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121/2 -   MATHEMATICS ALT A   - FORM FOUR PAPER 2

NAME: …………………………………..……………...…………ADM NO: …………..……

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GAUGE 1 2023 KCSE
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INSTRUCTIONS TO CANDIDATES

a) Write your name, index number and date in the spaces provided at the top of this page.
b) Write name, admission number and class in the spaces provided above.
c) This paper contains **TWO** sections: **section I** and **section II**
d) Answer **ALL** the questions in **Section I** and only **five** questions from **section II.**
e) **Show all the steps in your calculations, giving your answers at each stage in the spaces provided below each question.**
f) Marks may be given for correct working even if the answer is wrong.
g) **Non-programmable** silent electronic calculators and KNEC mathematical tables may be used except where stated otherwise.
h) **This paper consists of 17 printed pages.**
i) **Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.**

FOR EXAMINER'S USE ONLY:

Section I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	**TOTAL**

Section II   **GRAND**
TOTAL

17	18	19	20	21	22	23	24	**TOTAL**

This paper consists of 16 printed pages.
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1. Use logarithms, correct to **4 decimal places**, to evaluate (4mks)

$$\sqrt[3]{\frac{83.46x0.0054}{1.52^2}}$$

2. Given that the ratio of x:y = 4:5, find to the **simplest form** the ratio of (7x-2y):(x+2y)
(2mks)

3. Ruto bought a plot of land for Ksh.280,000. After 4 years, the value of the plot was Ksh.495,000. Determine the rate of appreciation, per annum, **correct to one decimal place**. (3mks)

4. The height in centimeters, of 100 tree seedlings in a tree nursery are shown in the table below.

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| Height(cm)	10-19	20-29	30-39	40-49	50-59	60-69
Number of trees	9	16	19	26	20	10

Find the quartile deviations of the heights. (3mks)

5. The equation of a circle is given by $4x^2-12x+4y^2-8y-3=0$. Determine the coordinates of the centre of the circle and the radius of the circle. (4mks)

6. Simplify the expression $\frac{\sqrt{48}}{\sqrt{5}+\sqrt{3}}$, leaving the answer in the form $a\sqrt{b}+c$ where a, b and c are integers (3mks)

7. In the figure below R, T and S are points on a circle centre O. PQ is a tangent to the circle at T, POR is a straight line and <QPR = 20^0.
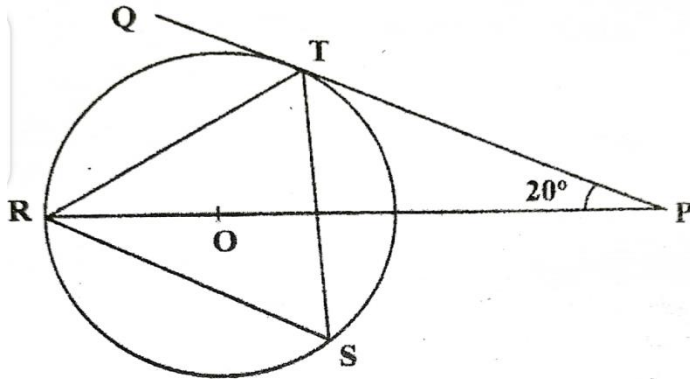
Giving reasons find the size of $< RST$ (2mks)

8. a) Expand the expression $\left(1 + \frac{1}{2}x\right)^5$ in ascending powers of x, leaving the coefficients as fraction in their simplest form. (2mks)

b) Use the first three terms of the expansion in (a) above to estimate the value of $(1.05)^5$ correct to **4** significant figures (2mks)

9. Make t the subject of the formula in $s = \sqrt{\frac{3d(t-d)}{8}}$ (3mks)

10. A trader bought maize for Ksh 20 per kilogram and beans for Ksh 60 per kilogram. She mixed the maize and beans and sold the mixture at Ksh 48 per kilogram. If she made a 60% profit, determine the ratio of maize:beans per kilogram in the mixture.   (3mks)

11. The cash price of a digital television is Ksh. 27,500. A customer decided to buy it on hire purchase terms by paying a deposit of Ksh 17,250. Determine the monthly rate of compound interest charged on the balance if the customer is required to repay by six equal monthly instalments of Ksh. 2,100 each.   (3mks)

12. The first, the third and the seventh terms of an increasing arithmetic progression are three consecutive terms of a geometric progression. If the first term of the arithmetic progression is 10, find the common difference of the arithmetic progression.   (4mks)

13. The lengths of two similar pieces of wood were given as 12.5 m and 9.23 m. Calculate the absolute error in calculating the difference in length between the two bars. (3mks)

14. Solve for x given that $\frac{1}{3}log_2 8 + log_2(2x - 4) = 5$ (3mks)

15. In nomination for a committee, two people were to be selected at random from a group of 3 men and 5 women. Find the probability that a man and a woman were selected. (2mks)

16. Pipe A can fill an empty tank in 3 hours while, pipe B can fill the same tank in 6 hours. When the tank is full it can be emptied by pipe C in 8 hours. Pipe A and B are opened at the same time when the tank is empty. If one hour later, pipe C is opened, find the total time taken to fill the tank. (4mks)

SECTION II (50 marks)

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

17. The table below shows the income tax rates for a certain year.

Monthly taxable income in Ksh	Tax rate (%) in each shilling
1-11,180	10
11,181-21,714	15
21,715-32,248	20
32,249-42,782	25
Over 42,782	30

    i.   During the year, Njuguna's monthly income was as follows: Basic salary Ksh 40,000, House allowance Ksh 11,090 and Commuter allowance Ksh 7,000.

           Calculate   a) Njuguna's total monthly taxable income.   (1mk)

                        b) Total income tax charged on Njuguna's monthly income (4mks)

    ii.   Njuguna's net monthly tax was Ksh. 10,750.80. Determine the monthly tax relief allowed.   (1mk)

    iii.   A proposal to expand the size of the first income tax band by 50% while retaining the size of the next three bands was made. The tax rates would remain as before in each band. Using the proposal, calculate:
          a) the tax Njuguna would pay in the first band.   (2mk)

b) the tax Njuguna would pay in the last tax band.   (2mks)

18. a) Given that $A=\begin{bmatrix} 3 & x \\ x+1 & 2 \end{bmatrix}$ and $B=\begin{bmatrix} 1 & 2 \\ 3 & 0 \end{bmatrix}$, find the values of x for which AB is a singular matrix.   (3mks)

b) Otieno bought 3 exercise books and 5 pens for a total of Ksh 165. If Otieno had bought 2 exercise books and 4 pens, he would have spent Ksh 45 less. Taking letter **e** to represent the price of an exercise book and letter **p** to represent the price of a pen

   i.   Form two equations to represent the above information.   (2mks)

   ii.   Use matrix method to find the price of an exercise book and that of a pen. (3mks)

   iii.   The principal of Njabini boys decided to reward 36 students **each** with 2 exercise books and one pen. Calculate the total amount of money he paid.   (2mks)

19. Three quantities X, Y and Z are such that X varies directly as the square root of Y and inversely as the fourth root of Z. When X=64, Y=16 and Z= 625.

    i.   Determine the equation connecting X, Y and Z.   (4mks)

    ii.   Find the value of Z when Y=36 and X=160   (2mks)

    iii.   Find the percentage change in X when Y is increased by 44% and Z decreased by 19% correct **to one decimal** place.   (4mks)

20. The figure below shows a parallelogram OPQR with O as the origin, **OP** = **p** and **OR**= **r**. Point T divides RQ in the ratio 1:4. PT meets OQ at S.
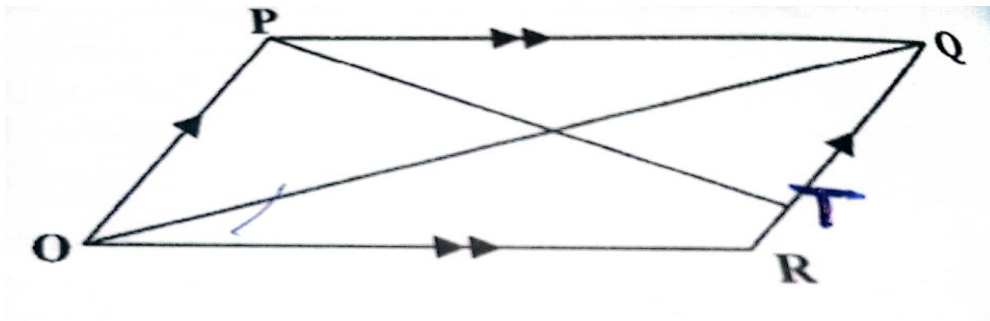
a) Express in terms of **p** and **r** the vectors
   i.   OQ   (1mk)

   ii. OT   (1mk)

b) Vector OS can be expressed in two ways; i) **OS**= m**OQ** ii) **OS**= **OT** + n**TP**, where m and n are constants. Express **OS** in terms of
   i.   m, **p** and **r**   (1mk)

   ii. n, **p** and **r**   (1mk)

   Hence find the

   iii. value of n and m   (5mks)

iv.   ratio **OS**:**SQ**   (1mk)

