# GOLDLITE ONLINE EDUCATIONAL SERVICES
## Kenya Certificate of Secondary Education
# KCSE REPLICA SERIES 2 TERM 2 2023
## MAY-AUGUST  2023- 2 ½ Hours

NAME …………………………………………… ADMISSION NUMBER …………………

CANDIDATE'S SIGNATURE…………………………………DATE………………………………………

# REPLICA 1

**121/2**
**MATHEMATICS**
**PAPER 2**

**REPLICA 1-10
CALL 0724351706
for answers**

## INSTRUCTIONS TO CANDIDATES

a) Write your name, school and Index Number in the spaces provided at the top of this page
b) The paper consists of two sections.  Section I and Section II.
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f) Marks may be given for correct working even if the answer is wrong.
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i) where stated otherwise.

**Section I**                        **FOR EXAMINER'S USE ONLY**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | TOTAL |
|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|-------|
| Marks    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |       |

**Section II**

| Question | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|----------|----|----|----|----|----|----|----|----|-------|
| Marks    |    |    |    |    |    |    |    |    |       |

**Grand Total**

1. The cash price of a phone is Ksh. 46,000. Linda bought the phone on hire purchase terms by paying a deposit of Ksh16,000 and the balance by 12 equal monthly installments of Ksh 3600. Find the compound rate of interest per month.                    (3 marks)

2. Given that $cos285° = \frac{\sqrt{6}-\sqrt{2}}{4}$ , simplify $\frac{1}{cos75°}$                    (3 marks)

3. Expand and simplify $(2 - \frac{1}{4}x)^6$ up to the fourth term. Hence use your expansion to solve $(1.96)^6$ correct to 3 decimal places.                    (4 marks)

4. Solve the equation $\log_2(2 + 3x) + 3\log_2 2 = 2 + \log_2(2x + 6)$                    (3 marks)

5.  Make x the subject of the formula; (3 marks)

$$w = 20 - \frac{1+x}{1-x}$$

6.  The ends of the diameter of a circle has coordinates (6,-5) and (-2,3). Find the equation of the circle in the form $x^2 + y^2 + bx + ay + c = 0$. (4 marks)

7.  The length and width of a rectangular floor are given as 24.2m and 7.2m respectively. The dimensions are given with 2.5% and 4% of error respectively. Find the range within which the area of this floor lie. (3 marks)

8.  Find the period, amplitude and the phase angle of y = $\frac{11}{2}$ Cos ( 3x + 28$^0$ ). (3 marks)

9. The second, sixth and the eighth terms of an arithmetic progression corresponds to the first three consecutive terms of an increasing geometric progression. If the first term of the A.P is -36, the common difference of the A.P is d and the common ratio of the G.P is r. find the value of d and r.

(4 marks)

10. A circle has two chords PQ and RS which intersect internally at point O. Given that PO= 8cm , OQ= 6cm and RO = 4.5cm, find the measurement OS.                    (2 marks)

11. The position vectors of points **U, V** and **W** are $\overrightarrow{OU} = 2\mathbf{i} - \mathbf{j} + 3\mathbf{k}$, $\overrightarrow{OV} = 6\mathbf{i} - 3\mathbf{j} + 9\mathbf{k}$ and **OW** = 18**i** – 9**j** + 27**k.** Show that **U, V** and **W** are collinear points.                    (3 marks)

12. The values below represent the height of different trees in a school.
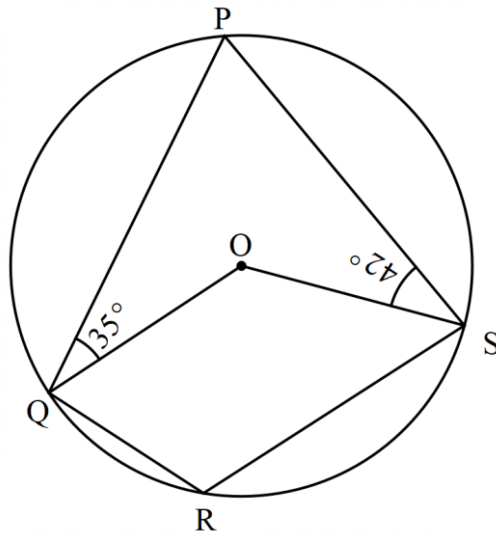
4

34,23,65,11,12,42,33,49,40,28,69,41,37,19,24,47, Calculate the quartile deviation of the height of the trees.
(3 marks)

13. The table below shows the values of x and y. Draw the curve on the graph below hence find the gradient of the curve when x = 2        (3mks)

| X | 1 | 2 | 3 |
|---|---|---|---|
| Y | 3 | 2 | 1.7 |
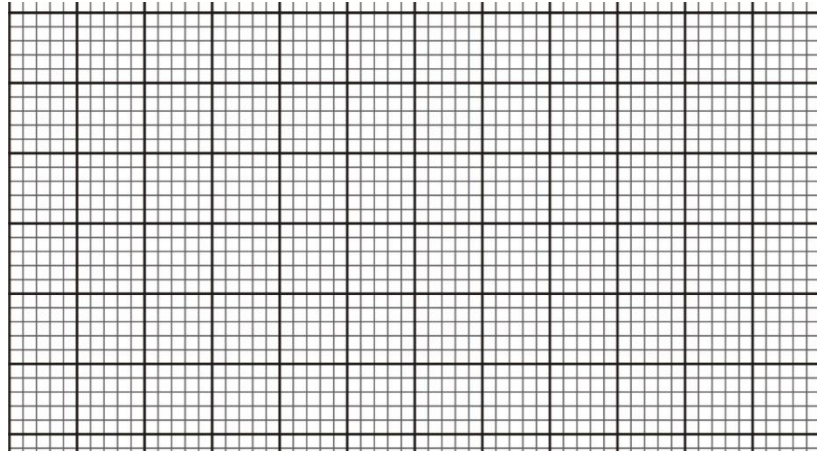
14. In the figure below, PQRS is a cyclic quadrilateral. Point O is the centre of the circle. Angle PQO = 35° and angle PSO = 42°

Calculate the size of angle QRS.                                                    (2 marks)

15. Use logarithm tables to evaluate                                                (4 marks)

$$\frac{\sqrt{0.0024}}{321} \times 32.48^2$$

16. T is a transformation represented by the matrix $\begin{pmatrix} 5x & 2 \\ x & -3 \end{pmatrix}$. Under T, a square of area 10cm$^2$ is mapped onto a square 110cm$^2$. Find the values of $x$.                (3 marks)
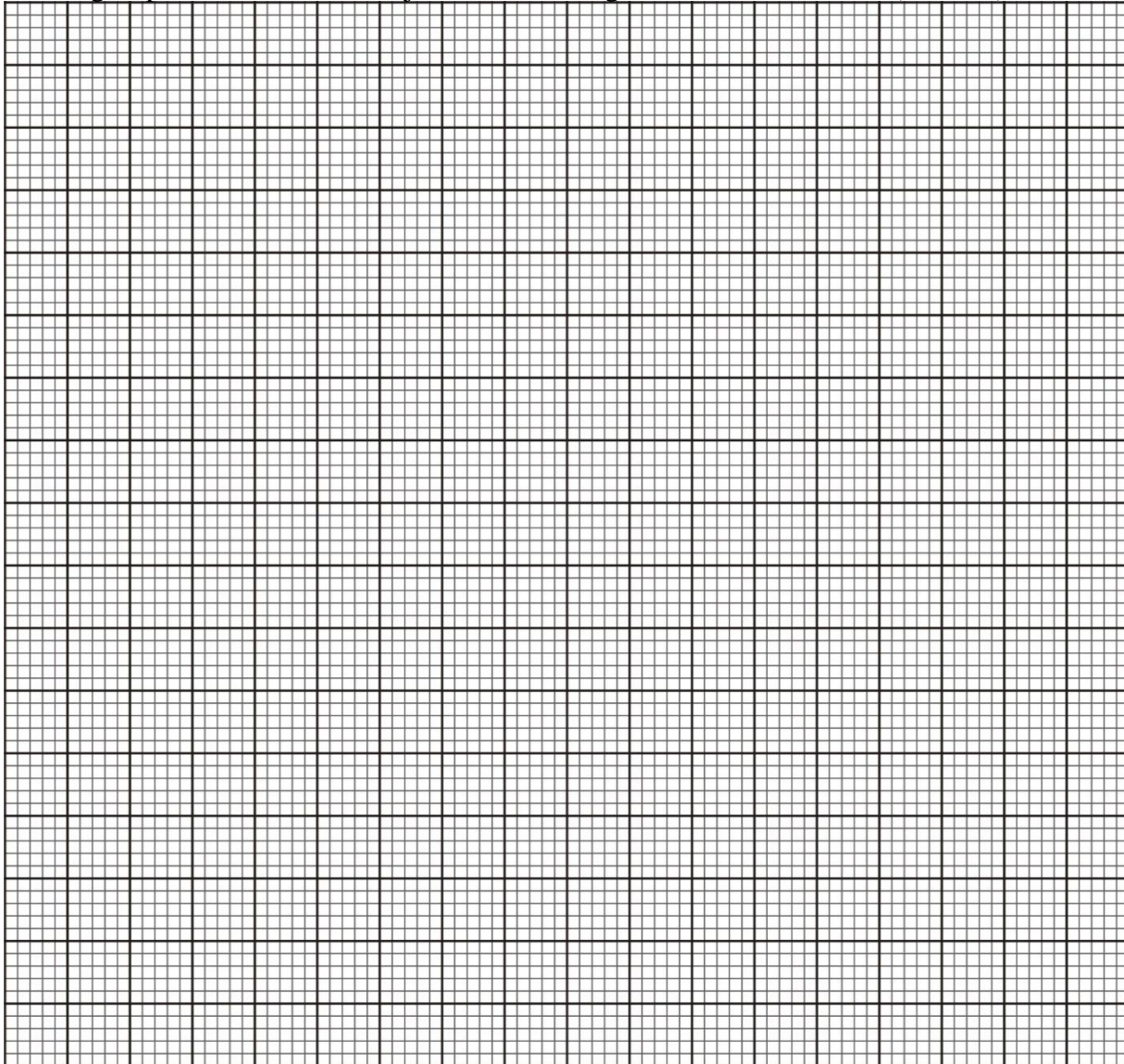
17. The vertices of triangle $A^1B^1C^1$ are $A^1(1,3), B^1(3,-4)$ and $C^1(5,-6)$. Triangle $A^1B^1C^1$ is the image of triangle ABC under a transformation whose matrix is $\begin{pmatrix} 1 & 0 \\ -2 & 1 \end{pmatrix}$.

    (a) Determine the coordinates of triangle ABC.                              (3 marks)

    (b) On the grid provided, draw the objects and the image.                   (2 marks)

    

    (c) (i) Describe fully the transformation which maps ABC onto $A^1B^1C^1$.    (2 marks)

    (d) The triangle ABC undergoes a transformation given by the matrix $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$, to give the image ABC. Draw the image on grid hence describe the transformation. (3 marks)

18. The table below shows the masses of form three students in a class

| Mass | Freq. | |
|---|---|---|
| 30 – 44 | 2 | |
| 45 – 49 | 8 | |
| 50 – 54 | 15 | |
| 55 - 59 | 18 | |
| 60 – 64 | 8 | |
| 65 – 69 | 4 | |
| 70 – 74 | 1 | |
| | | |

Using an assumed mean of 57, calculate

(i)     The mean.                                                                     (4 marks)

(ii)    The standard deviation.                                                       (6 marks)

19. (a)Using a ruler and a pair of compass only, construct triangle ABC in which AB = 8cm, and   AC=8cm and
    <BAC = $60^0$                                                    (2 marks)
    (b) Determine the locus $L_1$ of points equidistant from A and B                          (1 mark)
    (c) Determine the locus $L_2$ of points equidistant from AC and AB                         (1 mark)
    (d) Determine the locus P of points such that <APB = $140^0$                               (2 marks)

(e) Determine the locus Q of points such that CQ=5cm (1mark)
(f) A point W moves inside the triangle such that $AL_1 \leq BL_1$, $< BAL_2 \leq <CAL_2$ and $CQ \geq 5cm$.
   Shade the region W. (3 marks)

20. Complete the table below, giving your values correct to 1 decimal places. (2 marks)

| $x°$ | 0 | 30 | 60 | 90 | 120 | 150 | 180 |
|---|---|---|---|---|---|---|---|
| $3 \sin x$ | 0.0 | | | 3.0 | | | |
| $2 - \cos x$ | | | 1.5 | | | 2.9 | |

(a) On the grid provided using the same axes, draw the graphs of $y = 3 \sin x$ and $y = 2 - \cos x$ for $0° \leq x \leq 360°$. Scale Y-axis- 2cm rep 1 unit. X-axis, 1cm represent $10^0$

(5 marks)

(b) Use the graph in (b) above to solve the equations;
   (i) $4 - 2 \cos x = 4$ (1 mark)

   (ii) $3 \sin x + \cos x = 2$ (2 marks)

(c) Determine the amplitude of
   (i)    3Sin x. (1 mark)

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(ii)    2 – Cos x.                                                              (1 mark)
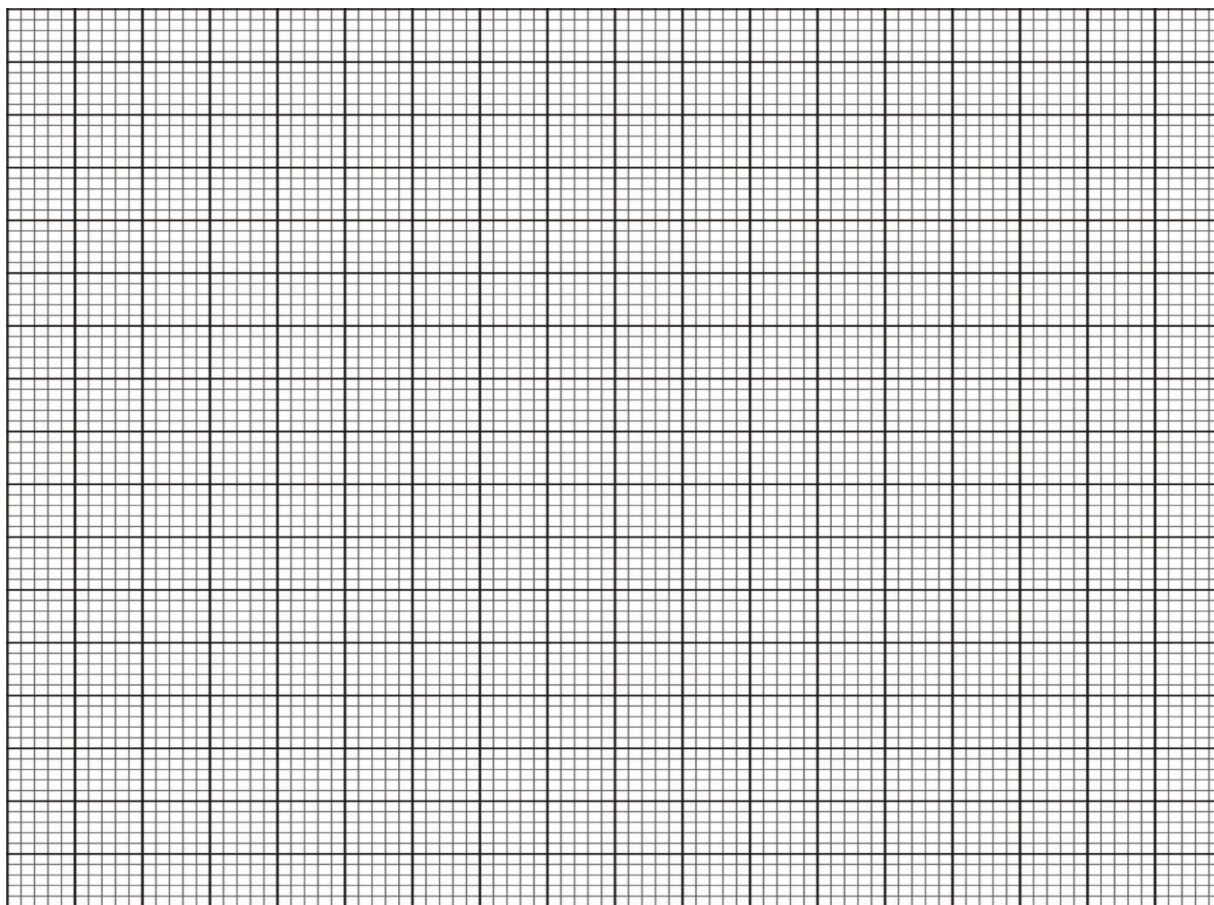
21. Triangle **OPQ** is such that OP = **p** and OQ = **q** .Point R divides OP in the ratio **1:3** and a point S divides PQ in the ratio **5:2**.OS and RQ meet at T.

a.  Express in terms of **p** and **q**.                                :
i)      OS                                                              ( 1 mark)

ii)     RQ                                                              (1 mark)

b. Given that OT=$k$OS. Express in terms of $k$, **p** and **q**.                    (1 mark)

c. Given also that RT=$h$RQ, express OT in terms of $h$, **p** and **q**.          (1 mark)

b. By expressing OT in two value of h and k.                                        (5 marks)

c. State the ratio in which S divides **OT**.                                       (2marks)

22. (a) The ratio of the cost of commodity X to that of commodity Y is 2:3 and the ratio of the cost of Y to the cost of commodity Z is 6:1. If the total cost of the three commodity is sh. 1100;

    (i)      Find the cost of x.                                           (2 marks)

    (ii)    Express the cost of Z as a percentage of the cost of Y.        (2 marks)

(b)A factory requires 100 workers to perform a certain job. After they have worked for 15 days the factory employs extra 26 persons for 6 days so that the job can be completed in time. How many workers would the factory have required at the beginning in order to complete the job in 12 days.

                            (3 marks)

(c)Tap A fills a tank in 20 minutes and tap B can empty the same tank when full in 25 minutes. Both taps are turned on at the same time for 10 minutes after which tap B is turned off. How long will it take tap A to fill the remaining part of the tank. (3 marks)

23. The table below shows tax rate in 2003.

| Income (sh p.m) | Tax rates in % |
|---|---|
| 1 -8270 | 5 |
| 8271 -15790 | 10 |
| 15791-23310 | 15 |
| 23311-30830 | 20 |
| 30831-38350 | 25 |
| 38351-45870 | 35 |
| 45871-53390 | 45 |
| Over 53390 | 50 |

Mrs Odundo earns a monthly salary of shs. 23,520, a monthly House allowance of sh. 10,000, a medical allowance of sh.3,018, a commuter allowance of sh.916 and A non-taxable allowance of sh. 4,500. He is also entitled to a personal relief of sh. 1,600 p.m.

