance from Nairobi to the meeting point. (2 marks)
(d) The distance of the bus from Nakuru when the car arrived in Nairobi. (2 marks)

23. Town B is 102km on the bearing of 122^0 from town A. Town C is 94 km on bearing of $N62^0 E$ from B. Town D is on a bearing of 073^0 from A and $N24^0W$ from C.
(a) Using a scale of 1cm to represent 20km, draw a scale diagram to show the relative positions of town A, B, C and D. (4 marks)
(b) Using your diagram, determine.
   (i) The bearing B from D. (1 mark)
   (ii) The bearing of A from C. (1 mark)
   (iii) The distance from town A to D. (2 marks)
   (iv) The distance from town B and D. (2 marks)

24. The table below gives some of the values of x and y for the functions $y= \frac{1}{2}x^2 +22x + 1$ in the interval $0 \le x \le 6$.

| x	0	1	2	3	4	5	6
y	1					23.5	

(a) Complete the values in the table above. (1 mark)
(b) Use the values in the table to draw the graph of function on the grid provided below. (2 marks)
(c) Using the graph and the mid-ordinate rule with 6 strips, estimate the area bounded by the curve, the x-axis, the y-axis and the line x=6. (3 marks)
(d) Using integration, calculate the exact area and hence find the percentage error made when mid-ordinate rule is used. Give your answer correct to 2.dp. (4 marks)

EASTERN CLUSTER, 2023
Kenya Certificate of Secondary Education
121/2
MATHEMATICS
PAPER 2
TIME: 2½ HOURS

SECTION I (50 MARKS)
Answer ALL questions in this section

1. Use logarithms to evaluate

$$\frac{2347 \, x0.4666^{2}}{\sqrt[3]{0.0924}}$$ (4mks)

2. In 100m race there are three main competitors namely Simiyu, Ondiek and Kamau. Simiyu is three times likely to win as Ondiek, while Ondiek is twice as likely to win as Kamau.
   Find the probability that
   i)   Ondiek wins the race. (2 marks)
   ii) Either Simiyu or Kamau. (1mark)

3. a) Find the expansion in ascending powers of x of $\left(1 - \frac{x}{3}\right)^{7}$ up to the term in x^{2}. (1mark)

   b) Hence evaluate $(0.99)^{7}$ to four significant figures. (2marks)

4. Given that $Tan75^{0} = 2 + \sqrt{3}$, hence determine $Tan\ 15^{0}$ leaving your answer in the form $a + b\sqrt{c}$ (3marks)

5. PQR is an equilateral triangle of sides 3cm. S is a variable point on the same side of PQ as R and on the same plane such that <PSQ=30⁰. Locate by construction the possible location of S (use a ruler and a pair of compasses only). (3marks)

6. The overall grade (A) attained by a student is directly proportional to the teacher's effort (t), square of student's effort (s) and the general discipline level (d) of the school. A student doubled his effort; teacher went further by 5% but the school discipline dropped by 40%. Find the percentage change in the overall grade. (3marks)

7. A circle of radius 7 units has it's Centre at the point of intersection between the lines
   x +2y + 1 = 0 and 2x + 3y – 3 = 0. Find the equation of the circle expressing it in the form
   $x^{2} + y^{2} + gx + fy + c = 0$. (4marks)

8. Kitheka deposited ksh.50,000 in a financial institution in which interest is compounded quarterly. If at the end of second year he received a total amount of ksh79,692.40. Calculate the rate of interest p.a.
   (3marks)

9. Evaluate $\int_{-1}^{2} \frac{1-x^{2}}{x+1} dx$ (3marks)

10. Chords AB and CD in the figure below intersect externally at Q. If AB 5cm BQ = 6cm and DQ = 4cm, calculate the length of chord CD. (3 marks)
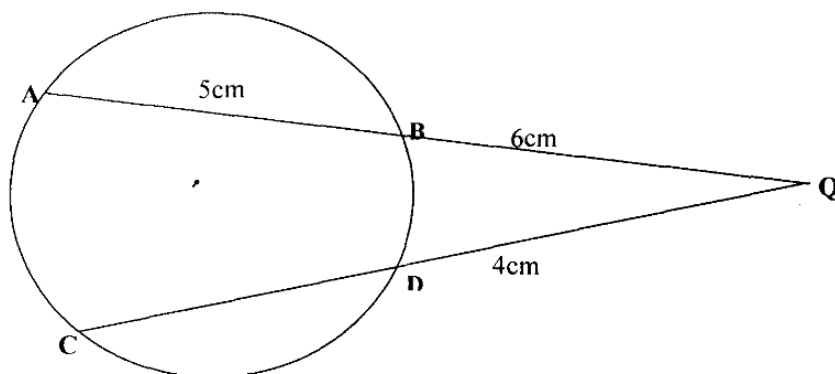
11. Find the value of x leaving your answer as a mixed fraction. (3marks)