21. A quadrilateral ABCD has vertices at A(1,1), B(4,2), C(1,3), D(2,2).
   a) Draw ABCD on the grid provided   (1mk)

   b) Give that $X=\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ $Y=\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$ $V=\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}.$ Find the coordinates of $A^1B^1C^1D^1$, $A^{11}B^{11}C^{11}D^{11}$ and $A^{111}B^{111}C^{111}D^{111}$ the images of ABCD under combined transformation **VXY.** Show all your working of coordinates below;
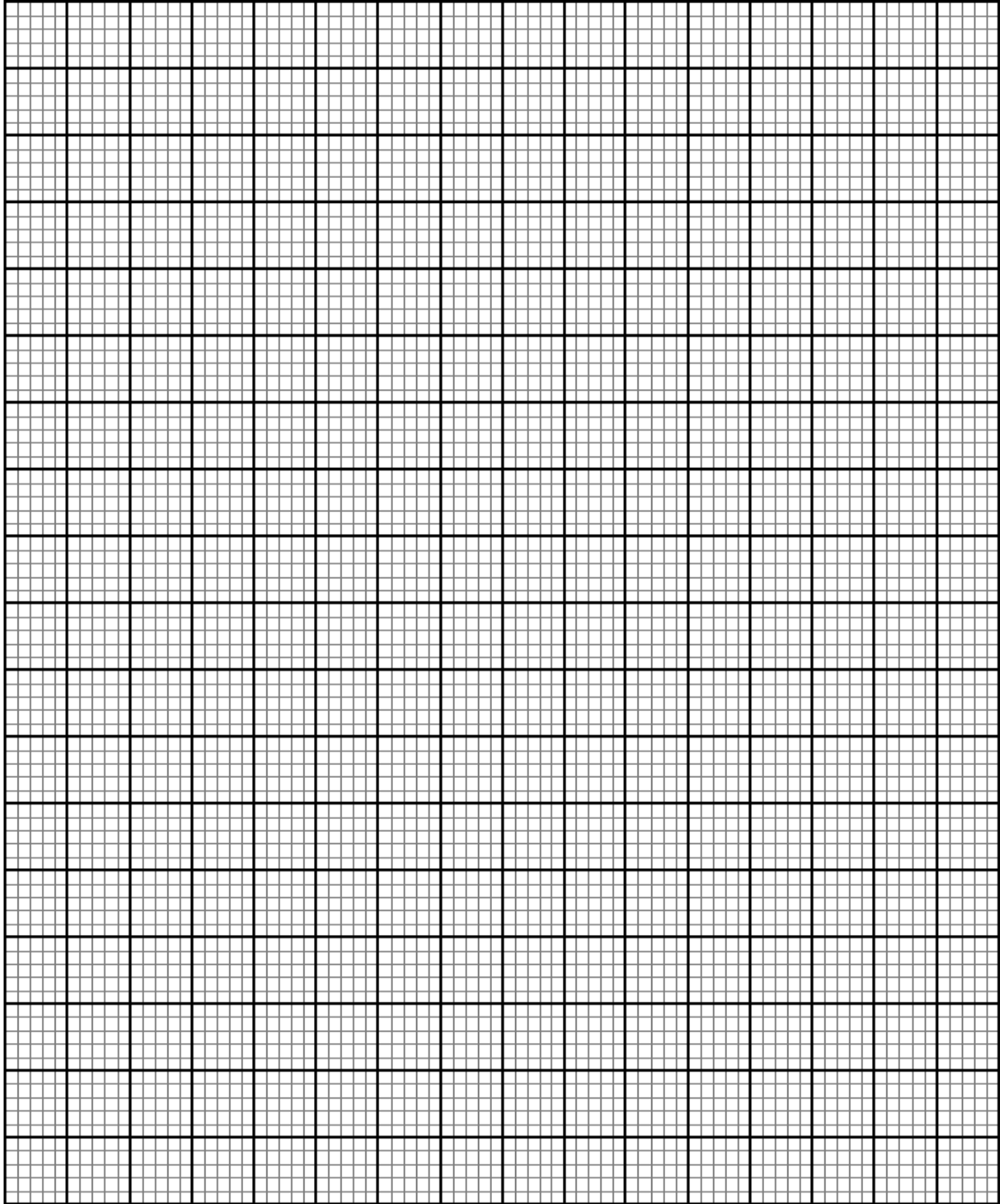   i.   Coordinates of $A^1B^1C^1D^1$ and draw it on the grid.   (2mks)

        ii.   Coordinates of $A^{11}B^{11}C^{11}D^{11}$ and draw it on the grid.   (2mks)

        iii.   Coordinates of $A^{111}B^{111}C^{111}D^{111}$ and draw it on the grid.   (2mks)

   c) Showing your working find a single matrix that will map ABCD onto $A^{111}B^{111}C^{111}D^{111}$.   (3mks)

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

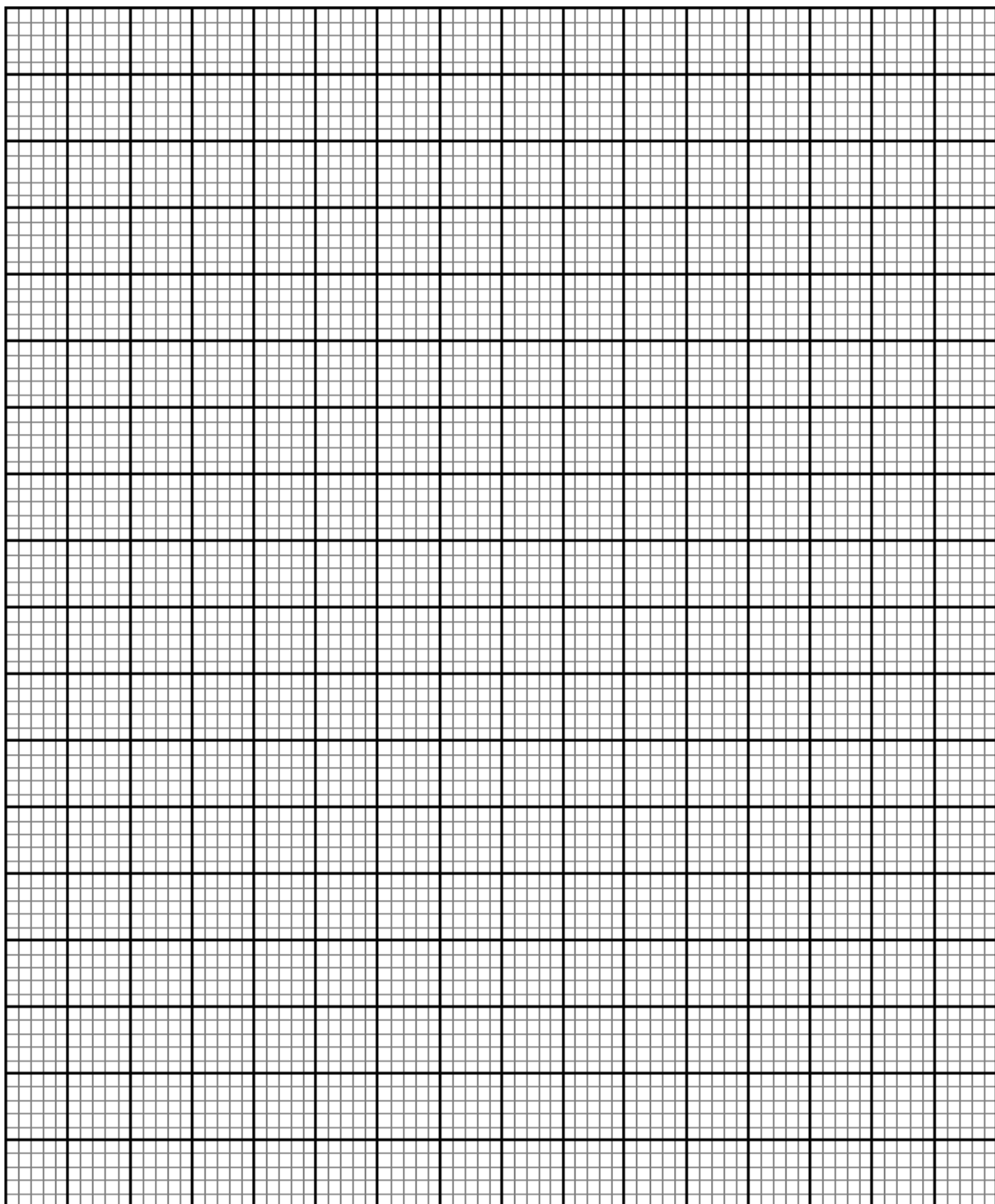| X	-5	-4	-3	-2	-1	0	1	2
$y = x^3 + 4x^2 - 5x - 5$			19			-5		

b) On the grid provided, draw the graph of $y = x^3 + 4x^2 - 5x - 5$ for $-5 \leq x \leq 2$ (3mks)

c) i) Use the graph to solve the equation $x^3 + 4x^2 - 5x - 5 = 0$ (2mks)

ii) By drawing a suitable straight line graph, solve the equation

$$x^3 + 4x^2 - x - 4 = 0$$ (3mks)

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23. A polytechnic planned to buy x lockers for a total cost of Ksh 16,200. The supplier agreed to offer a discount of Ksh 60 per locker. The polytechnic was then able to get three extra lockers for the same amount of money.

      a) Write an expression in terms of x, for the:

          i)   Original price of each locker;   (1mk)

          ii)   Price of each locker after the discount.   (1mk)

      b) Form an equation in x and hence determine the number of lockers the polytechnic bought.   (5mks)

      c) Calculate the discount offered to the polytechnic as a percentage   (3mks)

24. i) Using ruler and compasses only construct triangle ABC such that AB=4 cm, BC= 5cm
    and <ABC=120^0. (3mks)

    ii) Measure AC (1mk)

    iii) On the same diagram draw a locus of points equidistant from point A and point C and
    label the locus as L_1. (1mk)

iv) Draw on the same diagram a locus of points L_2 equidistant from point C and point B and lable the locus as L_2 (1mk)

v) label the point where L_1 and L_2 meet as O. Using O as a centre draw a locus of points L_3 touching points A, B and C. Measure the length from point O to L_3. (2mks)

vi) Draw the locus of points L_4 equidistant from line AC and Line AB. Extend L_4 to meet line BC and lable where they meet point D. Measure the length AD. (2mks)

121/2 -   MATHEMATICS ALT A   - FORM FOUR PAPER 2

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TOTAL

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o)   Marks may be given for correct working even if the answer is wrong.
p)   **Non-programmable** silent electronic scientific calculators and KNEC mathematical tables may be used except where stated otherwise.
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Section I

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Section II   **GRAND TOTAL**

17	18	19	20	21	22	23	24	**TOTAL**

SECTION I (50mks)

(Answer all questions in this section in the spaces provided.)