Calculate:

(a) Calculate his taxable income per month. (2 marks)

(b) Calculate his net monthly tax. (5 marks)

(c) He also has the following to pay. Nhif of sh. 1500, Nssf of sh. 2,500, wcps of sh. 4,500. Calculate his net pay. (3 marks)

24. A student has a probability of 2/3 of waking up on time. If he wakes up on time there is a probability of 7/10 that he will catch the bus and be on time to school. If he oversleeps there is a probability of 2/5 that he will catch the bus. If he catches the bus the probability that he will reach school on time is 7/8, if he misses the bus there is only a probability of a 1/4 that he will be on time for school. Using the tree diagram or otherwise

(a) Determine.

(i) The probability that he catches the bus. (3 marks)

(ii) The probability that he is late for the school. (2 marks)

(iii) The probability that he oversleeps and is on time for school. (2 marks)

(b) Science club is made up of 6 boys and 8 girls. The club has three officials. Find the probability that the club officials has more boys than girls (3 marks)

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# REPLICA 2

## INSTRUCTIONS TO CANDIDATES

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**Section II**

| Question | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|----------|----|----|----|----|----|----|----|----|-------|
| Marks    |    |    |    |    |    |    |    |    |       |

**Grand Total**

1. Make L the subject given that H = $\sqrt{\left(\frac{3d\,(L-d)}{10L}\right)}$ (3marks)

2. Expand $\left(1 + \frac{1}{x}\right)^9$ up to the term $x^3$ hence use your expansion to find the estimate value of $100(1.05)^9$ correct to 4 significant figures. (4marks)

3. 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)
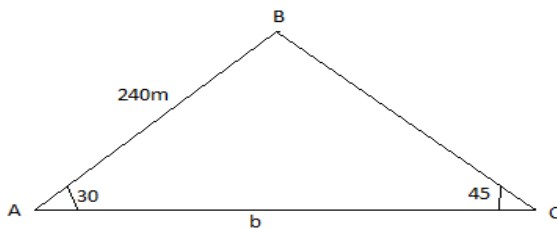
4. Without using a mathematical tables or calculators, simplify $\dfrac{3}{\sqrt{7}-\sqrt{2}} - \dfrac{2}{\sqrt{2}+\sqrt{7}}$ (3marks)

5. 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. (3marks)

6. The dimensions of a rectangle are given as 4.1cm by 2.8cm. Calculate the relative error in the area. (3marks)

7. The seventh term of an arithmetic sequence is 17, three times the third term is 3. Calculate the first term and the common difference of the sequence. (3marks)

8. At the start of the 1st year, Mr Cheruiyot, deposited Ksh. 180,000 in a bank which gives an interest of 12% p.a, compounded quarterly. Find the interest earn by Mr. Cheruiyot at the start of the 4rd year. (3marks)

9. A quantity P varies partly as n and partly as the square of n. When P= -3, n= -1 and when P= 18, n=2. Find P when n =1 (3marks)

10. Find the inverse of $\begin{pmatrix} 5 & -2 \\ 2 & -1 \end{pmatrix}$ hence find the point of intersection of the lines whose equations are

$5x - 2y = 5$ (4marks)
$y = 2x - 3$

11. Evaluate the following expression without using mathematical tables or a calculator

$3 \log_{10}4 + \log_{10}125 - 3\log_{10}2.$ (3marks)

12. The area of triangle ABC is 7cm². Find the area of the image of ABC, if its transformed using the matrix $\begin{pmatrix} 4 & 5 \\ 1 & 2 \end{pmatrix}$. (3marks)

13. Given that vectors a =3i-j=2k, b= 4i+2j-k and p= 2a-b.
    i)    Express p in terms of i, j and k. (2marks)

    ii)   Hence calculate /p/ correct to 3 significant figures. (1mark)

14. In what ratio must Murang'a coffee costing sh.25g per 100g be mixed with Kisii coffee costing sh.17.50 per 100g, so that by selling the mixture at sh.25 per 100g, a profit of 25% is made. (3marks)

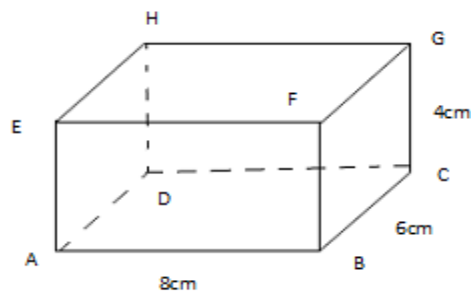15. Calculate the mean absolute deviation in the following 9,2,3,4,5,5,7,8,1. (3marks)

16. Solve for x in the equation $2 \sin (x-30^0)= -\sqrt{3}$ for the range $0 \le x \le 360^0$. (3marks)

**SECTION II (50MKS)**

17. In the cuboid below, AB = 8cm, BC = 6cm, AE = 4cm



Calculate,

a) The length BD                                                                (2marks)

b) The angle which BH makes with the plane ABCD.                               (2marks)

c) The angle between EC and the plane ADHE                                     (2marks)

d) The angle between EA and AG                                                  (2marks)

e) The angle between planes ABCD and EBCH                                      (2marks)

18. Use a pair of compass and ruler only in this question
   a) Construct a parallelogram ABCD in which AB = 6cm, AD = 4cm and angle BAD = 60°
                                                                                (3marks)

b) Measure the length AC (1mark)

c) Show the locus of point P which moves so that it is equidistant from A and C (3marks)

d) The locus of point Q which moves so that angle BQD = 90° (3marks)

19. In the figure below AB and AC are tangents to the circle center O at B and C respectively, the angle AOC = 60⁰, radius of the circle 5cm.
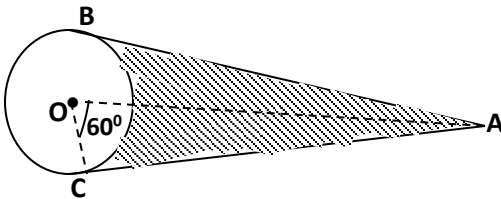


Calculate;

a) The length of AC (2marks)

b) The area of triangle OAC (2marks)

c) The area of minor sector COD (2marks)
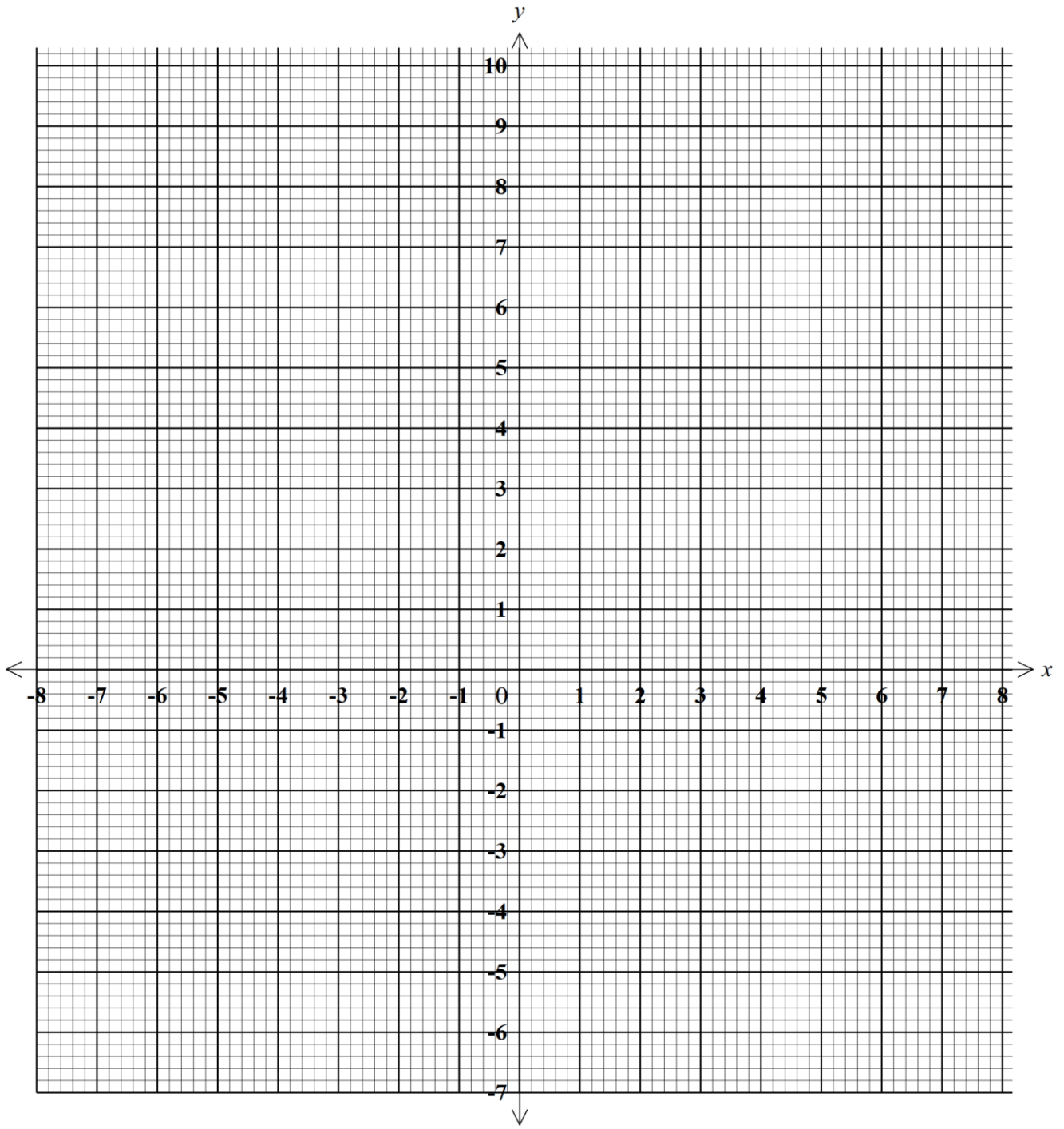
d) The area of the shaded region (4marks)

20. a) Complete the table below for the equation $y = x^3 - 5x^2 + 2x + 7$ in the range $-2 \leq x \leq 5$. (2marks)

| x | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|
| $x^3$ | | -1 | | | | | | 125 |
| $-5x^2$ | | | | | | | | |
| 2x | | | 0 | | | | | |
| 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| y | | -1 | | | | -5 | | |

b) Draw the graph of $y = x^3 - 5x^2 + 2x + 7$. (3marks)

c) Use your graph to solve the equation $x^3 - 5x^2 + 2x + 7 = 0$. (2marks)

d) By drawing a suitable straight line, use your graph to solve the equation $x^3 - 5x^2 + x + 4 = 0$. (3marks)

21. Mungai, Koskei and Kendie are participating in an athletic competition. The probability that Mungai, Koskei and Kendie complete the race in $\frac{3}{5}, \frac{1}{6}$ *and* $\frac{4}{7}$ respectively. Find the probability that in a competition;

a) Only one of them completes the race. (3marks)

b) All the three completes the race. (1mark)

c) None of them completes the race. (1mark)

d) Two of them complete the race. (3marks)

e) At least one completes the race. (2marks)

22. A businessman obtained a loan of sh.450,000 from a bank to buy a matatu valued at the same amount. The bank charges interest at 24% per annum compounded quarterly

    a)  Calculate the total amount of money the businessman paid to clear the loan in $1\frac{1}{2}$ years to the nearest shillings          (3marks)

    b)  The average income realized from the matatu per day was sh.1500. The matatu worked for 3 years at an average of 280 days per year. Calculate the total income from the matatu          (3marks)

    c)  During the three years the value of the matatu depreciated at the rate of 16% per annum. If the businessman sold the matatu at its new value, calculate the total profit he realized by the end of the 3 years (To the nearest shillings)          (4marks)

23. A church has a sitting capacity of 468 people with the members sitting in rows which have 3 long benches and 2 short ones. The long bench takes 2 people more than the short bench. Let the number of people sitting on the short bench be $x$.

   a) Form an expression in $x$ for the number of rows of benches.                    (2marks)

   b) A new pastor finds this arrangement crowded and decides that by having one more person on each long bench, he can take out some rows and still sit the same number of people. Find an expression in x for the new number of rows of benches.                    (2marks)

   c) If one row of benches was taken out, find the original number of people per row. (6marks)

24. a) Fill in the table below giving the values correct to 2 decimal places. (3marks)

| x | 0 | $30^0$ | $60^0$ | $90^0$ | $120^0$ | $150^0$ | $180^0$ | $210^0$ | $240^0$ | $270^0$ | $300^0$ | $330^0$ | $360^0$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sin 2x | | | | | | | | | | | | | |
| 3cos x-2 | | | | | | | | | | | | | |

b) On the grid provided draw the graphs of y=sin2x and y=3cosx – 2 of $0^0 \le x \le 360^0$ on the same axis. Use the scale of 1cm to represent $30^0$ on the x axis and 1cm to represent 1 unit on the y axis. (5marks)

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

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# REPLICA 3

**121/2**
**MATHEMATICS**
**PAPER 2**

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**Section II**

| Question | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|----------|----|----|----|----|----|----|----|----|-------|
| Marks |  |  |  |  |  |  |  |  |  |

**Grand Total**

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

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 $\pi = 3.142$, 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.
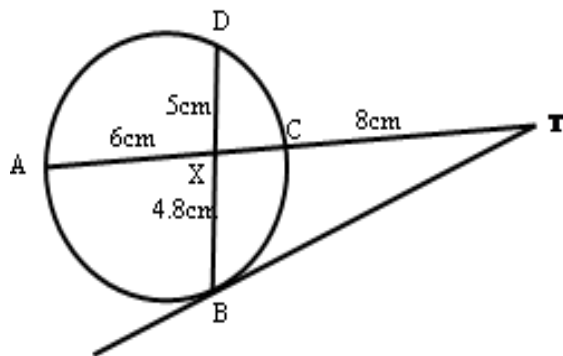


Find the length of **BT**. (3Marks)

8. Find the possible values of x given that $\begin{bmatrix} x+8 & 8 \\ 6 & x \end{bmatrix}$ 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 **2$^{nd}$, 4$^{th}$**and **7$^{th}$** 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)

## SECTION II (50MARKS) ANSWER ANY 5 QUESTIIONS ONLY

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)
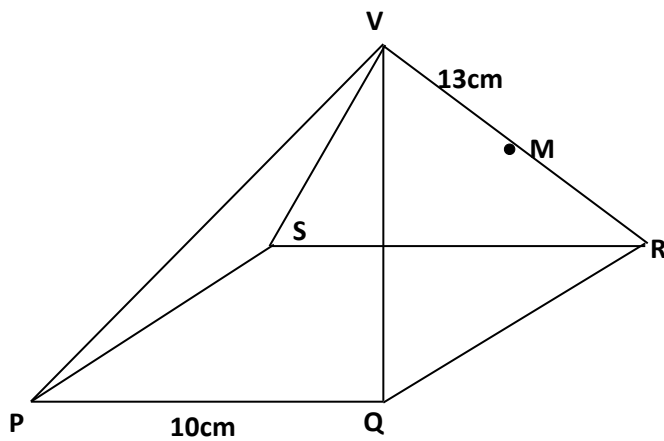
    (ii) Area of triangle AQ1B=Area of triangle AQ2B= 3/4 Area of triangle ABC