$$\log_4 3 - \frac{1}{2}\log_4(2x - 5) = \frac{3}{2}$$

12. Make x the subject of the formula.

$A - x = \sqrt{Bx + x^2}$ (3marks)

13. Two grades of tea, costing sh 100 and 150 per kg respectively are mixed in the ratio 3:5 by weight. The mixture is then sold at sh. 160 per kg. Find the percentage profit on the cost price. (4marks)

14. The length, width and height of a cuboid are measured to nearest cm as 20cm, 15cm and 10cm respectively. Calculate the percentage error in finding its volume. (3marks)

15. Solve the following by completing the square $2x^2 - 14x + 24 = 0$ (3marks)

16. If the area of an object is 10 square units, state the area of the image after a transformation whose matrix is $\begin{pmatrix} 1 & 0 \\ 0 & 3 \end{pmatrix}$ (3 marks)

SECTION B (50 MARKS)

Answer any FIVE questions in this section in the spaces provided

17. a) Mambo is employed with a starting salary of Ksh.4000 per month. His salary is increased by Ksh 250 after every year. How long does it take for his salary to double? (3marks)
    b) The population of insects was found to be 200. Thereafter, the population was known to double every day. How long did it take for the population to hit a half- million? (3marks)
    c) The nth term of a sequence is 2n + 3.
    i) Write down the first 3 terms of this sequence. (2marks)
    ii) Calculate the sum of the first 40 terms of this sequence. (2marks)

18. An aircraft leaves town P (30°S, 17°E) and moves directly northwards to Q(60°N, 17°E). It then moved at an average speed of 300 knots for 8 hours westwards to town R. Determine;
    a) The distance PQ in nautical miles. (3marks)
    b) The position of town R. (3marks)
    c) The local time at R if local time at Q is 3.12p.m (2 marks)
    d) The total distance moved from P to R in kilometers. Take 1 nautical mile = 1.853 kilometres. (2 marks)

19. The table below shows the marks scored by eighty Form 4 students in a mathematics test.

| Marks	10≤x<20	20≤x<30	30≤x<40	40≤x<50	50≤x<60	60≤x<70	70≤x<80	80≤x<90
Freq.	2	5	9	17	22	15	8	2

    a) Calculate:
    i) Mean mark using an assumed mean of 55. (3marks)
    b) On the grid provided draw the cumulative frequency curve to represent the above distribution. (3marks)
    c) Use the graph in (b) above to determine
    i) The quartile deviation. (2 marks)
    ii) The percentage of passion fruits whose masses lie in the range 41g to 89g. (2 marks)

20. $A^1B^1C^1D^1$ is the image of ABCD under a shear parallel to x – axis D(2,4) is mapped onto $D^1(1,4)$ while A(-1,1) is mapped onto $A^1(1,1)$. If the co – ordinates of A,B,C and D are (-1,1), (0,1), (3,4) and (2,4) respectively:-
    (a) Draw ABCD and $A^1 B^1C^1$ and D^1 under the shear on the grid provided and state co-ordinates of B^1 and C^1. (3marks)
    (b) State the invariant line. (1 mark)
    (c) $A^i B^i C^i$ and D^i undergoes a stretch parallel to y – axis with scale factor -2 and invariant line y =3. On the same grid, draw $A^{ii}B^{ii} C^{ii} D^{ii}$ the image of $A^i B^i C^i D^i$ under the stretch. (2 marks)
    (d) Describe completely the transformation that maps $A^{ii}B^{ii} C^{ii} D^{ii}$ onto ABCD. (4 marks)