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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 $0^0 \leq x \leq 360^0$ (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 < 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
iv. 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)
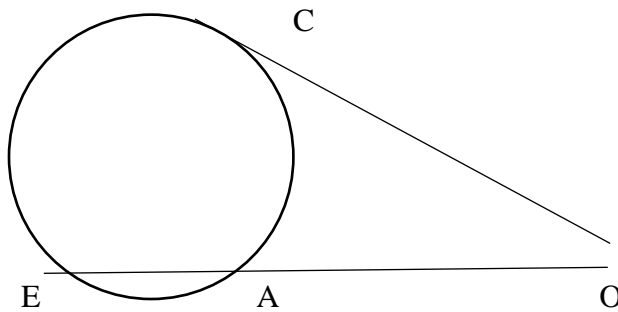
13. Evaluate $\int_1^4 (3x^2 + 1)dx$ (3mks)

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

   iv.   It is not rainy and John does not carry an umbrella. (2mks)

   v.   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

    c) Calculate the value of x (3mks)

    d) Find the common ratio of the series   (2mks)

e) Calculate the sum of the first ten terms of this series   (2mks)

f) 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)

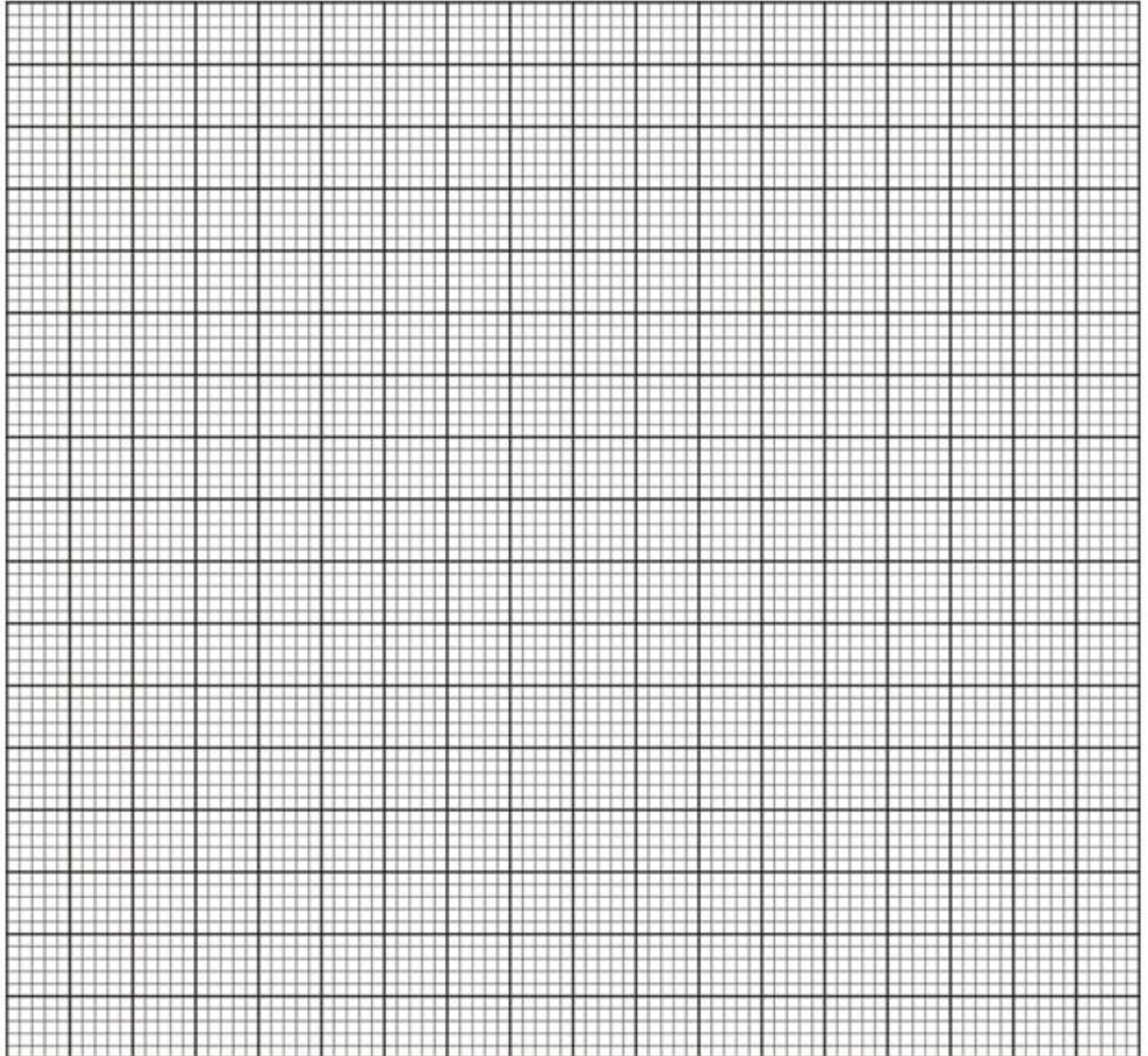19. Complete the table below for the function

$y=x^3+6x^2+8x$ (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

iii. Draw the graph of the function $y=x^3+6x^2+8x$ for $-5\leq x\leq 1$ (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)

iv. 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)

v. Find the values of x which will satisfy the inequality $x^3+6x^2+8x>1$ (2mks)

20. The figure below is a square based pyramid ABCDV with AD=DC=6cm. VO=10cm
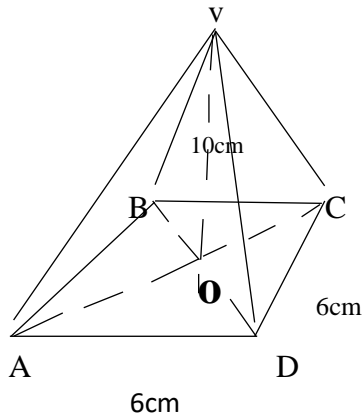
c) State the projection of VA on the base ABCD (1mk)

d) Find:

      iv. The length of VA (3mks)

v.   The angle between the planes VA and ABCD   (2mks)

vi.   The angle between the planes VDC and ABCD   (2mks)

vii. 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.

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

      Draw ABCD and A$^/$B$^/$C$^/$D$^/$ on the grid. Write down the coordinates of A$^/$B$^/$C$^/$D$^/$
      (3mks)
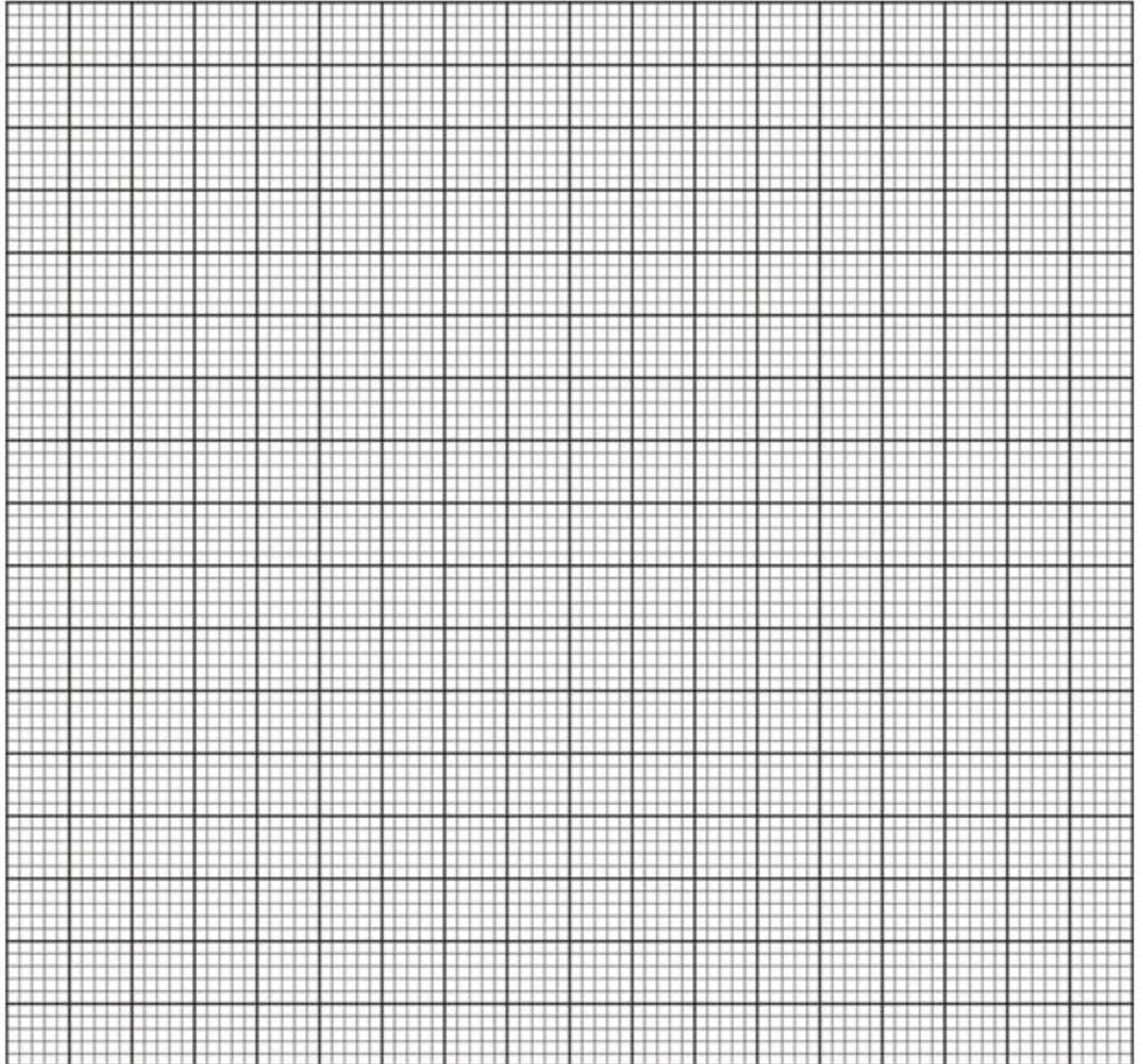
e) The points $A''(0,0)$ $B''(-6,2)$ $C''(2,6)$ and $D''(8,4)$ are the vertices of $A''B''C''D''$ the image of ABCD under a certain transformation. Draw $A''B''C''D''$ on the same grid as ABCD. Describe this transformation fully. (3mks)

f) A single transformation T maps A$^{\prime}$ B$^{\prime}$C$^{\prime}$D$^{\prime}$ on to A$^{\prime\prime}$ B$^{\prime\prime}$C$^{\prime\prime}$D$^{\prime\prime}$. 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.