    (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 |

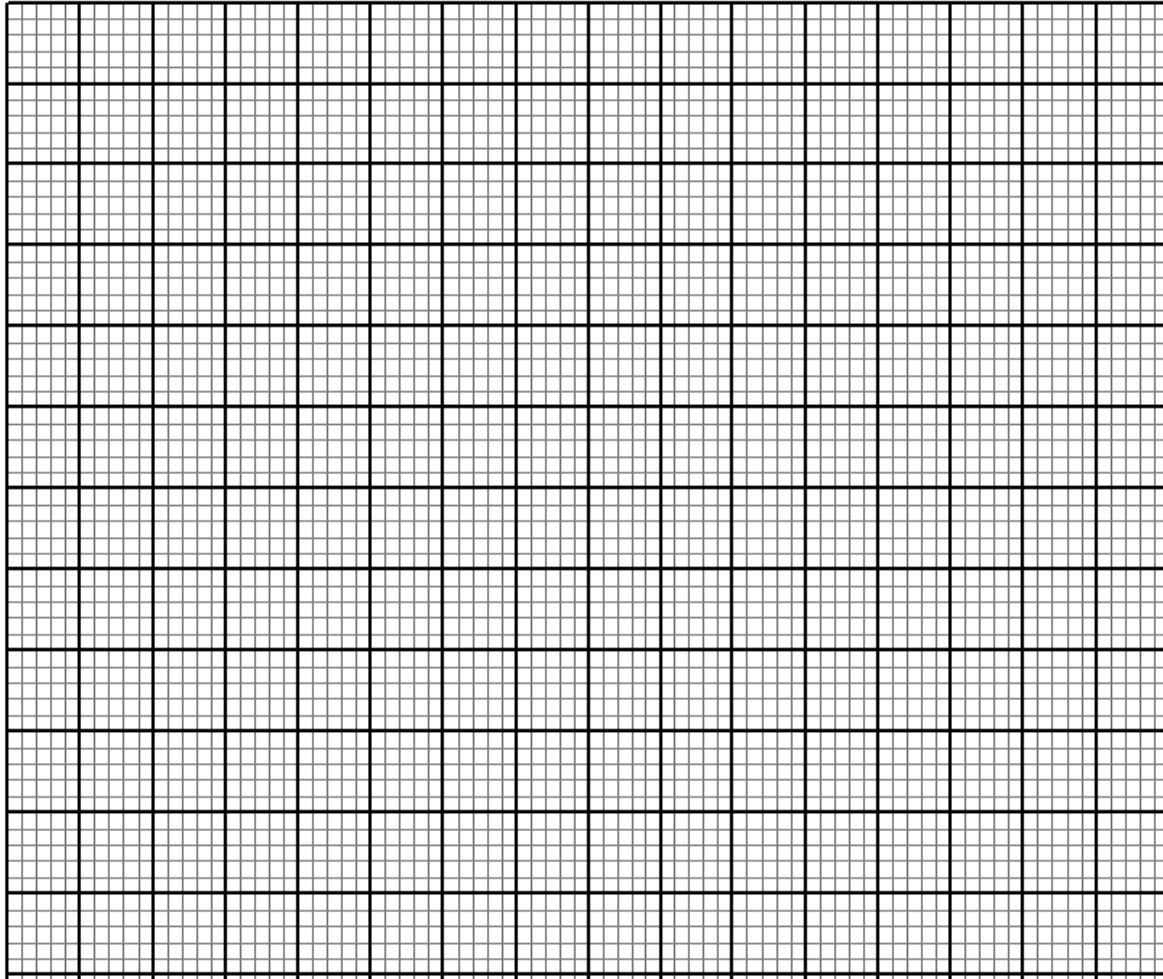b) Draw the graphs of y=sin 2x and y = sin (2x + 30) on the axis. (4mks)
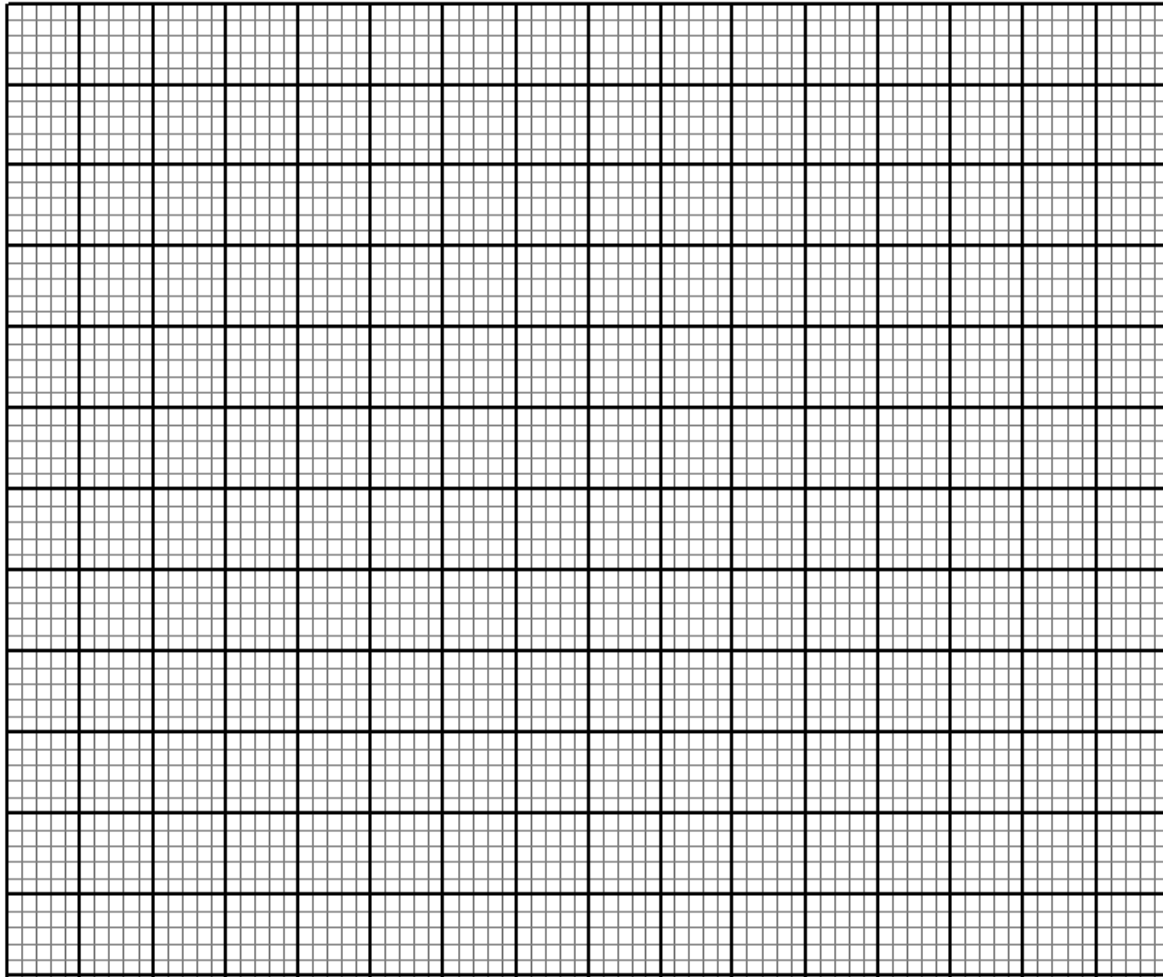


c) Use the graph to solve $sin\ (\ 2x\ +\ 30) - sin\ 2x\ =\ 0$ (1mk)

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)

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)       Atleast 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)

# GOLDLITE ONLINE EDUCATIONAL SERVICES

## Kenya Certificate of Secondary Education

# KCSE REPLICA SERIES 2 TERM 2 2023

## MAY-AUGUST 2023- 2 ½ Hours

NAME ……………………………………………… ADMISSION NUMBER …………………

CANDIDATE'S SIGNATURE………………………………DATE……………………………………

# REPLICA 4

**121/2**
**MATHEMATICS**
**PAPER 2**

## INSTRUCTIONS TO CANDIDATES

a) Write your name, school and Index Number in the spaces provided at the top of this page
b) The paper consists of two sections. Section I and Section II.
c) Answer ALL the questions in Section I and any FIVE from Section II.
d) All answers and working must be written on the question paper in the spaces provided below each
e) Question.
f) Marks may be given for correct working even if the answer is wrong.
g) Negligence and slovenly work will be penalized
h) Non programmable silent electronic calculator and KNEC Mathematical tables may be used except
i) where stated otherwise.

**Section I**                         **FOR EXAMINER'S USE ONLY**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | TOTAL |
|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|-------|
| Marks    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |       |

**Section II**

| Question | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|----------|----|----|----|----|----|----|----|----|-------|
| Marks    |    |    |    |    |    |    |    |    |       |

**Grand Total**

1.  Given that the expression $4X^2 + 28x + (K + 37)$ is a perfect square.  Find the value of K.
    (3 marks)

2.  Calculate the percentage error in the volume of a cylinder whose radius 8.75cm and its height 32.5cm.
    (3 marks)

3.  Make X the subject of the formula                                    (3 marks)
    $$b = \frac{c\sqrt{X^2 - 1}}{X}$$

4.  In the figure, O is the centre of the circle.  Line AB is parallel to line DC and angle $\Delta DC = 55^0$
    Determine the size of $\Delta ACB$.                                   (3 marks)
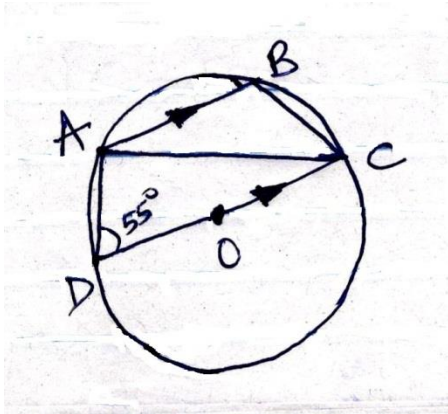


5.  Solve for X given that;
    $\frac{1}{2} Log_2\ 9 + Log_2\ [5x - 4] = 7$                          (3 marks)

6. An inlet tap can fill an empty tank in 6 hours. It takes 10hrs ro fill the tank when the inlet tap and outlet tap are both opened at the same time. Calculate the time the outlet takes to empty the full tank when the inlet tap is closed. (2 marks)

7. Solve the equation (4 marks)

$$x + 3y = 13$$
$$x^2 + 3y^2 = 43$$

8. Simplify $\dfrac{4}{\sqrt{6} + \sqrt{2}}$ (2 marks)

9. The cash price of a TV set is Ksh.20,000. A customer bought it on hire purchase terms by paying a deposit of Sh.10,000 followed by 18 equal monthly installments of Sh.900 each. Annual interest, compounded semi-annually was charged on the balance for the period of 18 months. Determine correct to 1d.p the rate of interest per annum. (4 marks)

10. The equation of a circle is given by $X^2 + 4X + y^2 - 2y - 4 = 0$. Determine the centre and radius of the circle. (3 marks)

11. In the figure AOBP is a straight line. PZ is a tangent to the circle. If PZ = 12cm and BP = 6cm, find the radius of the circle. (3 marks)
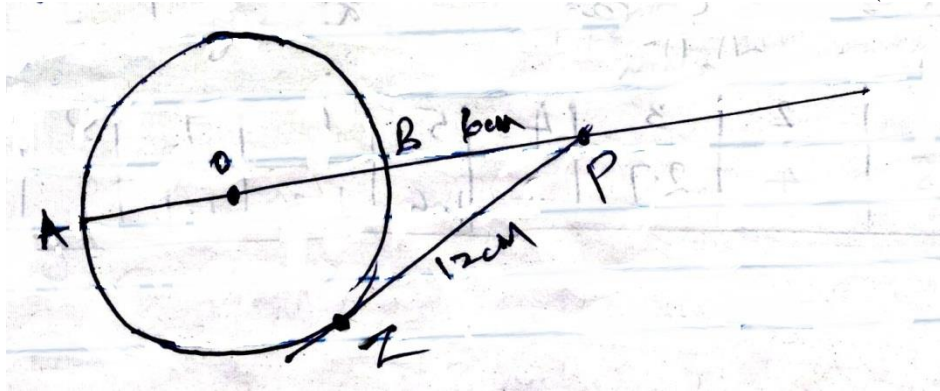


12. (a) Expand $\left(1 - \frac{3}{10}X\right)^5$ Leave the co-efficient as fraction in their lowest form.

(2 marks)

(b) Use the first three terms of the expansion in (a) above to estimate the value $(0.97)^5$ (4 marks)

13. Using the assumed mean of 50, determine the variance of the following set of numbers;
52, 45, 42, 59, 56, 46. (3 marks)

14. The table below shows the value of t and the corresponding values of h for a given relation.

| t | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| h | 8 | 4 | 2.7 | 2 | 1.6 | 1.3 | 1.1 | 1 |

a) On the grid, draw the graph to represent the information on the table given.(2 marks)
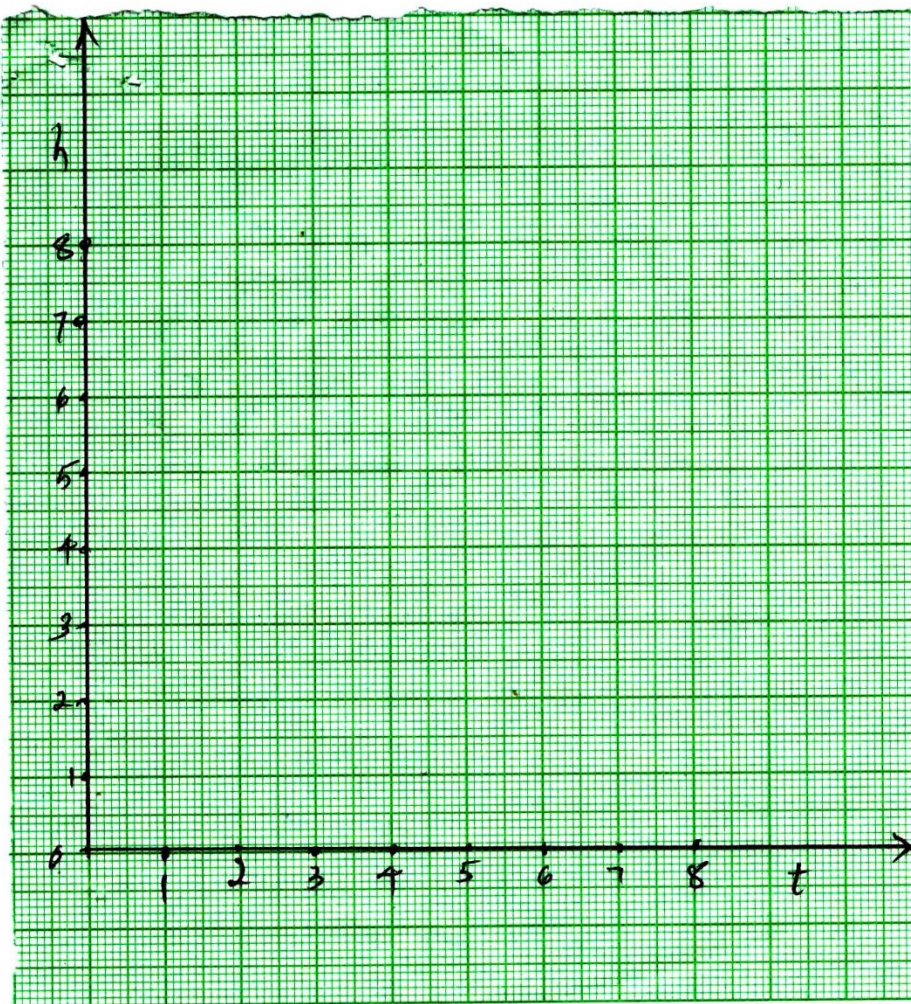


b) Use the graph to determine the rate of change of h at t = 4. (2 marks)

15. Given that **P** = 2**i** – 3**j** + **k**, Q = 3**i** – 4**i** – 3**k** and **R** = 3P + 2Q, find │**R**│ correct to 2 decimal places.

(3 marks)

16. Maize flour and millet flour were mixed.  If the maize flour costs sh.60 per kilogram and millet flour sh.90 per kilogram, find the ratio of maize flour to millet flour that gives a mixture costing sh.85 per kilogram.

(3 marks)

### SECTION II:  50 MARKS
*Attempt Only Five Questions In This Section*

17. A cup has 8 white plates and 4 brown ones all identical in shape and size.  Mrs. Kamau selected 3 plates at random without replacement.

   a)  Draw a tree diagram representing this information.

(2 marks)

   b)  Find the probability that she chooses:
       (i)  Two white plates and one brown in that order.

(2 marks)

(ii) At least one white plate. (3 marks)

(iii)Three plates of the same colour. (3 marks)

18. (a)  A quantity P varies partly as the square of M and partly a constant.  When P = 3.8, M = 2 and when
P = -0.2, M = 3.
Find:
   (i)  The equation that connects P and M (4 marks)

(ii) The value of P when M = 10.                                    (1 mark)

(b)  Q varies as the cube of x and inversely as the square root of R.  If X is increased by 20% and R is decreased by 36%;
    (i)  Find the law connecting Q, X and R.                         (2 marks)

(ii) Find the percentage change in Q                                (3 marks)

19. Three consecutive terms of geometric progression are $9^{2x+1}$, $81^x$ and 729 respectively.
    Calculate.
    a)  The value of x                                             (3 marks)

b) Find the common ratio (2 marks)

c) Calculate the sum of the first 10 terms of the series. (2 marks)

d) Given that the fifth and sixth terms of this G.P forms the first two consecutive of arithmetic sequence; calculate the sum of the first 20 terms of the sequence. (3 marks)

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

| Monthly taxable income in Kshs | Tax rates |
|---|---|
| 0 – 12298 | 10% |
| 12299 – 23885 | 15% |
| 23886 – 35472 | 20% |
| 35473 – 47059 | 25% |
| 47060 and above | 30% |

In the year, the monthly earnings of Mr.Korir
Basic salary          Ksh.60,000
Medical allowance     Ksh.16,500
Ksh.4,837.50 was erroneously exempted from his taxations.

a) Calculate Mr. Korir taxable income (2 marks)

b) Calculate Mr. Korir net tax for that month if his personal tax relief was Sh.1408 per month.

(6 marks)

c) Calculate Mr. Korir net pay for that month. (2 marks)

21. The vertices of the triangle ABC are A(3, 3); B(1, 1) and c $[5, 3]$ are mapped onto triangle $A_1B_1C_1$ by a matrix $\begin{pmatrix} 0 & 1 \\ 1 & -2 \end{pmatrix}$

a) (i) Find the co-ordinates of $A_1$ $B_1$ and $C_1$ (2 marks)

(ii)  On the grid provided below, draw triangle ABC and $A_1B_1C_1$                    (2 marks)
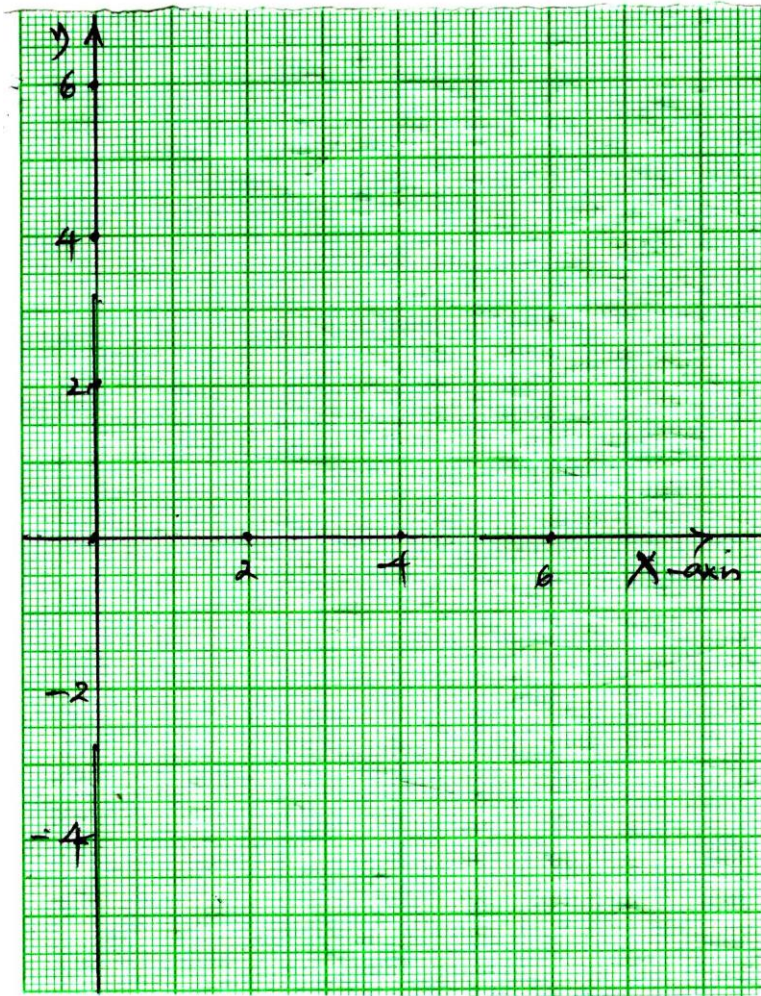


b)  (i)  Triangle $A_2B_2C_2$ is the image of the triangle $A_1B_1C_1$ under a transformation matrix. $\begin{pmatrix} -2 & 0 \\ 0 & -1 \end{pmatrix}$
    Determine the co-ordinates of A2, B2 and $C_2$                    (2 marks)