21. In the figure below AB= a , AD= b , AX:XC =2:3 and DX:XB = 4:5
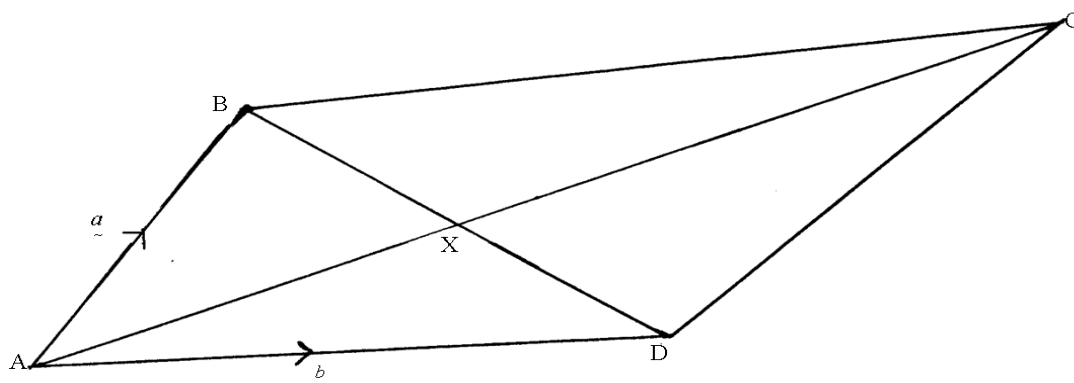
(a) Express AC in terms of a and b in the simplest form. (5marks)

(b) Express DC in terms of a and b in the simplest form. (2marks)

(c) If BC =n a +m b , find the values of n and m. (3marks)

22. The triangle below shows a triangular prism. AB=20m, BC=10m.
AE = ED = BF = FC = 8cm.
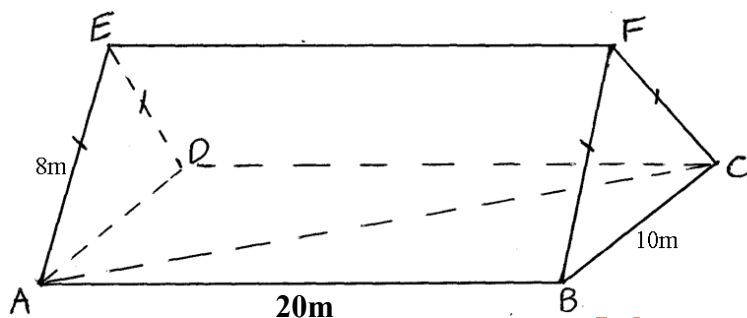
(a) Find the length
(i) AC. (1mark)
(ii) AF. (2marks)
(b) (i) Calculate the angle between line AF and the base ABCD. (3marks)
(ii) Find the angle between plane ADF and the base ABCD. (2marks)
(c) Find the volume of the prism. (2marks)

23. A particle moves such that t seconds after passing a given point O, its distance S metres from O is given as S = t (t–2) (t–1)
(a) Find its velocity when t = 2 seconds (3marks)
(b) Find its minimum velocity (2marks)
(c) Find the time when the particles is momentarily at rest. (3marks)
(d) Find its acceleration when t=3 seconds (2marks)

24. a) Complete the table below. (2marks)

x	0	15	30	45	60	75	90	105	120	135	150	165	180
2 sin (2x + 30º)	1	1.73		1.73			-1			-1.73			1
3 cos 2x	3		1.5	0					-1.5				3

b) On the graph provided draw the graphs of y = 2 sin (2x + 30) and y = 3 cos 2x. (5marks)
c) Find the values of x for which 1.5 cos 2x – sin (2x + 30) = 0. (3marks)

CEKENAS FORM FOUR MOCK EXAMINATION, 2023
Kenya Certificate of Secondary Education. (K.C.S.E
121/1
MATHEMATICS ALT. A
Paper 1
Time: 2½ Hours

SECTION I (50 MARKS)
Attempt All Questions in this section

1. Find the value of y given that (3 marks)
$$\frac{-2(5+3)-9\div3+5}{-3\times-5y+2y\times4}=1$$

2. The length of a minute hand of a clock is 3.5cm. What will be the time if from 10.15am it sweeps through an area of $19.25cm^2$? (4marks)

3. Use reciprocal, square and square root table to evaluate to 4 significant figures, the expression
$$\sqrt{\frac{1}{24.56}+4.346^2}$$ (3marks)

4. Given that sin $(90-x)^0$ =0.8, where x is an acute angle, find without using mathematical table the value of 2 tan x+cos(90-x) (3marks)