d) Calculate: i) The amount of money which was deposited. (2mks)

      iv.   The rate of interest r. (2mks)

e) 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)

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.
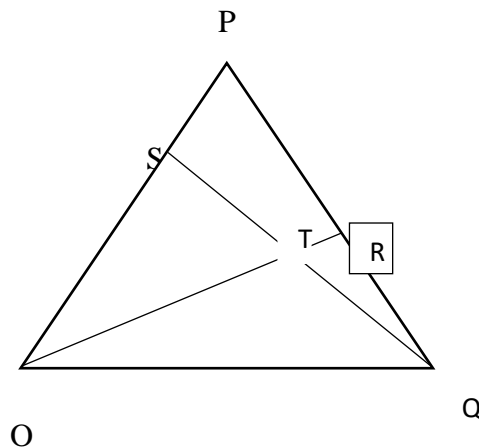
v.   Given that $\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{OQ} = \mathbf{q}$. Express the following vectors in terms of p and q:

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

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

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

vi.   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)

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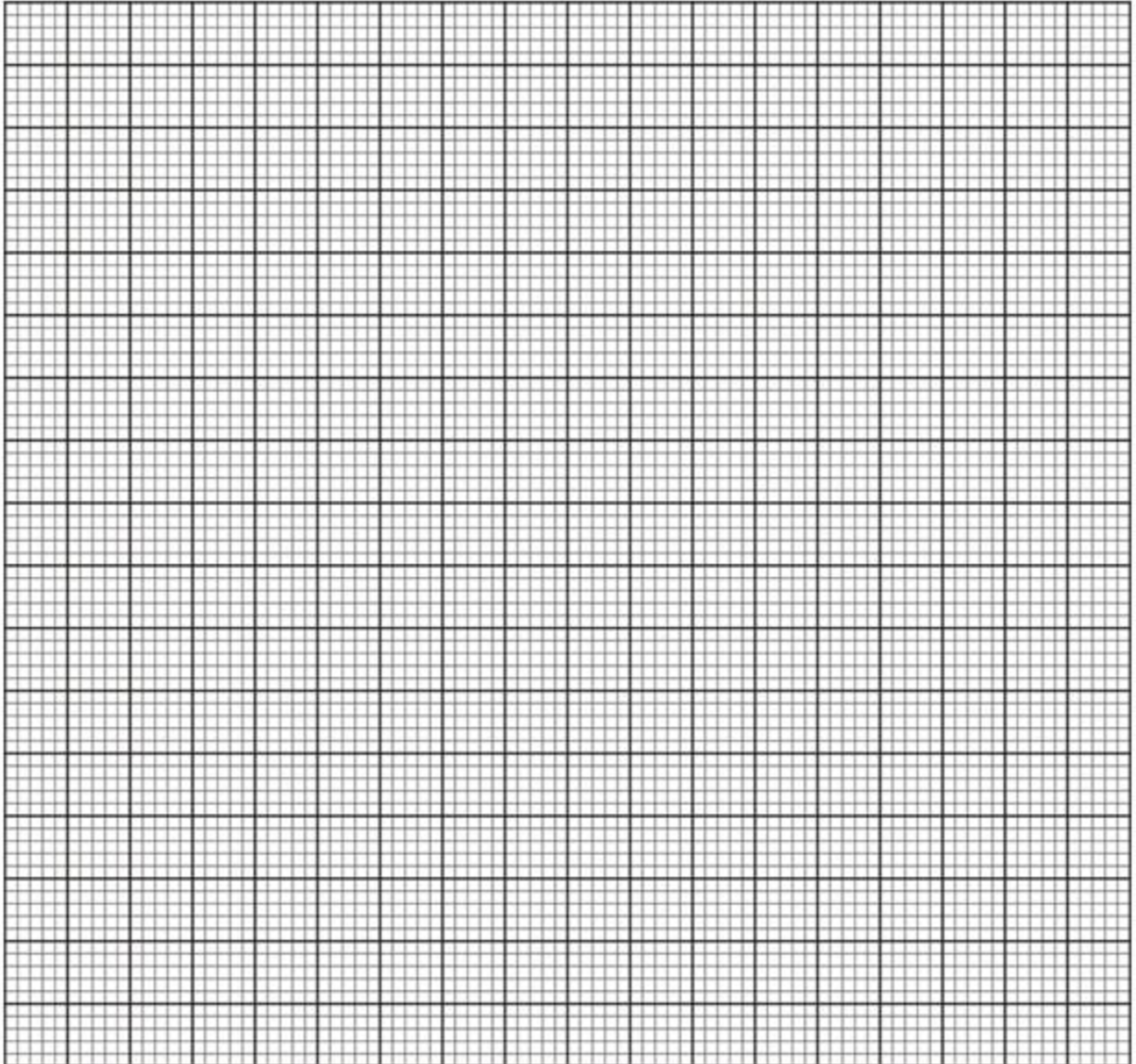
c) If type A bulbs cost sh.450 per piece and type B cost sh.350 per piece and that the higher the cost the higher the profit:

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

    e)   Calculate the maximum cost of lighting the street (2mks)

121/2 -   MATHEMATICS ALT A   - FORM FOUR PAPER 2

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FOR EXAMINER'S USE ONLY:

Section I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	**TOTAL**

Section II   **GRAND**
TOTAL

17	18	19	20	21	22	23	24	**TOTAL**

   This paper consists of 16 printed pages.
   Candidates should check the question paper to ensure that all pages are printed as indicated and no questions are missing

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

v.   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)

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

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

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

viii. 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)

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

ix. Solve for **x** in: $\text{Log}_2(x + 7) - \text{Log}_2(x - 7) = 3$ (3mks)

x. 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)

xi.   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.
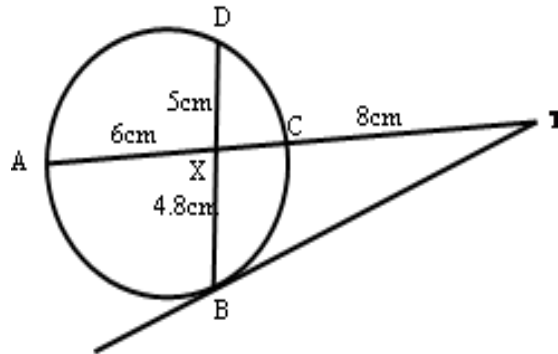
Find the length of **BT**.   (3Marks)

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

xiii.   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)

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xiv. 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)

xv. 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)

25. 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.

      iv.   Determine the fraction of the tank that is still empty.   (1mks)

      v.   Find how long it would take to fill the remaining fraction of the tank if all the three taps are opened.   (2mks)

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

27. Solve the equation $\sin(3x - 10)^0 = 0.4337$ for $0^0 \leq \Theta \leq 180^0$ (3mks)

28. (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)

SECTION II (50MARKS) ANSWER ANY 5 QUESTIIONS ONLY

29. 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;

iii) Calculate the net tax per annum.   (7mks)

iv) 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
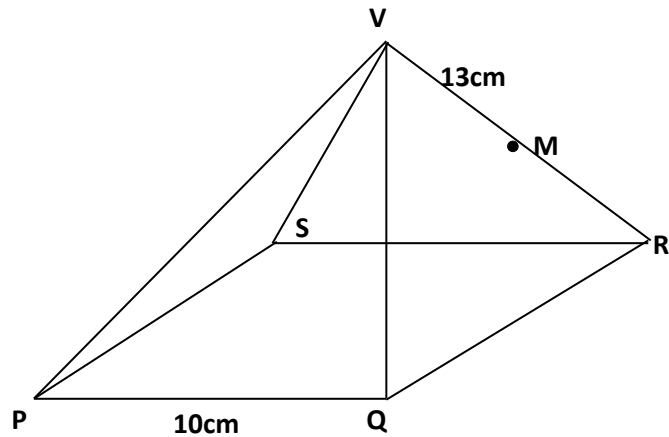
      (iii)Angle AQ1B=Angle AQ2B =30º