(ii)  Find the area of triangle $A_2B_2C_2$                    (2 marks)

c) Determine a single matrix that maps ABC onto $A_2B_2C_2$ (2 marks)

22. The table below shows the distances in kilometers covered by employees of a certain factory.

| Distance (Km) | 1 – 5 | 6 – 10 | 11 – 15 | 16 – 20 | 21 – 25 | 26 – 30 |
|---|---|---|---|---|---|---|
| Number of workers | 3 | 6 | 8 | 7 | 4 | 2 |

If the actual mean of the data above is 14.5km;
a) (i) Fill in the table given below.

| Class | Frequency | Midpoint (x) | d = x-14.5 | $d^2$ | $fd^2$ | |
|---|---|---|---|---|---|---|
| 1 - 5 | 3 | | | | | |
| 6 – 10 | 6 | | | | | |
| 11 – 15 | 8 | | | | | |
| 16 – 20 | 7 | | | | | |
| 21 – 25 | 4 | | | | | |
| 26 - 30 | 2 | | | | | |
| | $\sum f =$ | | | | $\sum fd^2 =$ | |

(ii) Use the values obtained from the table above to calculate standard deviations. (2 marks)

b) (i) Find upper and lower quartiles. (2 marks)

(ii) Hence calculate quartile deviation. (2 marks)

23. In this question use a ruler and a pair of compasses.
   a) (i) Construct triangle ABC such that AB = 9cm, AC = 7cm and $\Delta CAB = 60^0$ (2 marks)

   (ii) Construct the locus of point P within the triangle such that P is equidistant from A and B.
   (2 marks)

(iii)  Construct the locus of point Q within the triangle such that $CQ \leq 3.5$cm.      (2 marks)

b)  On the diagram in part (a)
(i)  Shade the region R, containing all the points enclosed by the Locus of P and Q, such that AP≥BP
(2 marks)

(ii) Find the area of triangle ABC                                                    (3 marks)

24. The table below shows some values of the curves $y_1 = 2 \cos x$  and $y_2 = 3 \sin x$
    a)  Complete the table to 1 decimal place                                          (2 marks)

| $X^0$ | $0^0$ | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Y_1 = 2 \cos x$ | 2 | | 1 | 0 | | -1.7 | | -1.7 | -1 | | 1 | 1.7 | 2 |
| $Y_2 = 3 \sin x$ | 0 | 1.5 | | 3 | 2.6 | | 0 | | -2.6 | | | -1.5 | 0 |

b)  On the grid provided, draw the graph of $y_1 = 2 \cos x$ and $y_2 = 3 \sin x$ for $0^0 \leq x \leq 360^0$
    On the same axes                                                                 (5 marks)
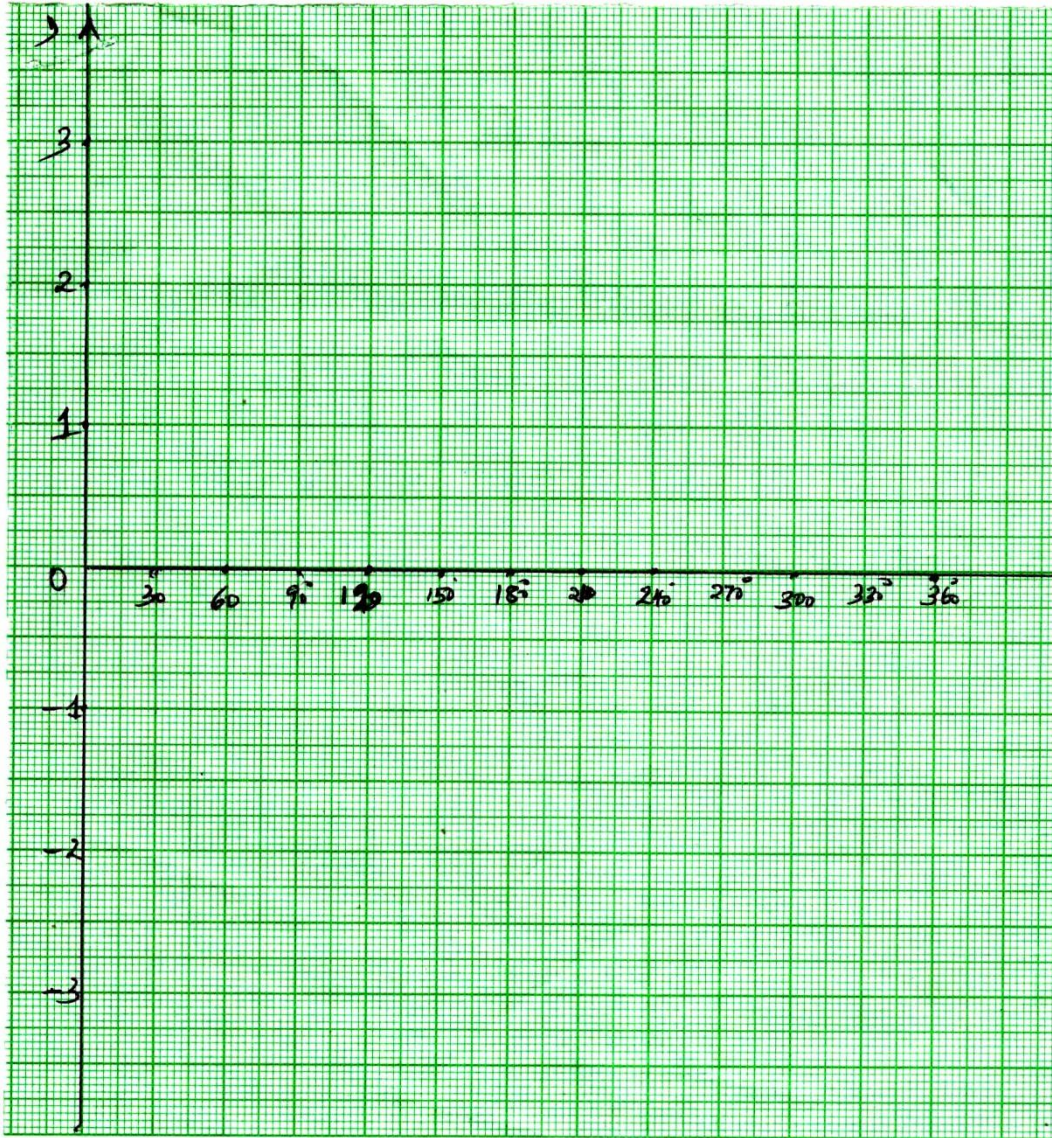
c) Use the graph to find the values of x when 2 cos x = 3 sin x          (2 marks)

d) Find the difference of the amplitude of $y = 2 \cos x$ and $y = 3 \sin x$.          (1 mark)

# GOLDLITE ONLINE EDUCATIONAL SERVICES

## Kenya Certificate of Secondary Education

# KCSE REPLICA SERIES 2 TERM 2 2023

## MAY-AUGUST 2023- 2 ½ Hours

NAME ………………………………………… ADMISSION NUMBER …………………

CANDIDATE'S SIGNATURE………………………………DATE……………………………………

# REPLICA 5

**121/2**
**MATHEMATICS**
**PAPER 2**

## INSTRUCTIONS TO CANDIDATES

a) Write your name, school and Index Number in the spaces provided at the top of this page
b) The paper consists of two sections. Section I and Section II.
c) Answer ALL the questions in Section I and any FIVE from Section II.
d) All answers and working must be written on the question paper in the spaces provided below each
e) Question.
f) Marks may be given for correct working even if the answer is wrong.
g) Negligence and slovenly work will be penalized
h) Non programmable silent electronic calculator and KNEC Mathematical tables may be used except
i) where stated otherwise.

**Section I**          **FOR EXAMINER'S USE ONLY**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | TOTAL |
|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|-------|
| Marks |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |       |

**Section II**

| Question | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|----------|----|----|----|----|----|----|----|----|-------|
| Marks |    |    |    |    |    |    |    |    |       |

**Grand Total**

**Answer ALL questions in this section in the spaces provided**

1. Solve for x

$$(\log_3 x)^2 - \frac{1}{2}\log_3 x = \frac{3}{2}$$　　　　　　　　　　[4marks]

2. In the figure below PT is a tangent to the circle from an external point P. $PT = 24\ cm$ and $OP = 25\ cm$.
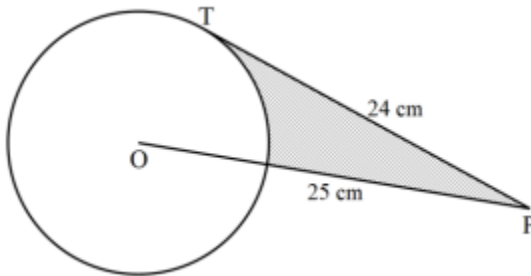


   Calculate the area of the shaded region correct to 2 decimal places　　　[4marks]

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

[2marks]

4. Simplify

$$\frac{4}{\sqrt{5}+\sqrt{2}} - \frac{3}{\sqrt{5}-\sqrt{2}}$$

(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 750cm$^2$ and 120cm$^2$ respectively. Calculate the volume of the larger container in litres given that the volume of the smaller container is 400cm$^3$.
                                                                                    (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 $V = aP^n$
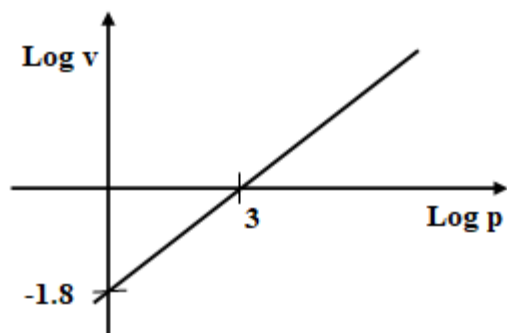


Write down the equation of a straight line in the form of $y = mx + c$ hence use the graph to find the of **a** and **n**                    [$3marks$]

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 ksh5,000, 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 $\angle CBO = 10^0$.
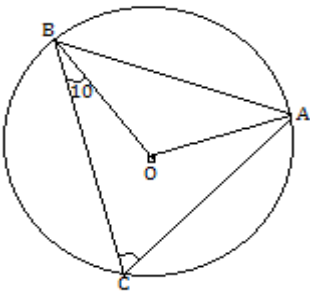


Determine the size of $\angle CAB$.                              (3 marks)

**Answer ONLY FIVE questions in the section in the space provided:**

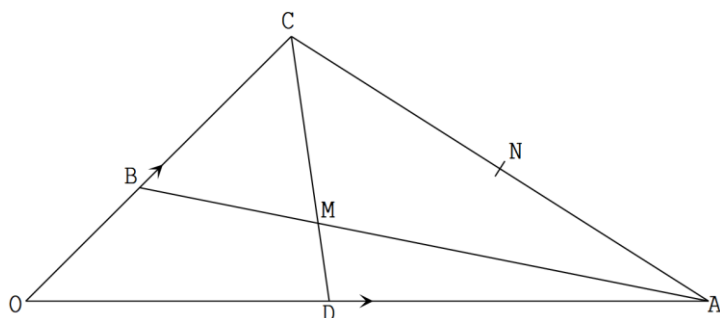17. In the figure below $\overrightarrow{OB} = \underset{\sim}{b}; OC = 3\overrightarrow{OB}$ and $OA = \underset{\sim}{a}$



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)

18. The table below shows the marks scored by form four students in a mathematics test in Amani secondary school.

| Marks | Mid-point X | Frequency $f$ | $d = x - A$ | $fd$ | $d^2$ | $fd^2$ |
|-------|-------------|---------------|-------------|------|-------|--------|
| 40-44 |  | 3 |  |  |  |  |
| 45-49 |  | 30 |  |  |  |  |
| 50-54 |  | 29 |  |  |  |  |
| 55-59 |  | 33 |  |  |  |  |
| 60-64 |  | 13 |  |  |  |  |
| 65-69 |  | 1 |  |  |  |  |
| 70-74 |  | 1 |  |  |  |  |
|  |  | $\sum f =$ |  | $\sum fd =$ |  | $\sum fd^2 =$ |

Using an assumed mean of 57
- a) Complete the table                                (4 marks)
- b) Determine
  - i)     the mean mark                               (2 marks)



  - ii)    The standard deviation                      (2 marks)



- c) Find the mark scored by the 50<sup>th</sup> student.          (3 marks



19. An arithmetic progression AP has the first term a and the common difference d.

(a)   Write down the third, ninth and twenty fifth terms of the AP in terms of a and d.

(2marks)

(b)   The AP above is increasing and the third, ninth and twenty fifth terms form the first three consecutive terms of a geometric progression (G.P).  The sum of the seventh and twice the sixth term of AP is 78. Calculate

(i)        The first term and common difference of the A.P   (5marks)

(ii)        The sum of the first 5 terms of the G.P                (3marks)

20. (a) (i) Taking the radius of the earth, R=6370km and $\pi = \frac{22}{7}$, calculate the shortest distance between two cities P($60^0$N, $29^0$W) and Q($60^0$N, $31^0$E) along the parallel of latitude.
(3marks)

(ii) If it is 1200hrs at **P**, what is the local time at **Q** (3marks)

(b) An aeroplane flew due south from a point A($60^0$N, $45^0$E) to a point B, the distance covered by the aeroplane was 8000km, determine the position of B. (4marks)

21. (a) Complete the table below to 2 decimal places. (2mks)

| X | $0^0$ | $30^0$ | $60^0$ | $90^0$ | $120^0$ | $150^0$ | $180^0$ | $210^0$ | $240^0$ | $270^0$ | $300^0$ | $330^0$ | $360^0$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $- \cos x$ | $-1$ | | $-0.5$ | | 0.5 | 0.87 | | 0.87 | | | -0.5 | $-0.87$ | |
| $\sin(x - 30^0)$ | | 0.0 | 0.5 | | | 0.87 | 0.5 | | $-0.5$ | | | $-0.87$ | $-0.5$ |

(b) Draw the graphs of $y = \sin(x - 30°)$ and $y = -\cos x$ on the same axes, for $0^0 \le x \le 360^0$. (5mks)
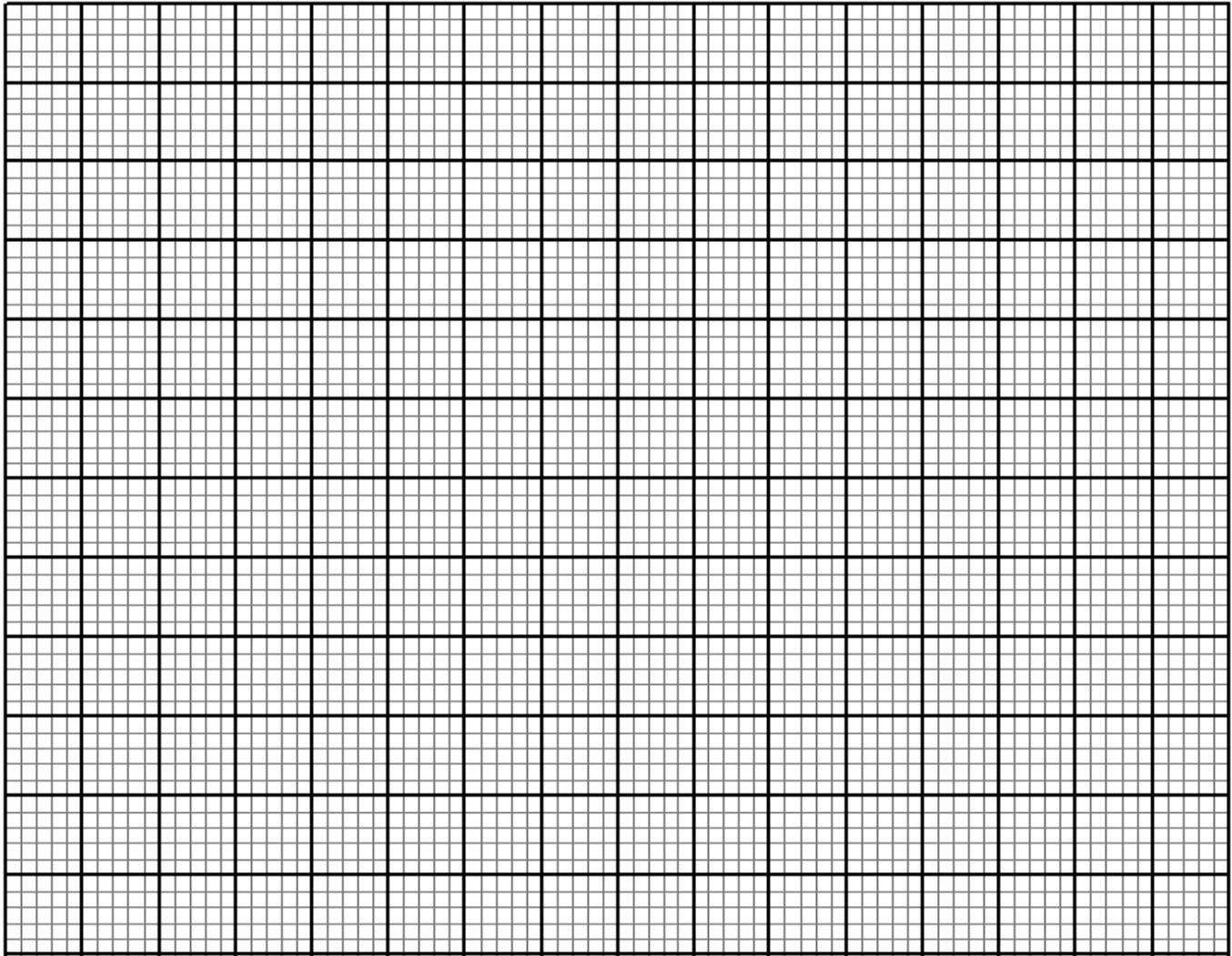


d) Use your graph to solve the equation s

(i)    $\sin(x - 30°) + \cos x = 0$. (2marks)

(ii)   $-\cos x = 0.5$ (1 marks)

22. Kamau, Njoroge and Kariuki are practicing archery. The probability for Kamau hitting the target is $\frac{2}{5}$, that of Njoroge hitting the target is $\frac{1}{4}$ and that of Kariuki hitting the target is $\frac{3}{7}$.