5. Find the equation of the tangent and the normal to the curve $y=2x^3-3x^2+6$ at the point (2,10) (4marks)

6. Simplify $\frac{2y^2+3xy-2x^2}{x^2-4y^2}$ (3marks)

7. Find greatest integral value of x which satisfies
$$\frac{2x+3}{2}<\frac{8-3x}{5}<\frac{5x+6}{3}$$ (3marks)

8. One of the roots of the equation $x^2+(k+1)x+28=0$ is 4. Find the values of k and hence the second root (4marks)

9. Solve for x in the following without using a calculator or mathematical table.
$9^x(27^{(x-1)})=\tan30^o$ (3marks)

10. A shear parallel to the x-axis maps point (1, 2) onto a point (5, 2). Determine the shear factors and hence state the shear matrix (invariant line is y=0) (3marks)

11. A solid is in the shape of a right pyramid on a square base on side 8cm and height 15cm. A frustum whose volume is a third of the pyramid is cut off. Determine the height of the frustum. (3 marks)

12. The interior angle of a regular polygon is 20º more than three times the exterior angle. Determine the number of sides of the polygon (2marks)

13. Three fifths of work is done on the first day. On the second day $\frac{3}{4}$ of the remainder is completed. If the third day $\frac{7}{8}$ of what remained id done, what fraction of work still remain to be done. (3marks)

14. A two-digit number is such that the sum of the digits is ten. If the digits are reversed, the new number formed is less than the original number by 18. Find the number (3marks)

15. In the figure bellow, $\angle$ CBD= 2$\angle$ CAD. Find the value of x (3marks)
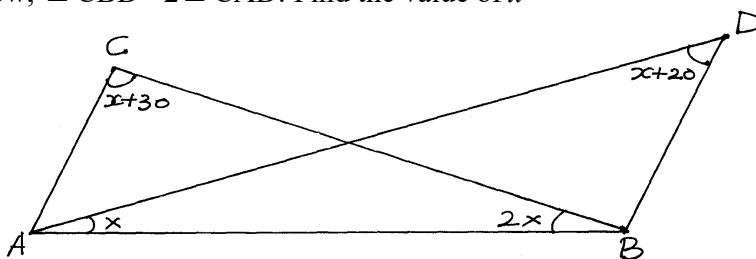
16. Two boys, Ababu and Chungwa, on the same side of a tall building are 100m apart. The building and the two boys are in a straight line and the angles of elevation from the boys to the top of the building are 30º and 20º respectively calculate the height of the building. (3marks)

1

17. A business lady bought 100 quails and 80 rabbits for sh25600. If she had bought twice as many rabbits as half as many quails she would have paid sh7400 less. She sold each quail at a profit of 10% and each rabbit at a profit of 20%.
   a) Form two equations to show how much she bought the quails and the rabbits. (2marks)
   b) Using matrix method, find the cost of each animal. (5mrks)
   c) Calculate the total percentage profit she made from sale of the 100 quails and 80 rabbits. (3marks)

18. A(3,7) B(5,5), C(3,1), D(1,5) are vertices of a quadrilateral
   a) On the grid provided below, plot ABCD on a Cartesian plan (2marks)
   b) $A^1B^1C^1D^1$ is the image of ABCD under a translation T $\begin{pmatrix} -6 \\ -9 \end{pmatrix}$ plot $A^1B^1C^1D^1$ and state its coordinates

   (2marks)
   c) Plot $A^{11}B^{11}C^{11}D^{11}$ the image of $A^1B^1C^1D^1$ after a rotation about (-1,0) through a positive quarter turn. State its coordinates. (3marks)
   d) $A^{111}B^{111}C^{111}D^{111}$ is the image of $A^{11}B^{11}C^{11}D^{11}$ after a reflection in the line y=x+2. Plot $A^{111}B^{111}C^{111}D^{111}$ and state its coordinates (3marks)