   Measure the length of the line Q1Q2 (3mks)

d) Calculate the area above the line Q1Q2 bounded by the locus of point P   (3mks)

    f) 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)

g)　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)
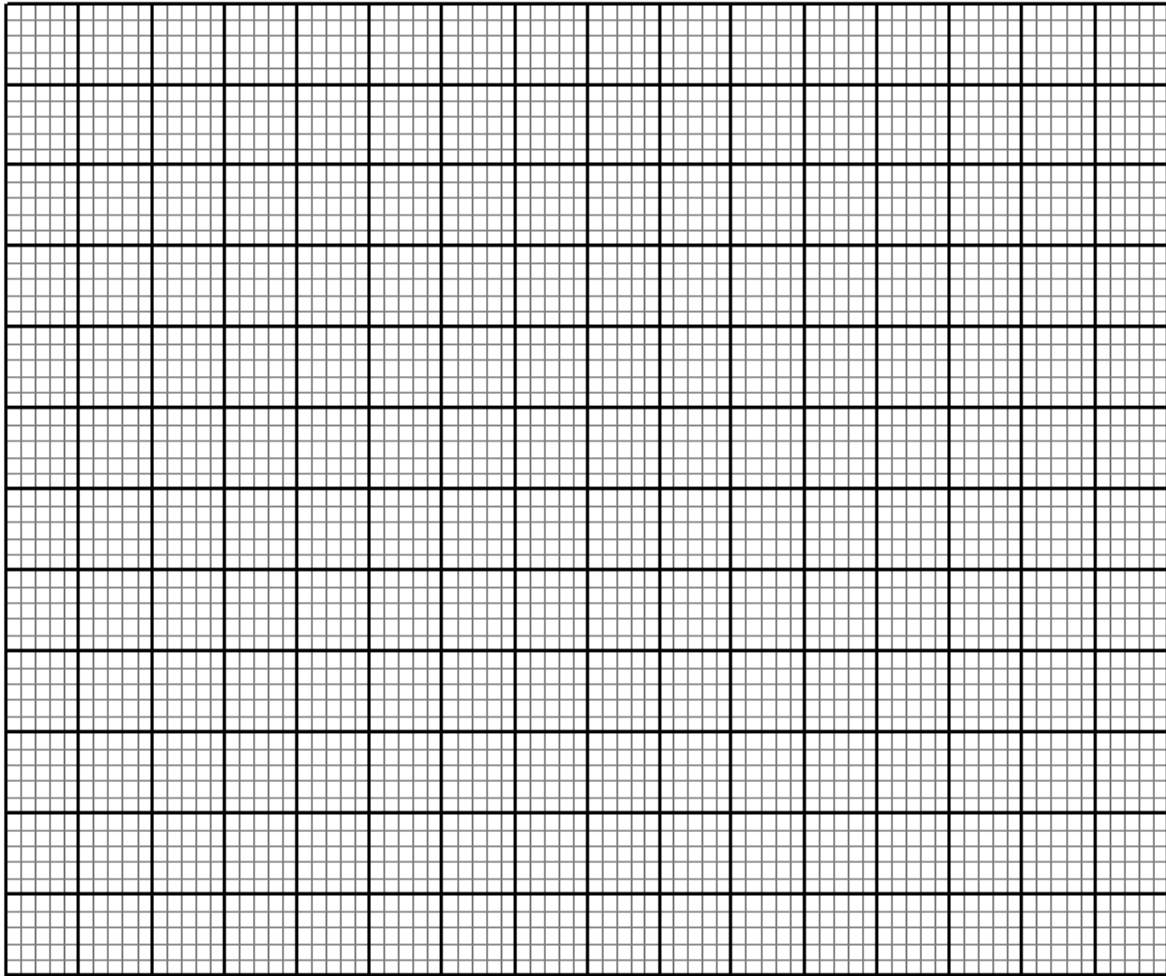
c) Use the graph to solve $sin\ (2x + 30) - sin\ 2x = 0$ (1mk)

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)

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.$\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix}$
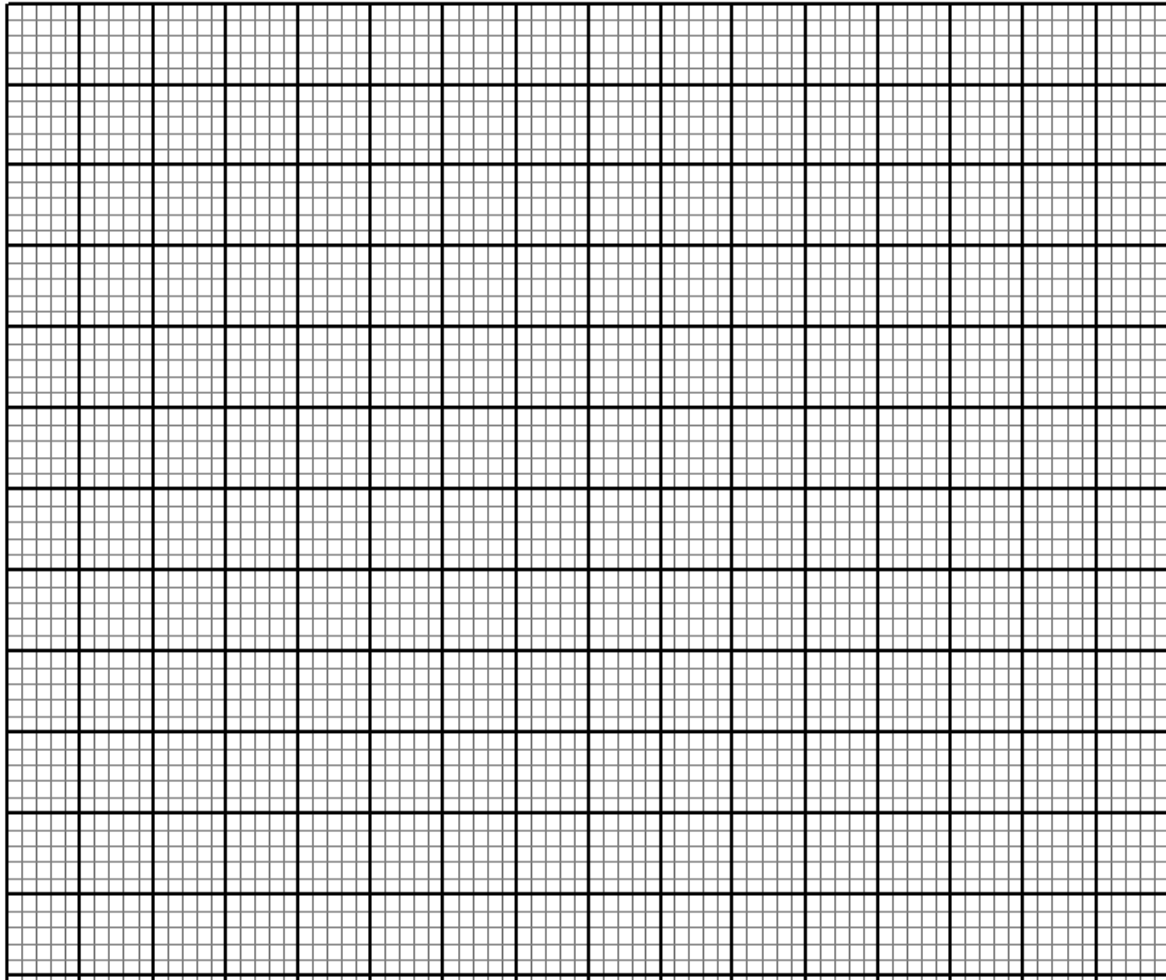
a) Find the coordinates of $O^1A^1B^1C^1$ (2mks)

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)

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

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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

c) The mean   (5mks)

d) The variance   (3mks)

e) The standard deviation   (2mks)

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

   d)   Find the probability of picking.
        g)   A brown peg.   **(1mark)**

        h)   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:

   viii.   Atleast one brown peg is picked   **(4marks)**

        ix.   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)

121/2 -   MATHEMATICS ALT A   - FORM FOUR PAPER 2

GAUGE 4 2023 KCSE
Kenya Certificate of Secondary Education (KCSE)

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b) Write name, admission number and class in the spaces provided above.
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TOTAL

17	18	19	20	21	22	23	24	**TOTAL**

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SECTION I

d) Use logarithms to 4 decimal places to evaluate   (4 marks)

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

e) Make **y** the subject of the formula   (3 marks)

$$m = d\left(\sqrt{\frac{y^2 - w^2}{r^2 + S^2}}\right)$$

f) Without using tables or calculator, evaluate and (3 marks)

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

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

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

h) 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
(3 marks)

i) 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)

j) 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.304, making a profit of 10%. Find the ratio in which he mixed the grades.
(3 marks)

k) Evaluate without using mathematical tables or calculators,

$$2 \log_{10} 5 - \tfrac{1}{2} \log_{10} 64 + 2 \log_{10} 40.$$ (3 marks)

l) 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 $x = 0.25$.   (3 marks)

m) In a triangle ABC, AB=7.2cm, AC=6.8cm and angle BAC=120^0.
   Calculate;

   e)   The length of BC to 3significant figures   (2 marks)

   f)   If a circle passes through the vertices A, B and C. Find the radius of the circle.   (2 marks)

n) The table below shows income tax rates in Kenya in a certain year.

Monthly taxable income in Ksh	Tax rate percentage % in each shilling
Upto 16 680	10%
From 16 681 to 28 900	15%
From 28 901 to 51 920	20%

During the year, MrSonga paid a net tax of Ksh. 5 449 after a relief of Ksh. 2 256 in a certain month. Calculate MrSonga's gross salary during the month if he enjoys a non-taxable travel allowance of Ksh. 15 000.