Find the probability that in one attempt;
a) Only one hits the target                                        (2marks)

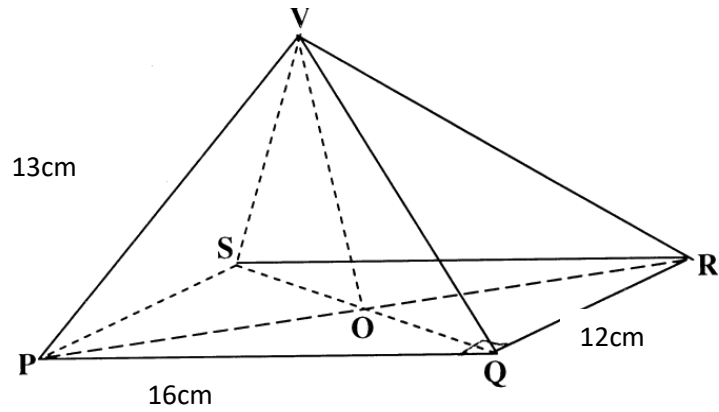b) All three hit the target                                        (2marks)

c) None of them hits the target                                    (2marks)

d) Two hit the target                                              (2marks)

e) At least one hits the target                                    (2marks)

23. Figure below is a pyramid on a rectangular base.  PQ=16cm, QR = 12cm and VP = 13cm.

13cm

S

R

O

12cm

P

16cm

Q

V

Find

(a) The length of **QS**.                                          (2marks)

(b) The height of the pyramid to 1 decimal place.                (2marks)

(c) The angle between **VQ** and the base.                       (2marks)

(d) The angle between plane **VQR** and the base.                (2marks)

(e) The angle between planes **VQR** and **VPS**                 (2marks)

24. **ABCD is** a quadrilateral with vertices as follows:  **A** (3, 1), **B** (2, 4) **C** (4, 3) and **D** (5, 1)

(a) (i) On the grid provided draw the quadrilateral **ABCD** and the image **A'B'C'D'** under a transformation
With matrix $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$. Find the co-ordinates of **A'B'C'D'** (3marks)
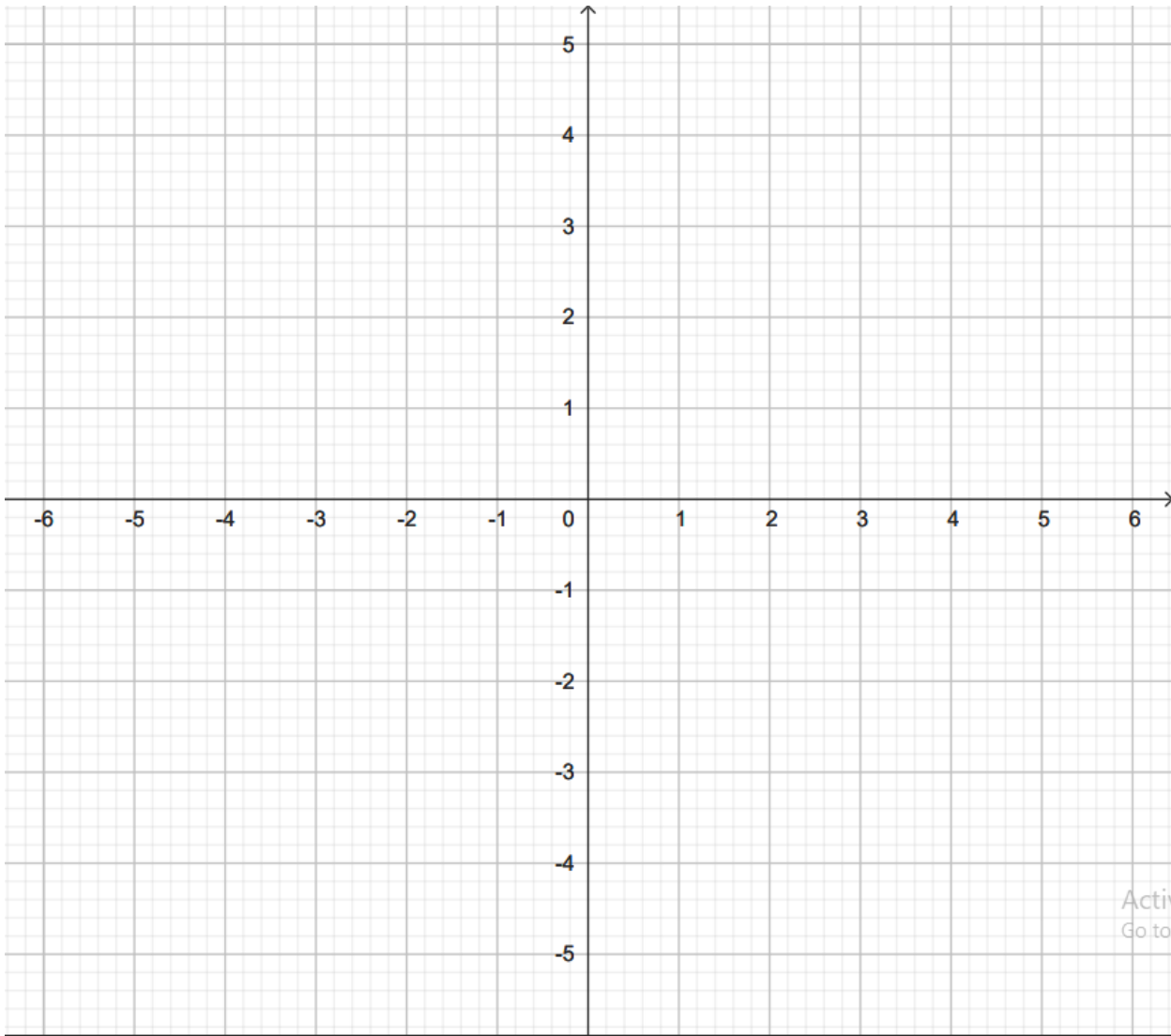


(ii) Describe the transformation that maps **ABCD** onto **A'B'C'D'** fully      (1mark)

(b) A transformation represented by the matrix $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$ maps **A'B'C'D'** onto **A''B''C''D''** find the co-ordinates of **A''B''C''D''.** Plot **A''B''C''D''** on the same grid.      (3marks)

(c) Determine a single transformation that maps **A''B''C''D''** onto **ABCD**. Describe this transformation fully.                                    (3marks)

# GOLDLITE ONLINE EDUCATIONAL SERVICES

## Kenya Certificate of Secondary Education

# KCSE REPLICA SERIES 2 TERM 2 2023

## MAY-AUGUST  2023- 2 ½ Hours

NAME ………………………………………………… ADMISSION NUMBER …………………

CANDIDATE'S SIGNATURE…………………………………DATE…………………………………

# REPLICA 6

121/2

MATHEMATICS

PAPER 2

## INSTRUCTIONS TO CANDIDATES

a)  *Write your name, school and Index Number in the spaces provided at the top of this page*
b)  *The paper consists of two sections.  Section I and Section II.*
c)  *Answer ALL the questions in Section I and any FIVE from Section II.*
d)  *All answers and working must be written on the question paper in the spaces provided below each*
e)  *Question.*
f)  *Marks may be given for correct working even if the answer is wrong.*
g)  *Negligence and slovenly work will be penalized*
h)  *Non programmable silent electronic calculator and KNEC Mathematical tables may be used except*
i)  *where stated otherwise.*

**Section I**                    **FOR EXAMINER'S USE ONLY**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | TOTAL |
|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|-------|
| Marks    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |       |

**Section II**

| Question | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|----------|----|----|----|----|----|----|----|----|-------|
| Marks    |    |    |    |    |    |    |    |    |       |

**Grand Total**

*Answer **all** the questions in this section*

1. Solve for x in the equation below without using a mathematical table or calculator. (4 marks) $(\log_{10} x)^2 = 3 - \log_{10} x^2$

2. The base of a right angled triangle is 4.1 cm and the height is 5.0 cm. Calculate the percentage error in the area of the triangle. (3 marks )

3. Given that $\tan \theta = \frac{1}{\sqrt{5}}$, $\theta$ is an acute angle, without using a calculator or mathematical tables, find $\sin(90 - \theta)$, leaving your answer in simplified surd form. (2 marks)

4. Find the interest on Ksh. 200,000 for 2 years at 14% per annum compounded semi-annually. (3 marks )

5. Make $v$ the subject of the formula (3 marks)

$$S = \frac{dv}{\sqrt{cv^2 - f}}$$

6. A coffee trader buys two grades of coffee at Kshs. 80 and Kshs. 100 per packet. Find the ratio in which she should mix the two brands so that by selling the mixture at Kshs. 120 per packet, a 25% profit realized? (3 marks)

7. A bakery prepares cakes for sale. It has 80 eggs and 10 cups of sugar for use. It bakes two cake types: P and Q. Type P cake requires 6 eggs and 2 cups of sugar while type Q cake requires 12 eggs and three-quarters cup of sugar. By letting type P cakes to be x and type Q cakes to be y, form all the inequalities that represent
the above information. (3 marks )

8. Find the radius and the centre of a circle whose equation is given by $3x^2 + 3y^2 + 6x - 12y - 12 = 0$. (3 marks)

9. The equation of a trigonometric function is $y = 2\cos(bx - 60)^0$. The period of the function is $120^0$.
    (a) Determine the value of $b$    (1 mark)

(b) Deduce the phase angle of the function. (1 mark)

10. A point R is 2100 nautical miles to the east of another point Q $(60^0\text{N}, 0^0)$, find the position of P.(3 marks)

11. An arithmetic progression is such that its first term is 200 and common difference 500. Given that
$S_n = 80,100$, find the value of $n$ (4 marks)

12. (a) Expand $(3 + x)^5$ in ascending powers of $x$ up to the term in $x^3$. (1 mark)

   (b) Use the expansion in (a) above to approximate the value of $\left(3\frac{1}{50}\right)^5$ correct to 4 decimal places.
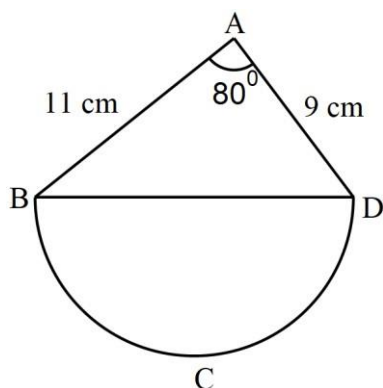
(2 marks)

13. **P** varies as the cube of **Q** and inversely as the square root of **R**. If **Q** is reduced by 20% and **R** increased by 21%, find the percentage change in **P**. (3 marks)

14. Use tables of squares, reciprocals and square roots only to evaluate (4 marks)
$$\frac{1}{345^2} + \sqrt{0.6789}$$
   2.

15. In the figure below, AD = 9 cm, AB = 11cm and angle BAD = $80^0$. BD is the diameter of the semi-circle BCD.

A

11 cm   $80^0$   9 cm

B   D

C

Calculate the area of the semi-circle, correct to 2 decimal places. Use $\pi = 3.142$     (4 marks)

16. Two regular polygons have sides $n$ and $n + 3$. Given that the ratio of the sum of their interior angles is 1: 2, calculate the value of $n$.                                                                 (3 marks )

**SECTION II (50 Marks)** *Answer any five question in this section*

17. 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; NHIF – Ksh 1 000, Union dues – Kshs 455 and BBF – Ksh 200. (3 marks)

18. A mode is in the shape of a polygon with vertices A, B, C, D and E such that; AB=4.4 cm, AE=10 cm, ED=5.2 cm and BC=7.9 cm. The bearing of B from A is $030^0$ and A is due east of E, while D is due north of E and angle EDC=$120^0$

(a) Using a ruler and a pair of compasses only,
   (i)   Construct the accurate plan of the model.       (4 marks)
   (ii)  Measure DC.     (1 mark)

(b) A foundation plaque is to be placed closer to CD than CB, nearer to D than to E and not more than 6 cm from A.
   (i)   Construct the locus of points equidistant from CB and CD.     (1 mark)
   (ii)  Construct the locus of points equidistant from E and D.       (1 mark)
   (iii) Construct the locus of points 6 cm from A.       (1 mark)

(c) Shade and label as R, the region within which the foundation plaque could be placed in the garden.
(2 marks)

19. The probability that it rains on a certain day is 0.8. If it rains the probability that a school bus will be stuck in a traffic jam is 0.7 but otherwise it is 0.4. If the bus is stuck in the jam, the probability that students using it to school will arrive late is 0.6, otherwise the probability of students using the bus to arrive late is 0.3.
    (a) Draw a tree diagram to represent this information. Use the letters R, J and L to represent the events of rain, jam and late respectively        (2 marks)

    (b) Determine:
        (i)    The probability that it rains, the bus isn't held in the jam  but the students arrive late in school.
                                                                                                        (1 mark)

        (ii) The probability that students arrive in school on time.                            (3 marks)

        (iii) The probability that the students arrive in school late.                           (2 marks)

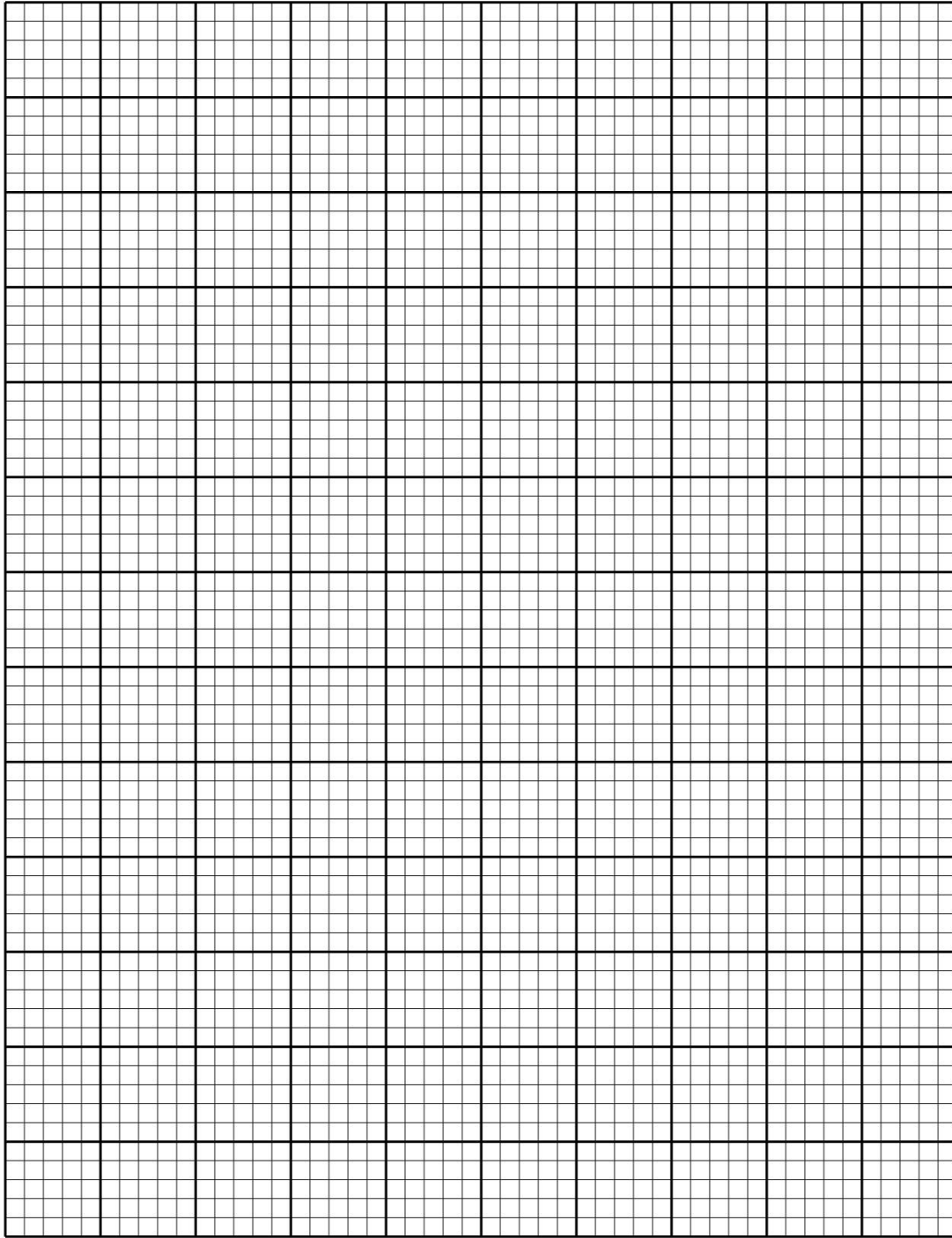        (iv) The probability that the bus is held in the jam.                                    (2 marks)
20. The vertices of a triangle $ABC$ are $P'(-1, 1)$, $B'(-5, 4)$ and $C'(-1, 2)$ under a transformation whose matrix is $\begin{pmatrix} -2 & 1 \\ 1 & 0 \end{pmatrix}$

(a) Find the coordinates of $ABC$ (3 marks)

(b) On the grid provided, draw triangles $ABC$ and $A'B'C'$. (2 marks)

(c) Triangle $A''B''C''$ is the image of triangle $A'B'C'$ under a transformation represented by the matrix
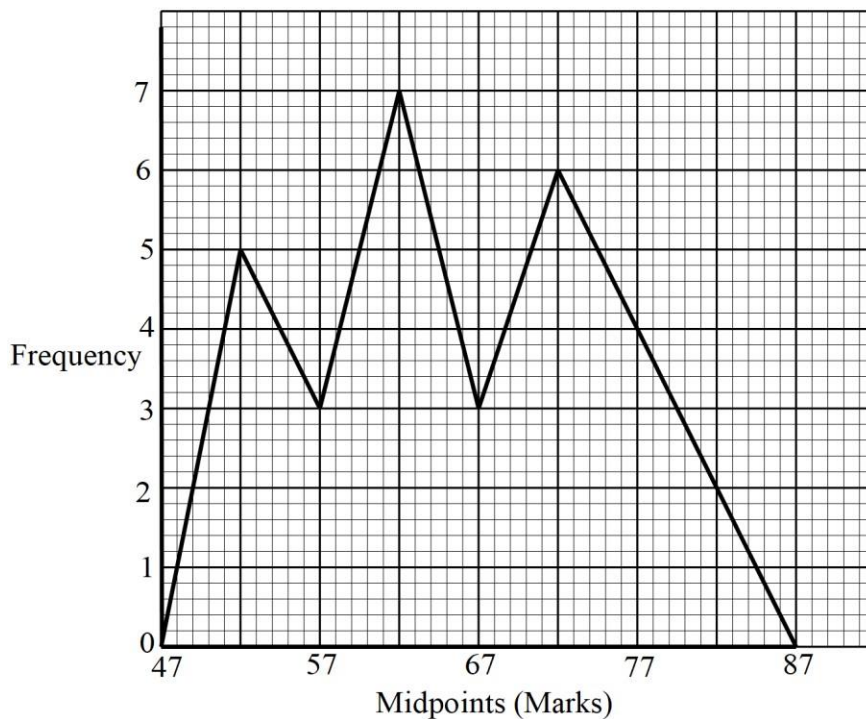
$$\begin{pmatrix} -1 & 0 \\ 0 & -2 \end{pmatrix}$$

       (i) Determine the coordinates of $\triangle A''B''C''$.    (2 marks)

       (ii) On the same grid, draw $\triangle A''B''C''$.  (1 mark)

(d) Another transformation $\boldsymbol{T}$ maps $\square A''B''C''$ on to $\square A'''B'''C'''$ such that $A'''(-1, -2)$, $B'''(-5, -8)$ and $C'''(-1, -4)$. Describe $\boldsymbol{T}$ fully. (2 marks )

21. The figure below shows a frequency polygon representing the scores of Form 4 Green students in a History contest.



Midpoints (Marks)

(a) Generate the frequency distribution table for the data under the headings given in the table below.