19. The figure below shows a velocity time graph of a journey of a car. The car start from rest and accelerates at $2\frac{3}{4}m/s^2$ for t seconds until it is 22m/s
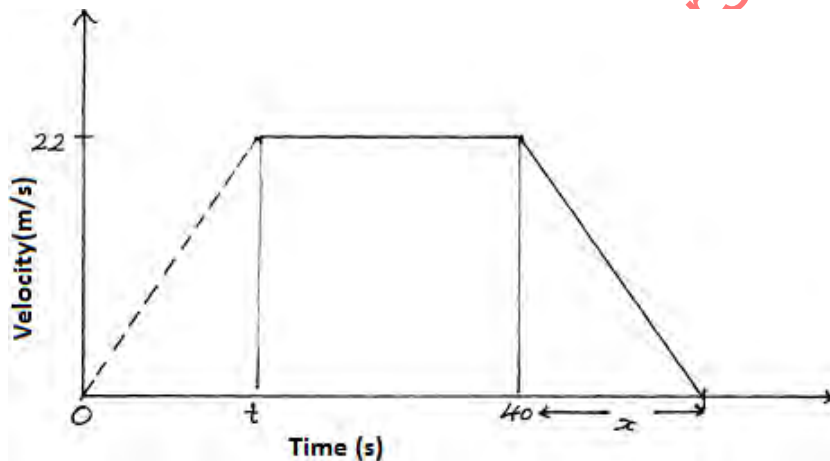
Brakes are applied bringing it uniformly to rest. The total journey is 847m long. Find.
   a) The value of t, the acceleration time (2marks)
   b) The distance travelled during the first t seconds. (2marks)
   c) The value of x, the deceleration time (4marks)
   d) The rate of deceleration (2marks)

20. The diagram below shows a histogram representing the mass of some pupil in a school.
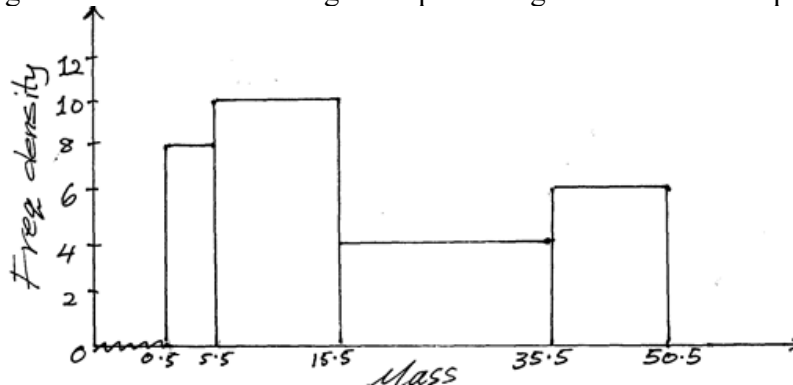
   a) Prepare a frequency distribution table of the data (3marks)
   b) From the table above, estimate
   i) The mean mass of the pupils to 3 s.f (3marks)
   ii) The median mass (3marks)

2

iii) How many pupils were 40kg and above (1marks)

21. In the figure below **OY**:**YA**=1:3 AX:XB=1:2 **OA**= a and **OB**= b . N is the point of intersection of **BY** and **OX**
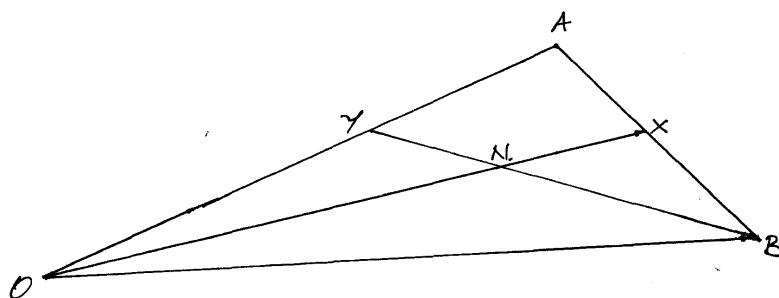
a) Determine
   i) **OX** (2marks)
   ii) **BY** (1mark)

b) Give that $\vec{BN} = k\,\vec{BY}$ and **ON**=hOX, express $\vec{ON}$ in two ways in terms of $a\ b, h\ and\ k$ (3marks)

c) Find the value of h and k and hence show that O,N and X are collinear (4marks)

22. Using a ruler and a pair of compass only, construct triangle XYZ where XY is 6cm and XYZ is 135° and YZ=7cm (2marks)
a) Measure XZ (1mark)
b) Drop a perpendicular from Z to meet line XY at K , measure ZK. (2marks)
c) Bisect line XY and let the bisector meet line XZ at Q (1mark)
d) Join Q to Y and measure angle XQY (2marks)
e) Find the area of triangle XYZ (2marks)