(4 marks)

o) Given that A= $\begin{bmatrix} 3 & 4 \\ 2 & 5 \end{bmatrix}$ determine:

i. the inverse of matrix A.(1 mark)

ii. Price of a skirt and a blouse using the inverse of matrix A if Doreen bought 3 skirts and 4 blouses and paid Kshs.1150 while Lumumba paid Kshs. 1000 for 2 skirts and 5 blouses from the same stall. (3 marks)

p) 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. Findthe sum of the first 10 terms of the G.P.
(3 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)

Length 1(cm) of the metal rod

Temperature T(^{0}c)
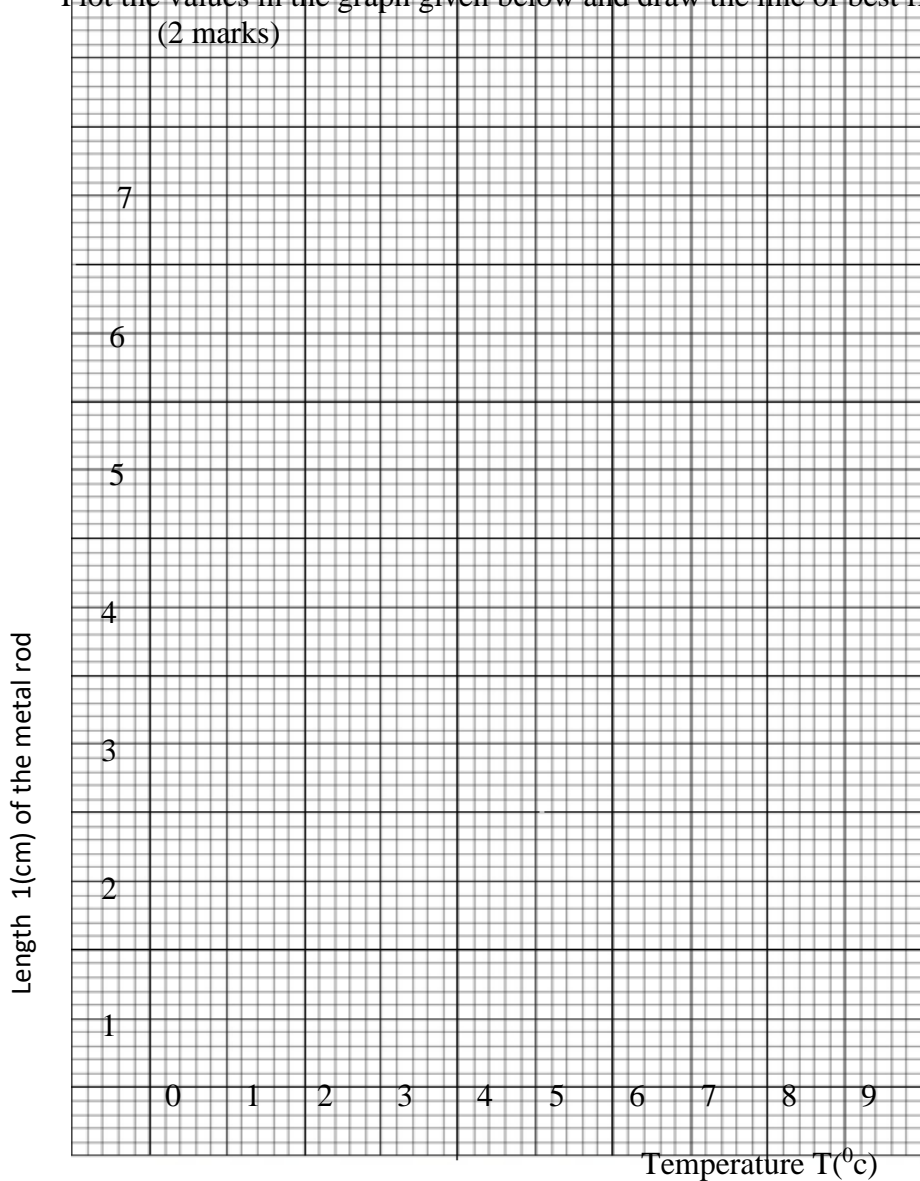
15. Evaluate the value of x in the following trigonometric equation.

$\frac{1}{2} sin^2 2x = +0.25$ 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 the equation of the circle expressing it in the form

$$x^2 + y^2 + ax + by + c = 0 \qquad\qquad \text{(3 marks)}$$

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 $P^1Q^1R^1$. Draw the triangle on the graph given. (2 marks)

iii) The triangle $P^1Q^1R^1$ 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 state its coordinates (3 marks)

v) Calculate the area of the triangle $P^{111}Q^{111}R^{111}$ drawn above. (2 marks)
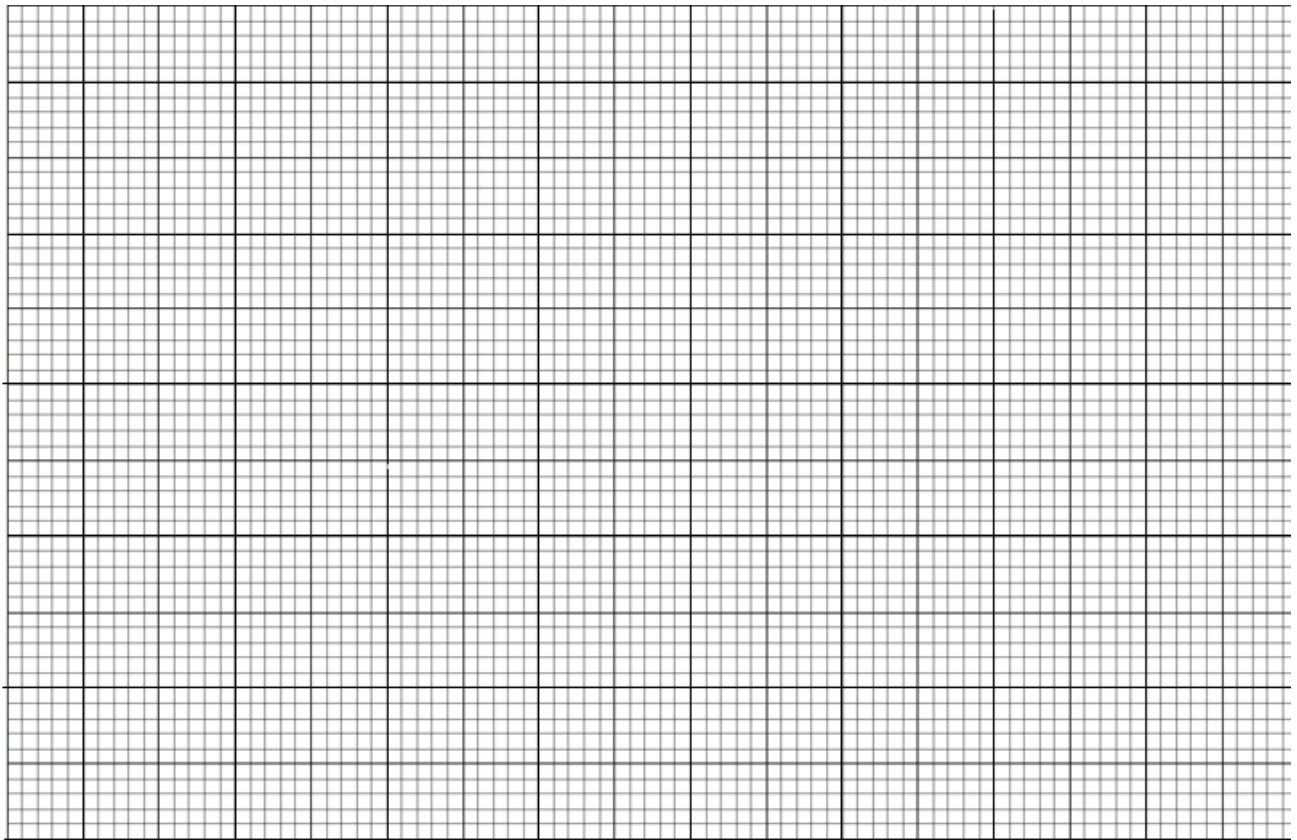
18. Using a ruler and a pair of compasses only;

   i.   Construct a triangle ABC such that AB=6cm, BC=8cm and angleABC=60^0.(2 marks)
   ii. On the same side of BC as A construct the locus of M such that angle BMC=60^0.(2 marks)
   iii. Draw the locus of a point **Q** which is equidistant from B and C.(2 marks)
   iv. Draw the locus of a point R such that RC=3cm.   (1 mark)
   v.   Draw the locus of a point P such that the area of triangle BPC=12cm^2.   (2 marks)
   vi. Locate the region by shading such that;Angle BMC $\geq$ 60^0, BQ $\geq$QC, RC<3 and area of BPC> 12cm^2(1 marks)

19.
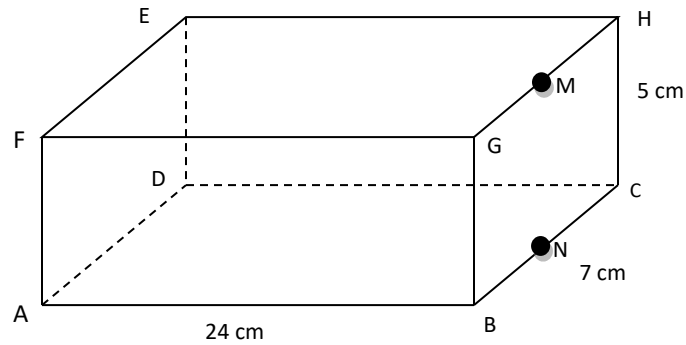
The figure above shows a cuboid in which AB = 24cm, BC = 7cm and CH = 5cm. M and N are the mid points of GH and BC respectively.