(5 marks)

| $x$ | $f$ | $d = \dfrac{x - 67}{5}$ | $fd$ | $fd^2$ |
|---|---|---|---|---|
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  | $\Sigma f =$ |  | $\Sigma fd =$ | $\Sigma fd^2 =$ |

10

(b) Calculate the standard deviation of the marks.　　(3 marks)

(c) The mean weight of 11 babies in a clinic is 4.5 kg. If one more baby comes to the clinic, the total mass of the babies becomes 60 kg. Find the mass of the additional baby.　　(2 marks)

22. In a triangle OAB, $OA = 12a$, and $OB = 12b$. P and Q are points on OA and OB respectively such that $3OP = OA$ and $OQ = \frac{1}{3}OB$. M is the midpoint of AB.

(a) Express the following in terms of $a$ and $b$

(i) $OM$　　(1 mark)

(ii) $PM$　　(1 mark)

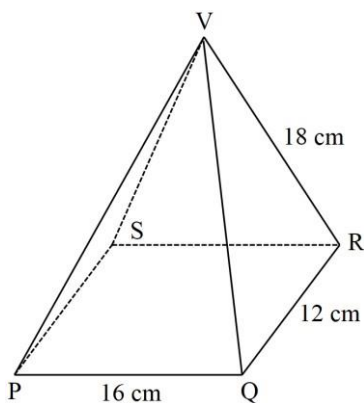(b) **OM** and **BP** intersect at R such that $PR = kPB$ and $OR = hOM$.

                    (i)   Express **PR** in two ways        (2 marks)

                    (ii)  Hence find the values of $h$ and $k$ (3 marks)

(c) Show that A, R and Q are collinear.                        (3 marks)

23. The figure below represents a right pyramid with a vertex V and a rectangular base PQRS. VP=VQ=VR=VS=18 cm. PQ=16 cm and QR=12 cm. M and O are the midpoints of QR and PR respectively.



Calculate, correct to 2 decimal places;

(a) The length of the projection of the line VP on the plane PQRS      (2 marks)

(b) The angle between the lines VP and the plane PQRS.  (2 marks)

(c) the angle between planes VQR and VPS.        (4 marks)

(d) The angle between the planes VQR and PQRS        (2 marks)

24. Two functions, $x + y = 4$ and $y = x^2 + 2$, intersec at C and D
    (a) Determine the coordinates of C and D        (4 marks)

    (b) Using the trapezium rule with 6 trapezia, estimate the area  bound by $y = x^2 + 2$, the x-axis and the vertical lines through C and D.                                                    (4 marks)

    (c)  (c) Find the exact area in (b) above.  (3 marks)

# GOLDLITE ONLINE EDUCATIONAL SERVICES

## Kenya Certificate of Secondary Education
# KCSE REPLICA SERIES 2 TERM 2 2023
## MAY-AUGUST 2023- 2 ½ Hours

NAME ……………………………………………… ADMISSION NUMBER …………………

CANDIDATE'S SIGNATURE………………………………………DATE……………………………………

# REPLICA 7

121/2
MATHEMATICS
PAPER 2

## INSTRUCTIONS TO CANDIDATES

a) Write your name, school and Index Number in the spaces provided at the top of this page
b) The paper consists of two sections. Section I and Section II.
c) Answer ALL the questions in Section I and any FIVE from Section II.
d) All answers and working must be written on the question paper in the spaces provided below each
e) Question.
f) Marks may be given for correct working even if the answer is wrong.
g) Negligence and slovenly work will be penalized
h) Non programmable silent electronic calculator and KNEC Mathematical tables may be used except
i) where stated otherwise.

Section I                          FOR EXAMINER'S USE ONLY

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | TOTAL |
|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|-------|
| Marks    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |       |

Section II

| Question | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|----------|----|----|----|----|----|----|----|----|-------|
| Marks    |    |    |    |    |    |    |    |    |       |

**Grand Total**

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

1. A picture frame is rectangular in shape with dimensions 10 cm by 14 cm. Calculate the maximum percentage error in the area of the frame.                                          (3 marks)

2. On the grid provided below, draw the circle whose equation is $2x^2 + 2y^2 + 8x - 10 = 0$.     (4 marks)
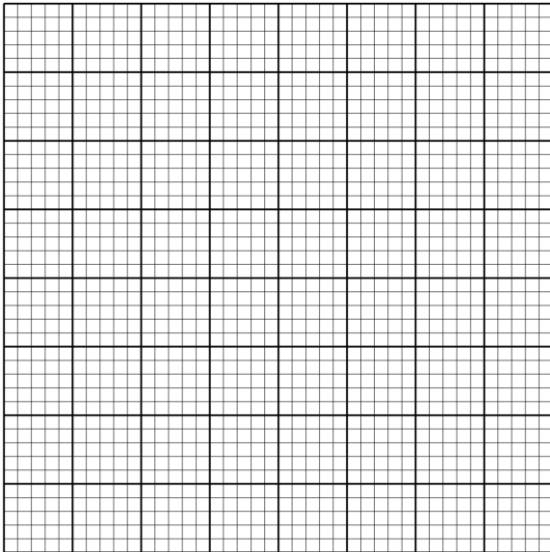


3. Without using a mathematical table or a calculator, find the values of $a$, $b$ and $c$ given that:     (3 marks)

$$\frac{\tan 60^0}{1 - \cos 30^0} = a + b\sqrt{c}$$

FOR MS CALL 0724351706

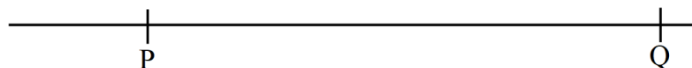4. Without using mathematical tables or a calculator, evaluate: (3 marks)

$$2\log_3 9 - \frac{1}{2}\log_3 144 + \log_3 972$$

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

$$T = \frac{2m}{n}\sqrt{\frac{L - A^2}{3k}}$$

6. Expand $(1 - 2x)^7$ in ascending powers of $x$ up to the term in $x^4$. Hence use your expansion to find the value of $(0.98)^7$. (3 marks)
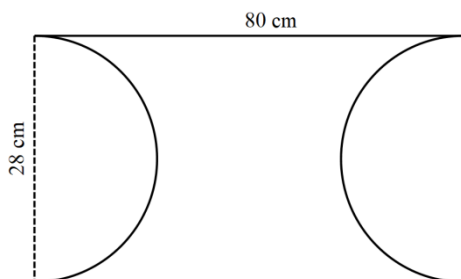
3

7. The line PQ below is part of a triangle PQR in which $\angle QPR = 75^0$ and PR=5.5 cm.



Using a ruler and a pair of compasses only;
(a) complete triangle PQR.                                                      (1 mark)

(b) determine the shortest distance from R to PQ.                               (1 mark)

8. The figure below shows cross-section of a steel beam used in a construction site.



Calculate the volume of the beam if it is 1.8 m long. Use $\pi = \frac{22}{7}$        (3 marks)

9. Given that $\mathbf{p} = 2\mathbf{i} - 3\mathbf{j} + \mathbf{k}$ and $\mathbf{q} = 3\mathbf{i} - 4\mathbf{j} - 3\mathbf{k}$, a point R divides the line PQ externally in the ratio of 4: 1. Find the coordinates of R.                    (3 marks)

4

10. Find the obtuse angle made by the line $3x + 4y = 12$ and the $x -$ axis, correct to 1 decimal place.

(3 marks)

11. In a transformation, an object with area 9 square units is mapped onto its image whose area is 54 square units. Given that the transformation matrix is $\begin{pmatrix} x & x-1 \\ 2 & 4 \end{pmatrix}$. Find the value of $x$.

(3 marks)

12. The figure below shows the graph of $\log P$ against $\log Q$.
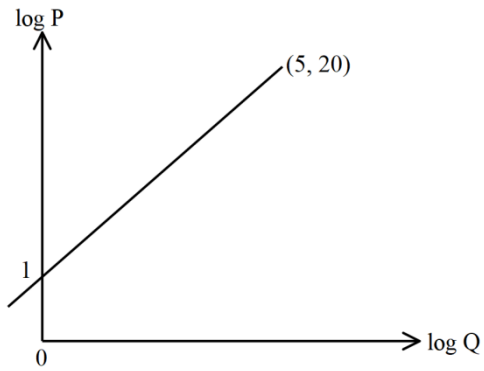


Given that $P = aQ^n$, find the values of $a$ and $n$.

(3 marks)

5

13. Five geometrical sets and three mathematical tables cost sh. 2,816 while three geometrical sets and five mathematical tables cost sh. 3,360. Use the matrix method to determine the cost of each item. (4 marks)

14. The length of an arc of a circle is $\frac{1}{5}$ of its circumference. If the area of the circle is 346.5 cm$^2$, find the area of the sector enclosed by this arc. (3 marks)

15. Rose a branding machine on hire purchase. The cash price of the branding machine is Kshs. 750,000. She pays a deposit of Kshs. 275,000 and followed by 15 monthly installments of Kshs. 55,000 each. Calculate the monthly rate at which compound interest was charged. (4 marks)

16. Jose had 200 buckets of water each having a mass of 20 kg. After one week, due to evaporation, the mass decreased in the ratio 29: 32. Calculate the total mass lost to evaporation. (3 marks)

**SECTION II (50 Marks)**

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

| Taxable pay per month (Kshs) | Tax rate (%) |
|---|---|
| 1 – 9,680 | 10% |
| 9,681 – 18,800 | 15% |
| 18,801 – 27,920 | 20% |
| 27,921 – 37,040 | 25% |
| 37041 – and above | 30% |

That year Marylinnet paid net tax of Kshs. 4,312 per month. Her total monthly taxable allowances amounted to Kshs.15,220 and he was entitled to a monthly relief of Ksh. 1,062. Every month the following deductions were made; NHIF – Kshs.320, Union dues – Ksh.200, Co-operative shares – Ksh. 500.
Calculate:
(a) Marylinnet's monthly basic salary in Kshs. (7 marks)

(b) Her monthly net salary in Kshs. (3 marks)

18. In the figure below, ABC is a triangle in which AB = 6 cm, BC = 11 cm and AC = 7 cm (not drawn to scale). The circle centre O passes through A, B and C.
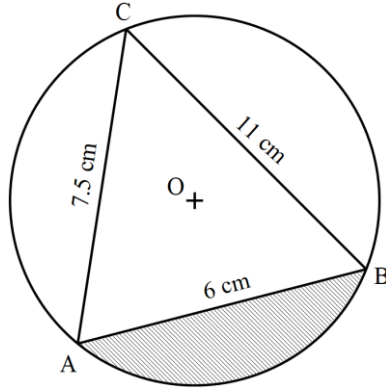


Calculate correct to 1 decimal place
(a) angle ACB                                                                                                     (3 marks)

(b) radius of the circle.                                                                                      (2 marks)

(c) shaded area.                                                                                                  (5 marks)

8

19. (a) Given the series $2 + 4 + 8 + 16 + \cdots + 16384$
   (i)    Identify the type of series.                                            (2 marks)

   (ii)   Find the number of terms in the series                                  (3 marks)

   (iii)  Calculate the sum terms in the series                                   (2 marks)

(b) Given that the sum of the first $n$ terms of the sequence $3 + 7 + 11 + 15 +  \ldots$  is 820, find the last term of the sequence                                                                          (3 marks)

9

20. The table below shows the distribution of marks scored by 110 students in a test.

| Marks | 11 – 20 | 21 – 30 | 31 – 40 | 41 – 50 | 51 – 60 | 61 – 70 | 71 – 80 | 81 – 90 |
|-------|---------|---------|---------|---------|---------|---------|---------|---------|
| No. of Students | 7 | $a + 3$ | 12 | $2a + 13$ | 37 | 11 | 6 | 3 |

(a) Find the value of $a$. (1 mark)

(b) Using $d = \dfrac{x - 45.5}{10}$, calculate, to 4 significant figures;

    (i)    The mean mark. (4 marks)

    (ii)    The standard deviation. (3 marks)

(c) If 60% of the students passed, calculate the pass mark. (2 marks)

10

21. A water vendor has a tank of capacity 18900 litres. The tank is being filled from two pipes A and B that are closed immediately the tank is full. Water flows at the rate of 150,000 cm$^3$ per minute and 120,000 cm$^3$ per minute from pipes A and B respectively.
    (a) Calculate the time it takes to fill the tank if both taps A and B are opened at the same time in hours.
    (4 marks)

    (b)  On a particular day the vendor started refilling the empty tank using taps A and B but was forced to start serving his clients after 25 minutes of filling. Given that the draining tap C supply 20 litres per minute to the clients, determine the exact time of the day the tank was filled assuming that the clients supply was continuous from 11.15 a.m. (6 marks)

11

22. The vertices of a triangle ABC are $A(2, 2)$, $B(2, -2)$ and $C(-1, -4)$ as shown in the figure below.
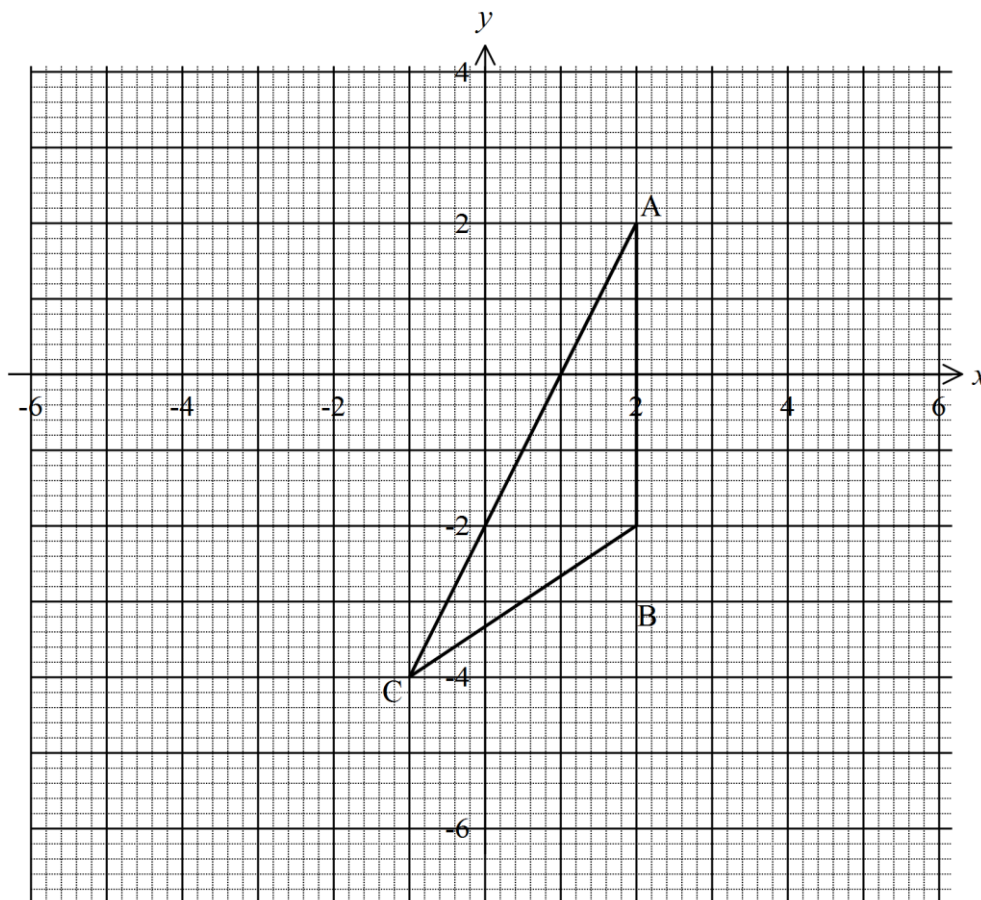


(a) If the vertex $B(2, -2)$ is mapped onto $B'(5, -2)$ by a shear with x – axis invariant.

   (i)   Find the matrix that represents the shear in (a) (i) above.                    (2 marks)

   (ii)  Draw triangle $A'B'C'$, the image of triangle ABC, under the shear.            (3 marks)

12

(b) A transformation matrix $\mathbf{T} = \begin{pmatrix} 0 & 1 \\ 1 & 1.5 \end{pmatrix}$ maps triangle $A'B'C'$ onto $A''B''C''$. Draw triangle $A''B''C''$.