23. Four towns are situated in such that a way that town Q is 500km on a bearing of 120° from P. Town R is 240 km on a bearing of 210° from town P, while town S is due north of town Q and due east of town P
a) Draw a sketch diagram showing the relative position of P,Q,R and S (scale:1cm :100km) (3marks)
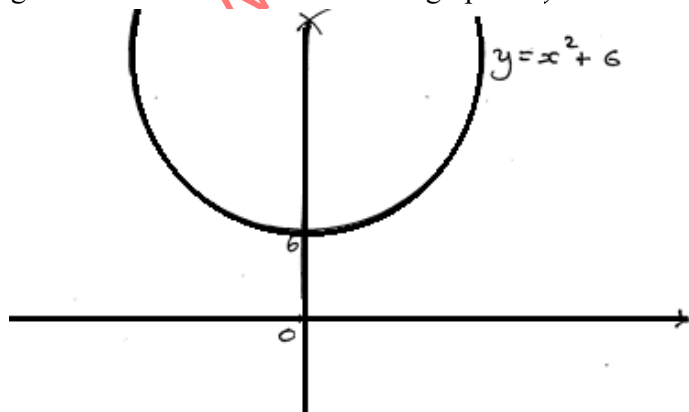b) Find by calculation
   i) The distance QR (1mark)
   ii) The distance QS (2marks)
   iii) The angle PRSQ (2marks)
   iv) The area of triangle PQS (2marks)

24. The figure below shows a sketch of the graph of $y = x^2 + 6$.

a) Estimate the area bounded by the curve, the *x*-axis and the line *x* =-4 and *x*=4 using
i) The trapezium rule with 8 sides (3marks)
ii) The mid- ordinates rule with and strips (3marks)
b) What percentage error is caused by estimating the area of the curve using the mid ordinates rule as in a (ii) above (4marks)

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Kenya Certificate of Secondary Education.
**121/2**
MATHEMATICS ALT. A
Paper 2
Time: 2½ Hours

SECTION A (50 MARKS)
Answer All Questions in this section

1. The area of a rectangle is 48.4cm² and its length is 9.37cm. Calculate the percentage error in width (3marks)

2. The base of a triangle is $(3x - 2)$cm. The height of the triangle is 5cm shorter than its base. Given that the area of the triangle is 25cm². Find length of the base. (4marks)

3. Find the area of the triangle shown below (3marks)
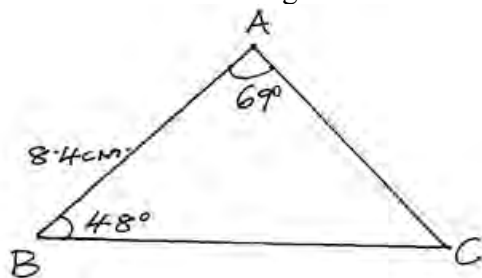
4. Express the following expression in surd form and simplify by rationalising the denominator

   $$\frac{2}{1 - \tan 30}$$ (3marks)

5. Solve for x in the expression $(\log_2 x)^2 + \log_2 x^3 = 10$ (3marks)

6. The table below is part of the tax for monthly income for the year 2007

Monthly income (ksh)	Rate %
Under ksh 10165	10
From 10165 but under ksh19741	15
From 19741 but under ksh29317	20

   In that year, John's monthly gross tax was Ksh 2885. Calculate his monthly income (3marks)

7. A quantity E is partly constant and partly varies as square root of F.
   i) Write down an equation connecting E and F where K and C are constants respectively.
   ii) If F=25 where E=22 and F=49 when E=28. Find the value of K and C (3marks)

8. a) Expand $\left(1 + \frac{1}{2}x\right)^7$ in ascending power of x (1mark)

   b) Using the first four times of the expansion in (a) above estimate the value of $\left(1\frac{1}{30}\right)^7$ (2marks)

9. Find the number of terms of the series 5+8+11+14+17+……….. that will give a sum of 2183 (3marks)

10. Find the inverse of the matrix $M = \begin{pmatrix} 4 & -3 \\ 2 & 1 \end{pmatrix}$ hence find the co-ordinates of the point at which line

    $4x - 3y = 4$ and $2x + y = 7$ intersect (3marks)

11. A trader mixed grade I, II and III of coffee in the ratio 2:3:5 respectively. Grade I cost Sh650 per kg, grade II costs sh 500 per kg and grade III costs sh 420 per kg.
    a) Find the cost of one kg of the mixture (2marks)
    b) If the trader sold the mixture at a profit of 20% calculate the selling price of 3kg of the mixture (2marks)

12. Solve for the equation $4\cos^2 x = 5 - 4\sin x$ for $0^o \le x \le 360$ (3marks)

13. The figure below has a cross-section of the prism which is an isosceles triangle of side AE= 8cm, DE= 8cm and AD=6cm, where AB=20cm