(a) Find the length of AC, AH and EM (6mks)
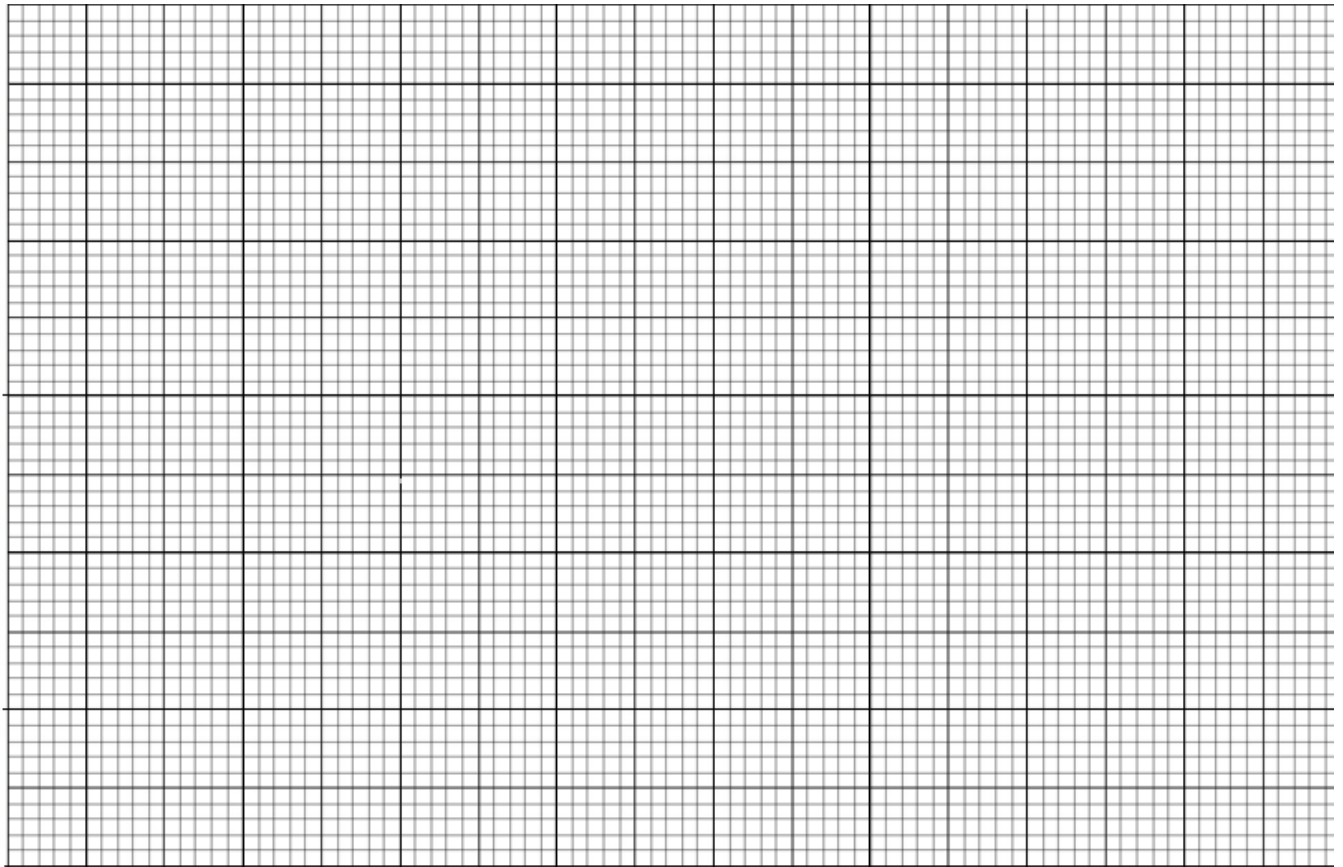
(b) Find the angle between

(i) AH and FH (2mks)

(ii) The line MD and the plane ABCD   (2mks)

20. 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

e) Draw a cumulative frequency curve in the space below. (3 marks)

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

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

x.   Calculate the 6th decile   (2 marks)

xvi. In the figure below, PQRS is a trapezium. PQ is parallel to SR. The diagonals SQ and PR intersect at T and SR=2PQ. $PQ = q$, $PS = s$, $PT = hPR$ and $ST = kSQ$, where h and k are constants
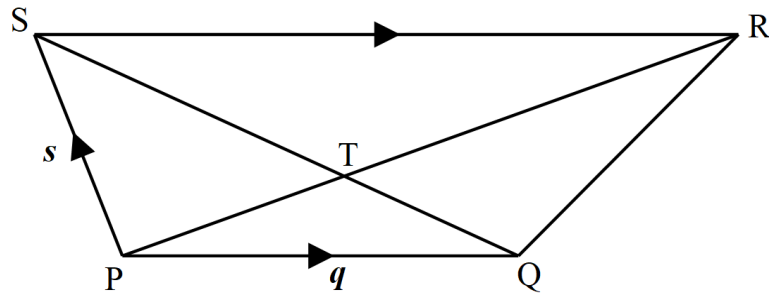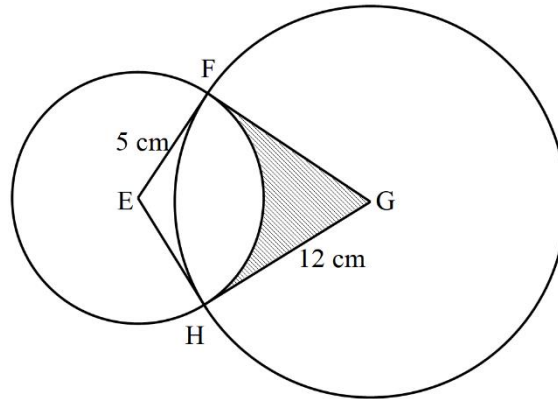

a. Find in terms of q and s:
iii. QR (2 marks)

iv. PT (2 marks)

v. ST (2 mark)

b. Determine the values of h and k (4 marks)

xvii.   The figure below, two circles, centres E and G and radii 5 cm and 12 cm respectively intersect at F and H. EG = 13 cm.
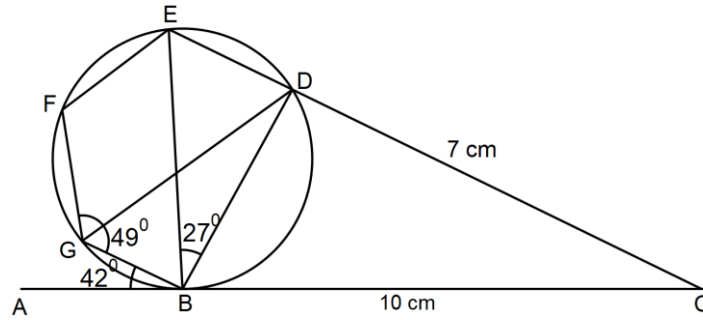

vi.   Show that $\angle EFG = 90^0$.
             (3 marks)

vii.   Calculate
        (i) the size of obtuse $\angle FEH$
             (3 marks)

        (ii) the area of the shaded part, correct to 2 decimal places. Use $\pi = 3.142$
             (4 marks)

xviii.　In the figure below, ABC is a tangent to the circle at B.

a. Given that $\angle ABG = 42^0$, $\angle EBD = 27^0$ and $\angle BGD = 49^0$, calculate the sizes of the following angles. Give reasons in each case

(i) $\angle DGE$

(2 marks)

(ii) $\angle GFE$

(3 marks)

(iii) $\angle DBC$

(2 marks)

b. Given that BC = 10 cm and CD = 7 cm, calculate DE (3 marks)

xix. Kakamega south Sub-county advertised a tender to construct its TSC offices. Two contractors
A and B assessed the work. Contractor A indicated would do the work in 12 months while contractor B indicated would do the same work in 18 months. The two contractors were awarded the tender. Contractor B did the work for three months then he was joined by contractor A.

(a) Determine;

(i) the fraction of the work done by contractor A in 3 months, (2 marks)

(ii) how long the two contractors took to complete the remaining work. (4 marks)

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(b)   Given that contractors A and B would incur expenditure amounting to sh. 120 000 per   month and sh. 90 000 per month respectively, calculate the total expenditure of each
                contractor.
(4 marks)

121/2 -   MATHEMATICS ALT A   - FORM FOUR PAPER 2

NAME: ……………………………………..……………...…………ADM NO: ……………..……

SCHOOL: ……………………………………………..………………INDEX……………………

DATE……………………………SIGN…………………………….TARGET…………………

<u>GAUGE 5 2023 KCSE</u>

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SECTION I (50 marks)

1. The sides of a triangular stool were measured as 8 cm, 10cm, and 15cm. calculate the percentage error in the perimeter correct to 2d.p.   (4marks)

2. If $2.\dot{5} \times 0.\dot{4}\dot{5} = \frac{a}{b}$ where a and b are in their simplest forms. Find the values of a and b

     (3marks)

3. The diameter AB of a circle passes through points A (-4, 1) and B(2, 1). Find the equation of the circle and leave your answer in the form $\chi^2 + y^2 + a\chi + by = c$ where a, b and c are constants.(4 marks)

4. Without using mathematical tables and calculators simplify.

                                                       (3marks)

$$\frac{2}{3 - \sqrt{7}} - \frac{2}{3 + \sqrt{7}}$$

5. Expand $(2 + x)^5$ up to the terms in x^3. Hence approximate the value of $(2.03)^5$. (3marks)

6. In the figure below it shows a triangle ABC not drawn to scale. Calculate the value of b given that AB =240m $< BAC = 30^0 \ and \ < ACB = 45^0$ (3marks)
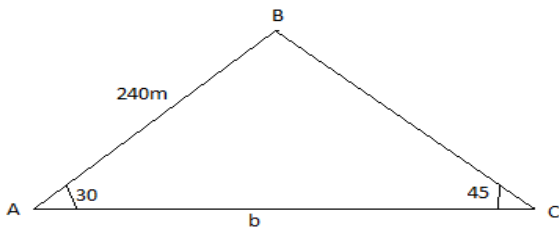
(3marks)

7. Solve for x given that the following is a singular matrix (3mks)

$$\begin{pmatrix} 1 & 2 \\ x & x-3 \end{pmatrix}$$

8. The current price of a vehicle is sh. 500,000. If the vehicle depreciates at rate of 12% p.a find the number of years it will take for its value to fall to sh. 180,000.   (3 marks)

9. Two variables are such that A is partly constant and partly varies as the square root of B. Given that

A = 27 when $B = \dfrac{1}{4}$ and A = 18; when B = 25, find A when $B = 12\dfrac{1}{4}$.   (3 marks)

10. Determine the amplitude and period of the graph of $y = 6 \sin (\dfrac{x}{2} - 90^0)$.   (2marks)

11. A cylindrical container of radius 14 cm and 7cm is filled with water. If the container was a cube, what would be the base area of the cube?   (3marks)

12. Solve the following equation. (3marks)

$$1 + \log_5 x = \log_5 12$$

13. A law relating some two variables K and L was found to be $KL^n = C$. Make n the subject of the formula. (3marks)

14. Solve the equation below by completing the square method $3x^2 - 7x + 2 = 0$ (3 marks)

15. Maize and millet costs Sh. 45 and Sh. 56 per kilogram respectively. Calculate the ratio in which they were mixed if a profit of 20% was made by selling the mixture at 66 per kilogram. (4marks)