(2 marks)

(c) A transformation matrix $\mathbf{U}$ maps triangle $A''B''C''$ onto triangle ABC
    (i)       Determine the transformation matrix $\mathbf{U}$.         (2 marks)

    (ii)      Describe the transformation represented by $\mathbf{U}$.       (1 mark)

13

23. The probability of Patrick passing his exam is 0.8 that of James is 0.6 while that of Linda is 0.2.
    (a) Draw a tree diagram to represent the above information                    (2 marks)

    (b) Use your tree diagram to find the probability that;
       (i)    Exactly two students pass in the exam                              (2 marks)

       (ii)   At most  two students pass the exam                               (2 marks)

       (iii)  Only one student passes the exam                                  (2 marks)

       (iv)   At least one passes in the exam                                   (2 marks)

14

24. A triangle OPQ is such that $\mathbf{OP} = 3\mathbf{OS}$ and $3\mathbf{OR} = \mathbf{OQ}$. T is a point on QS sch that $4\mathbf{QT} = 3\mathbf{QS}$. Given that $\mathbf{OP} = \mathbf{p}$ and $\mathbf{OQ} = \mathbf{q}$,

(a) Express the following vectors in terms of p and q
   (i)  **SR**                                                                    (1 mark)

   (ii)  **QS**                                                                   (1 mark)

   (iii)  **PT**                                                                  (2 marks)

15

(iv) **TR** (3 marks)

(b) Show that the points P, T and R are collinear. (3 marks)

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# GOLDLITE ONLINE EDUCATIONAL SERVICES
## Kenya Certificate of Secondary Education
# KCSE REPLICA SERIES 2 TERM 2 2023
## MAY-AUGUST 2023- 2 ½ Hours

NAME …………………………………………… ADMISSION NUMBER …………………

CANDIDATE'S SIGNATURE…………………………………DATE…………………………………

# REPLICA 8

121/2
MATHEMATICS
PAPER 2

## INSTRUCTIONS TO CANDIDATES

a) Write your name, school and Index Number in the spaces provided at the top of this page
b) The paper consists of two sections. Section I and Section II.
c) Answer ALL the questions in Section I and any FIVE from Section II.
d) All answers and working must be written on the question paper in the spaces provided below each
e) Question.
f) Marks may be given for correct working even if the answer is wrong.
g) Negligence and slovenly work will be penalized
h) Non programmable silent electronic calculator and KNEC Mathematical tables may be used except
i) where stated otherwise.

## Section I
### FOR EXAMINER'S USE ONLY

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | TOTAL |
|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|-------|
| Marks    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |       |

## Section II

| Question | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|----------|----|----|----|----|----|----|----|----|-------|
| Marks    |    |    |    |    |    |    |    |    |       |

**Grand Total**

1. A man deposits his money in a savings bank on a monthly basis. Each deposits exceeds the previous one by Shs 500. If he started by depositing Shs 1500, how' much will he have deposited in 12 months?

(3mks)

2. Make x the subject in the formula: $M = \sqrt{\dfrac{x\text{-}p}{p(1+px)}}$ (3mks)

3. Calculate the shortest distance in nautical miles between M(45°N, 38°E) and N(45°N, I 42°W) (3mks)

4. Two circles of radii 3cm and 8cm have their centres 13cm apart. Calculate the length of the direct common tangent. (2mks)

5. (a) Expand $(1 - \tfrac{1}{2}x)^6$ (2mks)

(b) Hence use the above expansion to the fourth term to find the value of $(0.98)^6$ (2mks)

6. The points P, Q and R lie on a straight line. The position vectors of P and R are
$2i + 3j + 13k$ and $5i — 3j + 4k$ respectively. Q divides FR internally in the ratio 2:1. Find:
(a) the position vector of Q in terms of $i, j,$ and $k.$ (2mks)

(b) the distance of Q from the origin. (1 mk)

7. Solve for x: $(\log_3 x)^2 - \frac{1}{2}\log_3 x = \dfrac{3}{2}$ (4mks)

8. Find the longest side of the right-angled triangle whose other sides are; $(\sqrt{2} + 1)$cm and
$(\sqrt{2} - 1)$cm long, leaving your answer in surd form. (3mks)

9. A circle whose centre is C(2, 3) passes through a point P(a,b). A point M(-2, $-5/2$) is the mid-point of

the line segment CP.
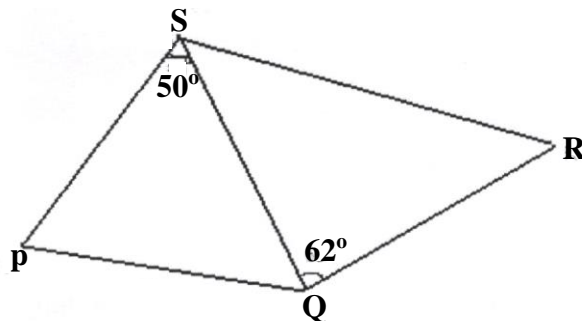(a) Calculate the co-ordinates of P                                                          (l mk)

(b) Determine the equation of the circle in the form $ax^2 + by^2 + cx + dy + e = 0$ where a, b, c,
d and e are integers.                                                                        (3mks)

10.    In the figure below, PS = PQ, PQ = 10cm, $\angle PSQ = 50°$, QR = 12cm and $\angle SQR = 62°$.        (3mks)



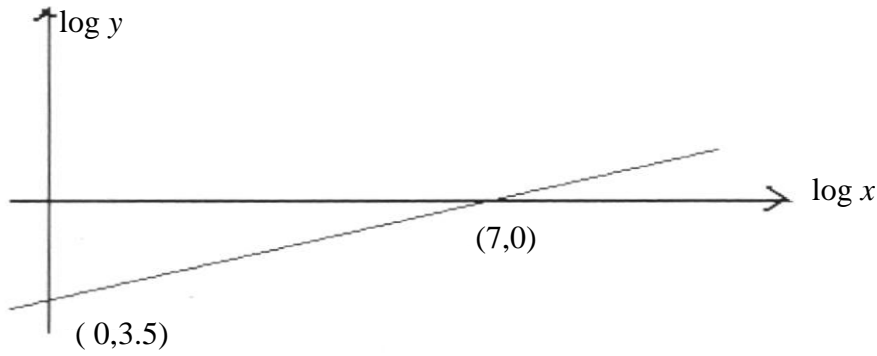Find $\overline{SR}$                                                                          (3mks)

11.  A quantity  $y$ varies partly as the square of $x$, and partly as $x$. When $y = 20$, $x = 2$ and when $y = 36$, $x = 3$.
Find the equation showing the relationship between $x$ and $y$.                               (3mks)

12.  The graph below is part of a straight line obtained from the initial equation $y = ax^n$.



Use the graph to calculate the values of *a* and *n*                                                (3mks)

13.  The price of a new car is Shs. 800,000. If it depreciates at a constant rate to Shs 550,000
     within 4 years, find the annual rate of depreciation.                                          (3mks)

14.  Solve the equation 2Cos 2 (*x* + 30) = 1 for 0 ≤ *x* ≤ 360.                                     (3mks)

15.  A mixture of sand, cement and ballast is in the ratio 5:1:3. If the cost of 7 tonnes of sand is Sh 3000,
     5 tonnes of cement sh 50,000 and 8 tonnes of ballast Sh 4000, find the cost of 7tonnes of the mixture.
                                                                                                     (3mks)

16.    In the figure below, PAQ is a tangent to the circle at point A.                    (3mks)
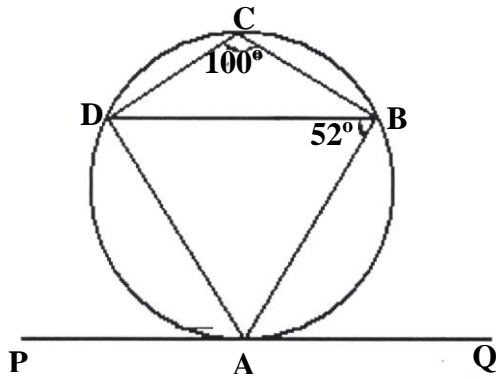


Find angle DAB and angle BAQ. giving reasons for your answer.

17.    The table below shows the income tax rates for the year 2006.

| Taxable Income per Tax rates KSh per K | Annum in K |
|---|---|
| 1-5808 | 2 |
| 5809-11280 | 3 |
| 11281-16752 | 4 |
| 16753-22224 | 5 |
| 22225 and above 6 | |

In the year 2006, Ali's monthly earnings were as follows:
Basic Salary KShs 22,600;House Allowance Kshs 12,000;
Medical Allowance Kshs 2,880;Transport Allowance KShs 340
Ali was entitled to a monthly personal relief of Sh 1162 and an insurance relief of Sh 450.
Every month the following deductions were made:
NHIF KShs 320; Insurance Premium Shs 3000;Sacco Loan repayment Shs 6000
Sacco Share contribution Shs 1500; Workers Union dues Shs 200
Calculate:
a) Ali's taxable income in K£ p.a.                                                    (1 mk)

b) Ali's monthly tax paid in Kshs                                                     (4mks)

c) Ali's monthly net income from his employment in KShs                    (2mks)

d) If Ali received a 10% increase in his basic salary, calculate the corresponding percentage
increase on the income tax.                                                 (3mks)

18.    A man goes to work either by a matatu or by bus from Monday to Thursday. If he goes by matatu the
probability that he will be late is $\frac{1}{5}$ while if he goes by bus, the probability that he will be late is $\frac{1}{8}$.
a)  Suppose he tosses a coin to decide whether to go by a matatu or by bus. what is the
probability that he will be late?                                          (4mks)

b) If he travels by matatu, what is the probability that he will be late
(i) every day                                                             (2mks)

(ii) On any three days                                                     (4mks)

19. The figure below is a cuboid ABCDFFGH such that AB 8cm, BC = 6cm and CF 4cm.
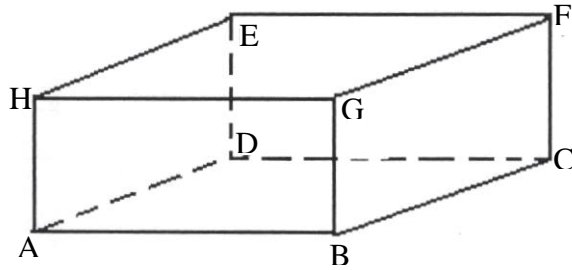


Determine:
a) the length
(i) AC                                                                                    (2mks)

(ii) AF                                                                                   (2mks)

b) The angle AF makes with plane ABCD.                                                    (2mks)

c) The angle plane AEFB makes with the plane ABCD                                         (2mks)
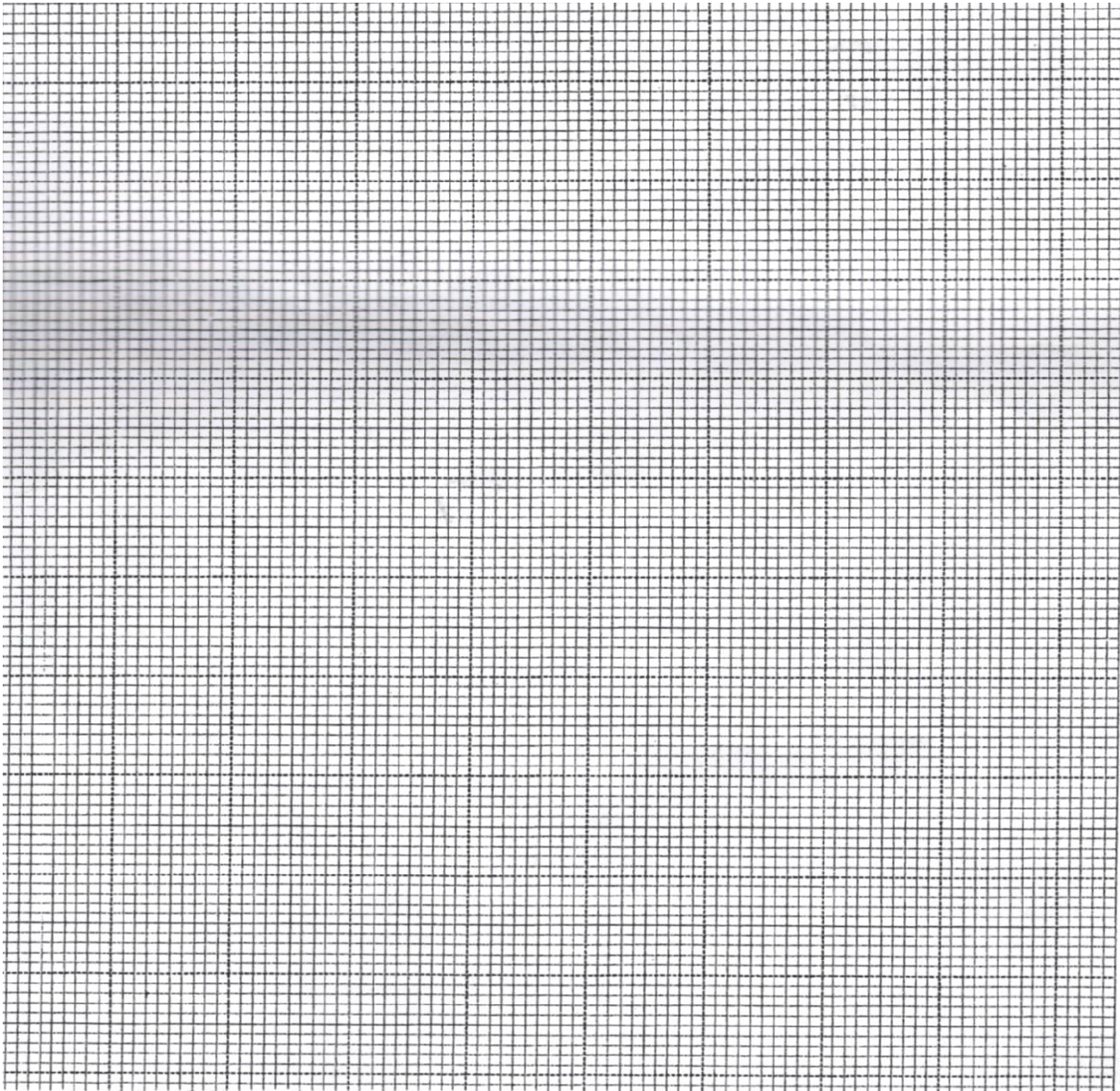
d) Find the angle between line EG and line DC                                             (2mks)

20 (a) Complete the table below for the equation $y = x^3 - 5x^2 + 2x + 9$ (2mks)

| $x$ | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|
| $x^3$ | -8 | . | 0 | 1 | 8 | 27 | 64 | 125 |
| $-5x^2$ | | -5 | 0 | -5 | -20 | | -80 | |
| $2x$ | -4 | -2 | 0 | 2 | 4 | 6 | 8 | 10 |
| 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| $y$ | | | 9 | 7 | 1 | | 1 | |

(b) On the grid provided, draw a graph of $y = x^3 5x^2 + 2x + 9$ for $-2 \le x \le 5$ (3mks)



c) Use your graph to estimate the roots of the equation $x^3 - 5x^2 + 2x + 9 = 0$ between $x = 1$ and x 4. (2mks)

d) By drawing a suitable line on the same axis, estimate the roots of the equation
$x^3 - 5x^2 + x + 5 = 0$ (3mks)

21. The following table shows the distribution of marks obtained by 50 students.

| 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 |

a) By using a suitable assumed mean, calculate:
(i) the mean                                                                     (5mks)

b) the variance                                                                  (3mks)

c) the standard deviation                                                        (2mks)

22. (a) Without using a protractor or a set square, construct a parallelogram PQRS such that
    PQ = 7.5cm, PS = 5cm and ∠QPS = 67½ °. (4mks)
    On the same diagram locate:
    (b) A point X such that it is equidistant from P and Q. (1 mk)
    (c) A point M such that ∠QMS 90°. M is on the same side of QS as R. [2mks]
    (d) A region inside the parallelogram in which a variable Y lies such that PY RY and
    ∠QYS ≥90°. Shade the region represented by Y. (3mks)
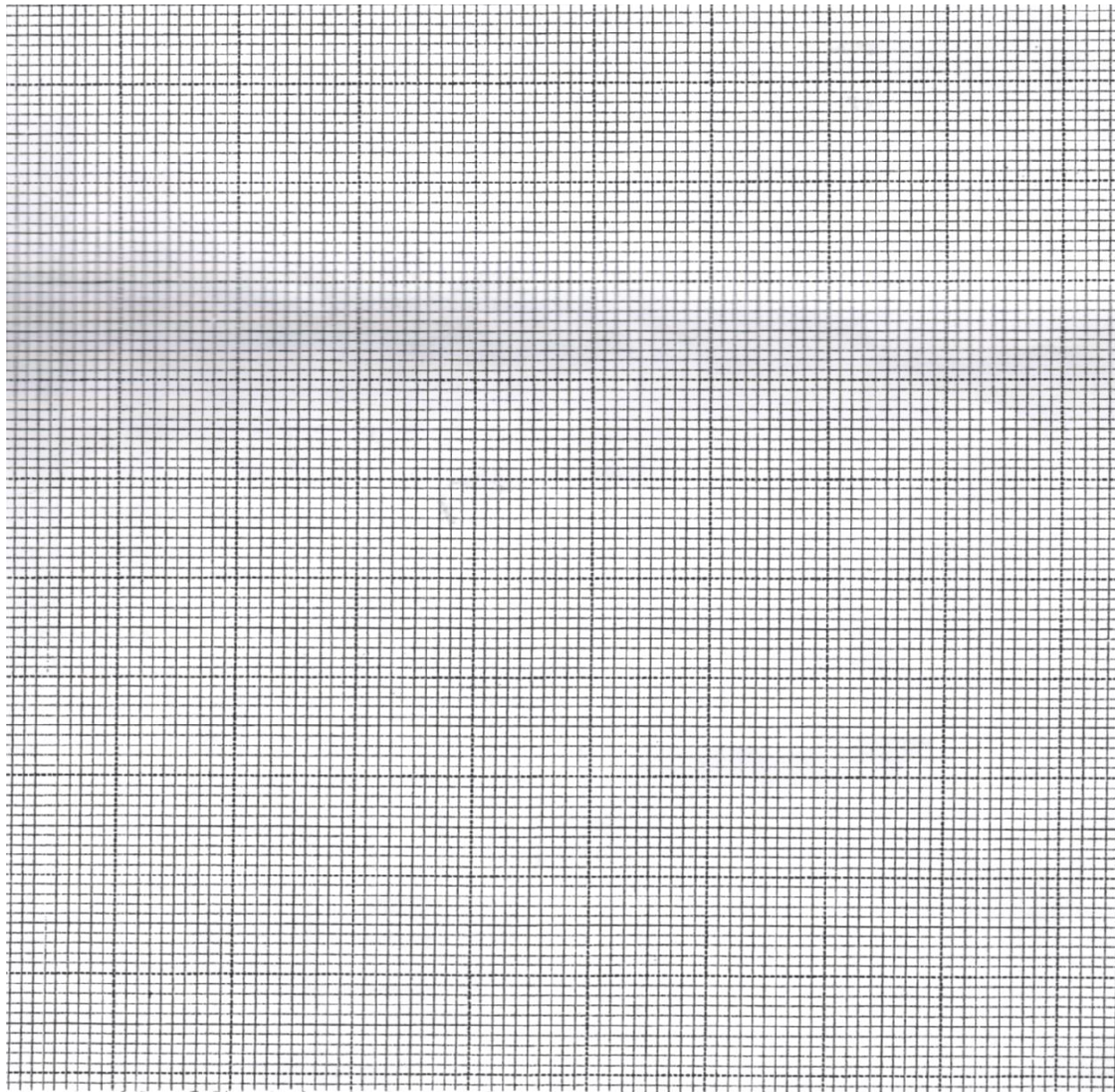
23    (a) Calculate the turning point of the function $y = x^3 - 3x$ and state their nature.
      Hence sketch the curve.                                                    (5mks)