16. In the figure below OA = 10cm and the radius of the circle is 4cm. Calculate the area of the shaded part. (Give your answer in terms of π)
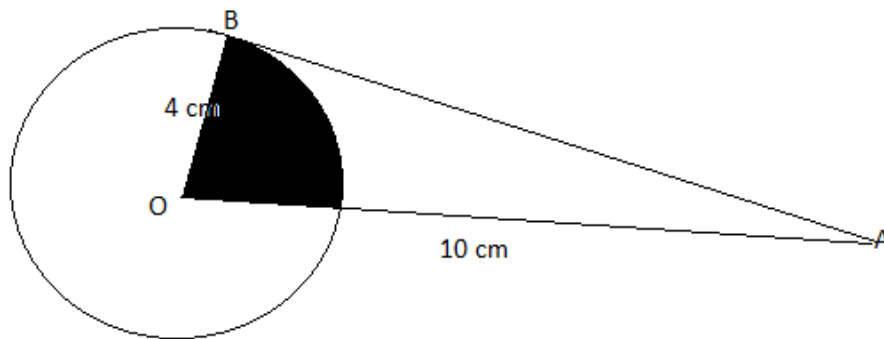
(3mk)

Section II (Answer five questions only from this section)

    a) 17. a) The 2nd, 4th and 7th terms of AP are the first 3 consecutive terms of a GP. If the common difference of the AP is 2, find

i.   Common ratio of the GP   (3mks)

ii.   Sum of the first eight terms of a GP   (2mks)

ii) Find the number of terms in the sequence -3, 0, 3 ……….54   (2mks)

(c) A business woman wants to raise her capital to sh20, 000. She opens an interest free account with initial deposit of sh1500 in the first month. After how many years will she be able to raise the capital?
        (3 marks)

18. Mr. Johnson is a teacher in Kenya .He earns a basic salary of Sh. 19,620 per month. He is paid a house allowance of Sh. 12,000, a medical allowance of Sh. 2,246 and a commuter allowance of Sh. 4,129 .He is deducted Sh. 1,327 towards a Retirement Benefit's Scheme.
Use the tax rates given below to answer the questions below.

Monthly taxable (sh p.m)	Rate of tax (%)
0 – 10,164	10
10,165 – 19,740	15
19,741 – 29,316	20
29,317 – 38,892	25
Over 38,892	30

(a) Calculate the monthly taxable income.
    (2marks)

(b) Calculate the PAYE he pays to the government if he gets a monthly tax relief of Sh. 1162.
                                                                                        (6mark
                                                                                        s)

(c) Calculate his net monthly salary
    (2marks)

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19. The table below shows the distribution of ages in years of 50 adults who attended a clinic:-

Age	21-30	31-40	41-50	51-60	61-70	71-80
Frequency	15	11	17	4	2	1

(a)   State the median class   (1mk)

(b)   Using a working mean of 45.5, calculate:-
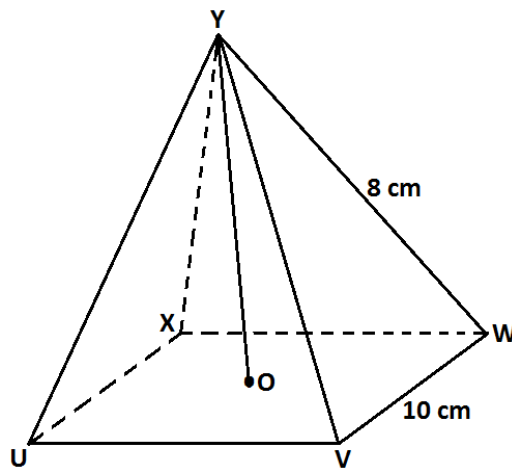
    (i)   the mean age

(3mks)

    (ii)   the standard deviation

(3mks)

(iii)   Calculate the 6thdecile.

(3mks)

20. UVWXY is a right pyramid on a horizontal square base of side 10cm. YU =YV = YW =YX = 8cm.

(a) Calculate the height of the pyramid.
        (3marks)

(b) The angle between
(i) The slant face YWV and the base UVWX.
        (2marks)

(ii) YV and the base UVWX.
    (2marks)

(c) Calculate the angle between the planes UVY and WXY.
    (3marks)

21 The probability that three candidates; Anthony, Beatrice and Caleb will pass an examination are

$\frac{3}{4}, \frac{2}{3}$ and $\frac{4}{5}$ respectfully. Find the probability that:-

(a)   all the three candidates will pass

(2mks)

(b)   all the three candidates will not pass.

(2mks)

(c)   only one of them will pass

(2mks)

(d)   only two of them will pass.

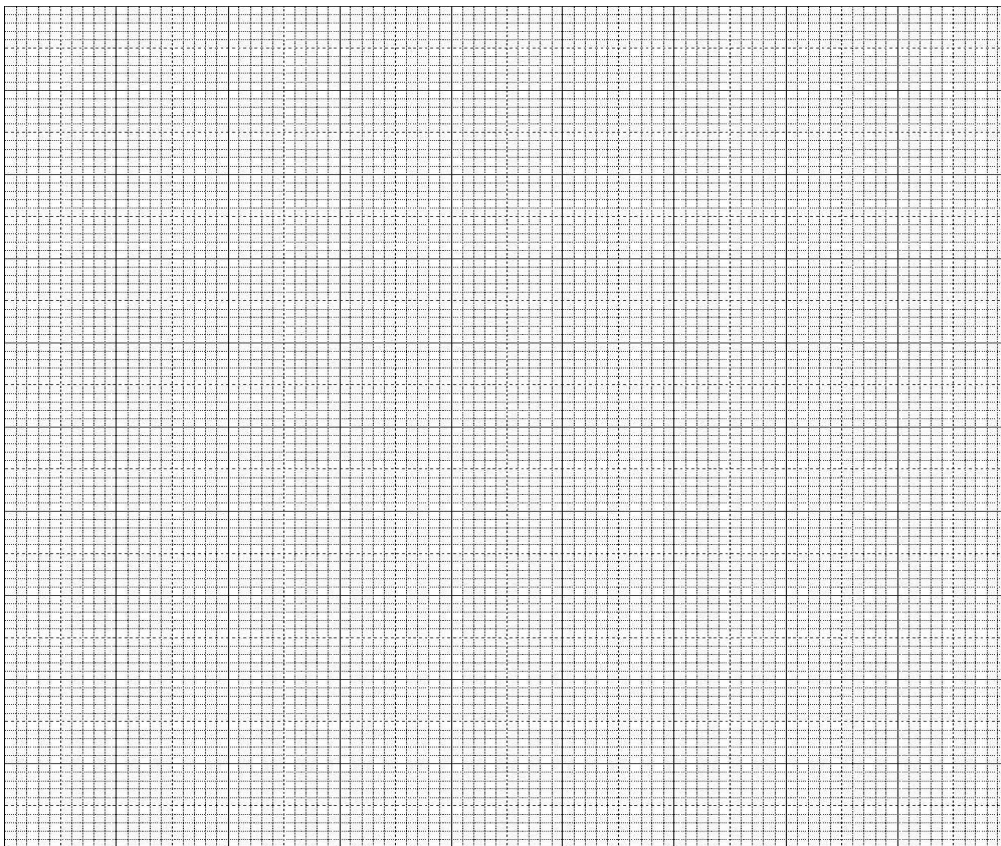(2mks)

(e)   at most two of them will pass.

(2mks)

22. Complete the table below giving your values correct to 2 d.p.
(2marks)

x	0^0	15^0	30^0	45^0	60^0	75^0	90^0	105^0	120^0
$3\cos x^0$	3.00		2.60		1.50		0	-0.78	
$4\sin(2x - 10^0)$		1.37		3.94	3.76		0.69		-3.06

(b) draw the graphs of $y = 3\cos x^0$ and $y = 4\sin(2x - 10^0)$ on the same set of axis on the grid provided.
(4marks)

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(c) Use your graph to find values of x for which $3\cos x - 4\sin(2x - 10^0) = 0$.
(2marks)

(d) State
(i) The amplitude of the graph $y = 3\cos x$.
(1mark)

(ii) The period of the graph $y = 4\sin(2x - 10^0)$.
(1mark)

23. (a) Given the matrix $P = \begin{pmatrix} 3 & 4 \\ 7 & 12 \end{pmatrix}$, find P^{-1} (2 marks)

(b) Two traders Samantha and Hussein bought goats and sheep at Sh. G per goat and Sh. S per sheep. Samantha paid a total of 60,000 for 15 goats and 20 sheep while Hussein paid a total of 64,000 for 14 goats and 24 sheep.
(i) Form a matrix equation to represent this information.   2marks)

(ii) Use the matrix method to find the cost of one goat and a sheep.
(4marks)

(c) Samantha sold all her animals at a profit of 20% per goat and 25% per sheep. Hussein sold all his animals at a profit of 25% per goat and 20% per sheep. Calculate the profit each trader made. (2 marks)

24. In the figure below, M and N are points on **OB** and **BA** respectively such that **OM**: **MB** = 2:3 and **BN:NA** = 2:1. ON and AM intersect at X
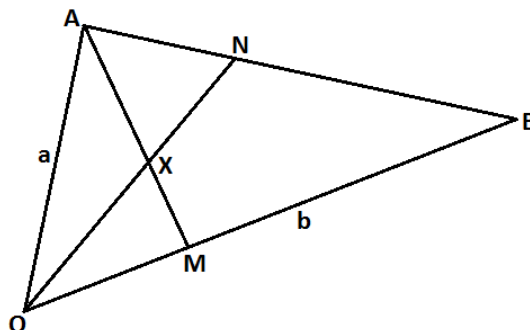
(a) Given that **OA** = a and **OB** = b, Express in terms of **a** and **b**
(i) **ON**
(2marks)

(ii) **AM**

      (1mark)

(b) Given that OX = h **ON** and **AX** = k **AM** where h and k are scalars

(i) Determine the constants k and h

      (5marks)

(ii) The ratio which X divides **AM**.

      (2marks)