      (b) Find the area of each of the two segments of the curve $y = x^3 - 3x$ cut off by the x-axis.    (5mks)

24.  Rectangle ABCD in which A(1,3), B(8,3), C(8,5) and D(1,5) undergoes a shear with $x = 4$
     as the invariant line.
     a) Plot the rectangle ABCD                                                  (1 mk)

     b) If the point C is mapped on the point $C^1(8,9)$ under this transformation, determine the co
        ordinates of $A^1$, $B^1$ and $D^1$.                                     (3mks)

     c) Plot the figure $A^1, B^1, C^1, D^1$                                     (1 mk)

d) Find the matrix representing this transformation. (3mks)

e) Using the determinant of the matrix in (d) above, find the area of the figure $A^l$, $B^l$, $C^l$, $D^l$ (2mks)

# GOLDLITE ONLINE EDUCATIONAL SERVICES
## Kenya Certificate of Secondary Education
# KCSE REPLICA SERIES 2 TERM 2 2023
## MAY-AUGUST 2023- 2 ½ Hours

NAME ………………………………………… ADMISSION NUMBER …………………

CANDIDATE'S SIGNATURE………………………………DATE……………………………………

# REPLICA 9

**121/2**
**MATHEMATICS**
**PAPER 2**

## INSTRUCTIONS TO CANDIDATES
  a) Write your name, school and Index Number in the spaces provided at the top of this page
  b) The paper consists of two sections.  Section I and Section II.
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**Section I**                                          **FOR EXAMINER'S USE ONLY**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | TOTAL |
|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|-------|
| Marks    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |       |

**Section II**

| Question | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|----------|----|----|----|----|----|----|----|----|-------|
| Marks    |    |    |    |    |    |    |    |    |       |

**Grand Total** [ ]

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

2. Make P the subject of the formula $\dfrac{1}{r}=\dfrac{1}{p^2}+\dfrac{1}{q}$        (3 marks)

3.
    a) Expand $(1-2x)^2$ up to the term in $x^3$        (1 mark)

    b) Use the expansion above o evaluate $(1.02)^6$ to decimal places     (2 marks)

4. Given the matrix $\begin{pmatrix} 5-x & 2 \\ 3x & 4 \end{pmatrix}$ has no inverse, find the value of x.     (2 marks)

5. Kiprono buys tea costing sh. 112 per kilogram and shs 132 per kilogram and mixes them, then sells the mixture at shs. 150 per kilo gram. If he is making profit of 25% in each kilogram of the mixture, determine the ratio in which he mixes the tea.    (3 marks)

6. Given that: $\frac{3}{3\sqrt{5}} + \frac{3\sqrt{5}}{3-\sqrt{5}} = a + b\sqrt{5}$. Find the values of A and B    (3 marks)

7. P varies directly as Q and inversely as the square of R. if P is increased by 20% and R is decreased by 10%. Find percentage changes in Q.    (3 marks)

8. Ashanti is a salesman and earns a commission on sales based on the monthly rates shown in the table below:-

| Sales (kshs) | Commission rate % of sales |
|---|---|
| The first 5,000 | 10% |
| The second 3,000 | 15% |
| Sales above 8,000 | 20% |

In addition, she earns a basic monthly pay of kshs. 6,700 during a certain month, she     earned a total salary amounting to kshs. 8,368. How much worth of sales did she make?

(4 marks)

**9.** In the figure below, O is the centre of the circle. A, B, C , and D are points on the circumference of the circle. A, o, X and C are points on a straight line. DE is a tangent to the circle at D. Angle BOC = 48°nad angle CAD = 36°.
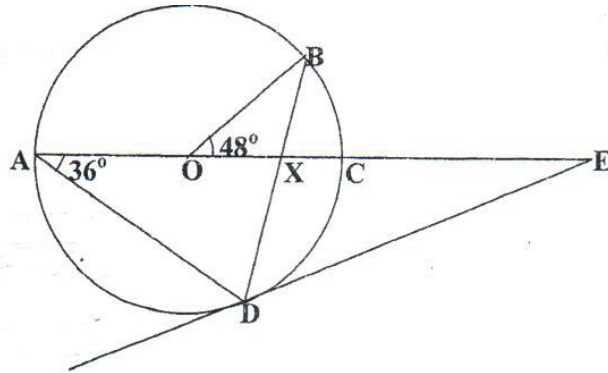


A) Find the value of the following angles:-

    i)      Angle ADE                                                  (2 marks)

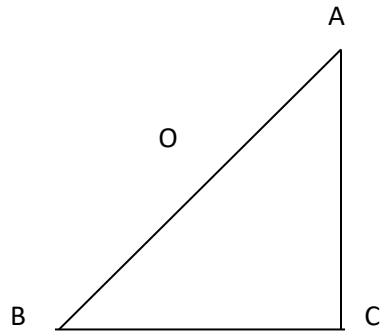    ii)     Angle BCD                                                 (2 marks)

**10.** Given that $p = 3^y$ express the equation             (3 marks)
        $3^{(2y-1)} + 2 \times 3^{(y-1)} = 1$ in terms of P hence or otherwise find y.

**11.** The diagram below shows a triangle ABC. Construct its image $A^1B^1C^1$ under a rotation of -120° about centre O. (3 marks)

A

O

B          C

**12.** Given that cos x -= 0.75; where x is an acute angle, find without using mathematical tables or calculators the following trigonometric ratios:

a) Tan X (1 mark)

b) $\sin^2 (90-x)$ (2 marks)

**13.** A farmer has 200m of fencing with which three sides of a rectangular enclosure, the fourth side being existing wall of the yard. Find in metres the dimension of the largest possible field that can be enclosed. (3 marks)

**14.** The point with co-ordinates (6,1) and (-4,9) are the ends of a diameter of a circle centre A

   A) Find the co-ordinates of the centre.                            (1 mark)

   B) Determine the equation of the circle in the form $x^2 + y^2 + ax + by = C$ where A, B, and C are
      constants.                                    (3 marks)

**15.** Use the trapezium rule to establish the area under the curve $Y = x2 + x - 6$ over the interval $0\ 0 \leq x \leq 8$ using 4 trapezia                      (3 marks)

**16.** Wambua invested sh. 6,400 at 15% per annum compound semiannually interest for 3 years. Muinde invested twice that amount at 12 ½ % per annum simple interest for the same period of time. Find whose investment earned more interest and by how much.       (4 marks)

**17.** .

a) Find the quadratic equation whose roots are $\frac{-3}{4}$ $and$ $\frac{2}{3}$ and write it in the form $ax2 + bx + c = 0$ where a, b and c are integers. (3 marks)

b) The length of a floor of a rectangular hall is 9m more than its width. The area of the floor is $136m^2$.

    i)       Calculate the perimeter of the floor (4 marks)

    ii)     A rectangular carpet is placed on the hall leaving am area of $64cm^2$. If the length of the carpet is twice its width, determine the width of the carpet

                                           (2 marks)

**18.** In the geographical progression, the sum of the second and third terms is 6; and the sum of the third and fourth terms is 1-12. Find:

a)  .
  i)     The first term                                                    (3 marks)

  ii)  The common ration                                                (3 marks)

b)  The sum of consecutive of an arithmetical progression -19 ½. If the first tern is 16 ½ and the common difference is -3. Find the number of terms.                    (4 marks)

**19.** The table below shows the number of students who scored marks in mathematics test.

| Marks | 1-10 | 11-20 | 21-30 | 31-40 | 41-50 | 51-60 | 61-70 | 71-80 | 81-90 | 91-100 |
|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| Frequency | 3 | 6 | 10 | 10 | 12 | 17 | 15 | 16 | 7 | 4 |

a) Draw a cumulative frequency graph for the data. (3 marks)
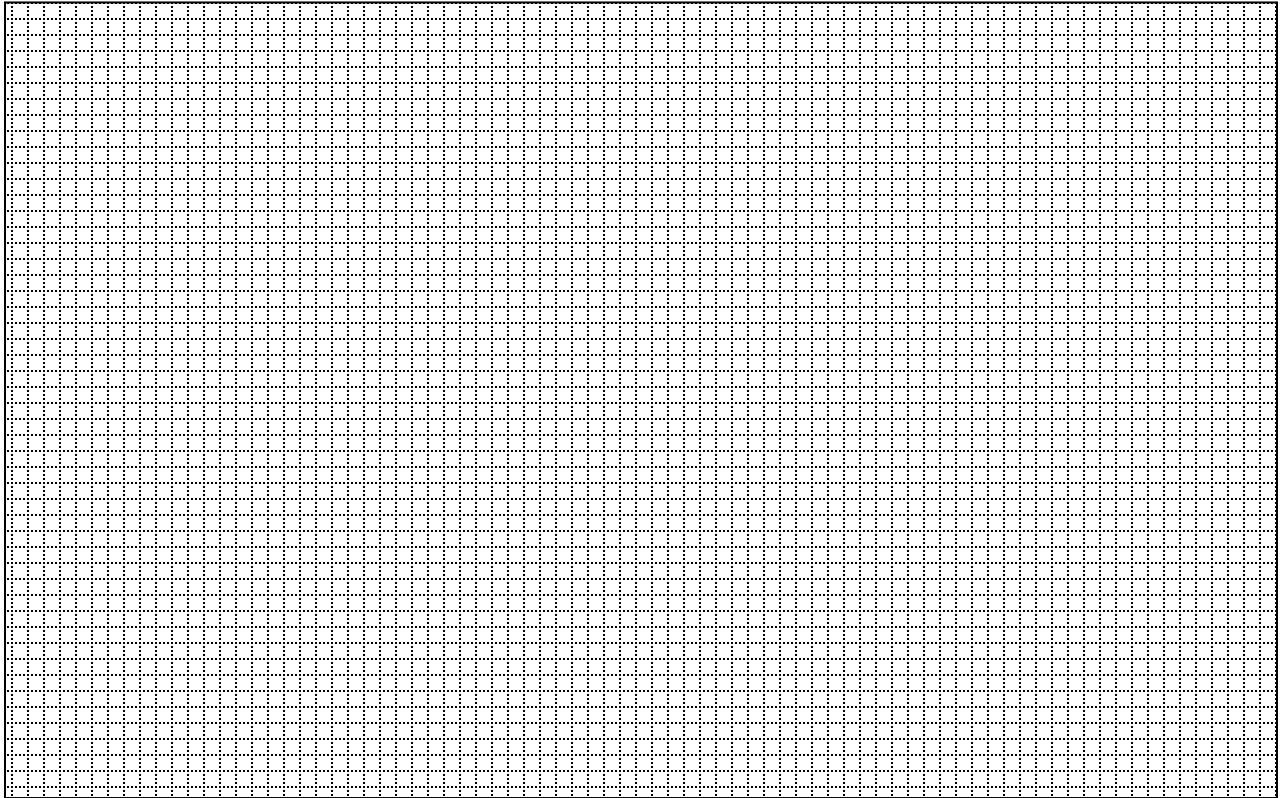
b) Use the graph to estimate the median mark (2 marks)

c) If students who score over 40 marks pass the test the tests estimates the percentage of the students who passed (2 marks)

d) Calculate the inter quartile deviation. (3 marks)

**20.** The probability of a candidate passing her secondary examination is 4/5. If she passes the examination the probability of her joining a university is 2/3. if she fails her examination, the probability of joining a university is ¼. If she joins the university the probability of getting a job is 6/7 and if he does not join the university the probability of getting a job is 2/9

a) Draw a tree diagram. (2 marks)

b) The probability that she fails her examination                    (2 marks)

c)  Find the probability that she got a job after failing her secondary examination
                                                                    (2 marks)

d) The probability that she joins university                        (2 marks)

e) The probability that she did not get a job                      (2 marks)

**21.** At 12.30pm, a ship leaves island A (80° N, 45°E) and sails due west for 120 hours to another island B at an a average speed of 27 knots.
   a)  Find the position of island B                                (3 marks)

   b)  The ship then sails due north to another island C which lies on latitude 75°N. Find the shortest distance between islands B and C in km.        (3 marks)

c) The ship had stopped at B for 70 minutes before it sailed to island C. I the ship increase its speed by 20% between B and C find the time arrival at island C to the nearest minute.
(4 marks)

**22.**
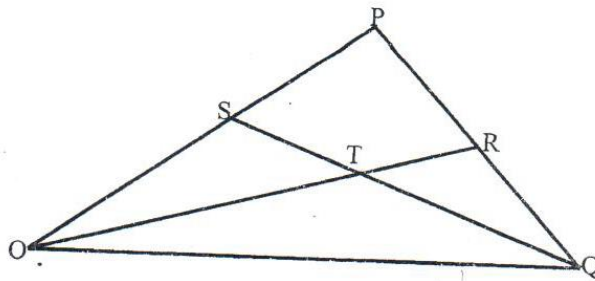


In  the figure above, OPQ is a triangle in which QS = ¾ OP and RP = 2:1

Line QR and SQ meet at T.

a) Given that O P = p and OQ = Q, Express the following vectors in terms of P and Q.
   i)    PQ                                                                                      (1 mark)

   ii)    OR                                                                                     (2 marks)

   iii)    SQ                                                                                    (1 mark)

b) You are further given that ST = Msq and OT = Nor. By expressing OT in two ways, determine the values of m and n.                                         (5 marks)
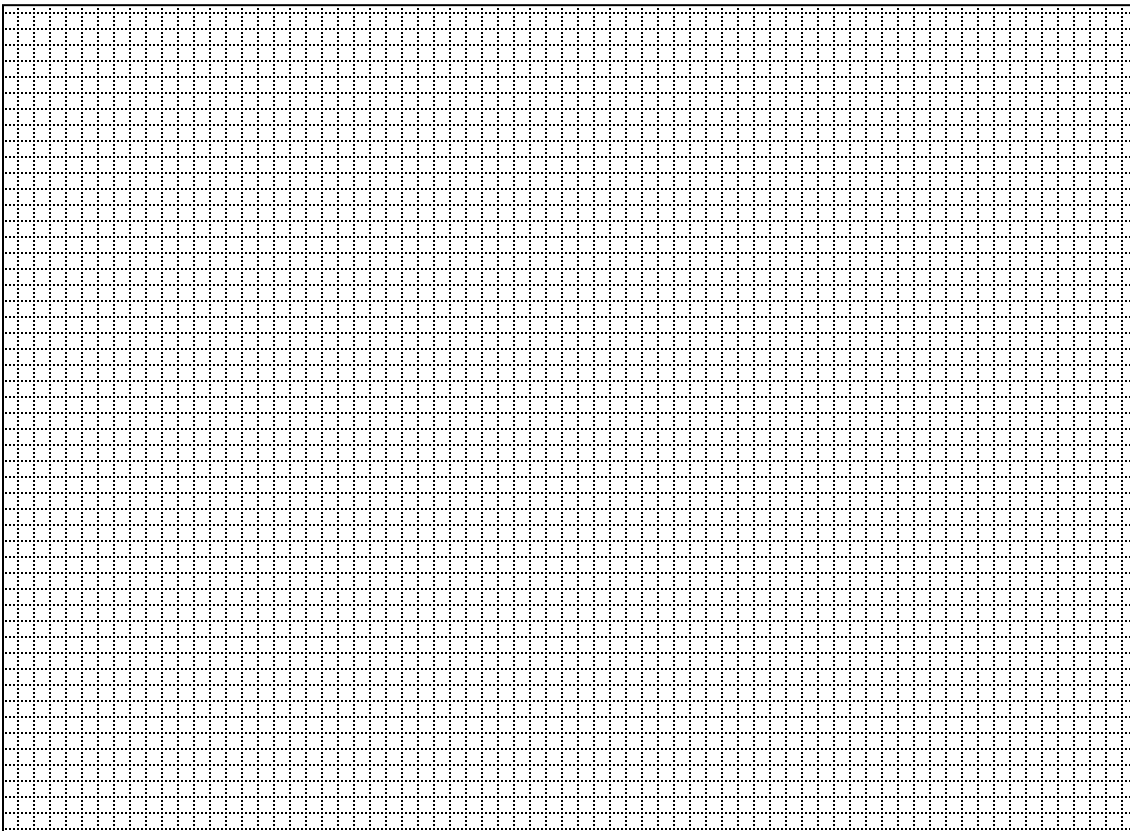
c) Find the ratio in which Q divides ST          (1 marks)

**23.** .

a) Complete the table below for the equation $y = x^3 - 2x^2 - 4x + 7$

| X | -3 | -2 | -1 | | 1 | 2 | 3 | 4 |
|---|-----|-----|---|---|---|---|---|---|
| Y | -26 | | 8 | 7 | 2 | | 8 | |

b) Using the scale 1 cm to represent 1 unit on x – axis and 1 cm to represent 5 units on the y – axis, draw the graph of $y = x^3 - 2x^2 - 4x + 7$          (3 marks)



c) Use your graph to estimate to roots of the equation $x^3 - 2x^2 - 4x + 7 = 0$ (1 mark)
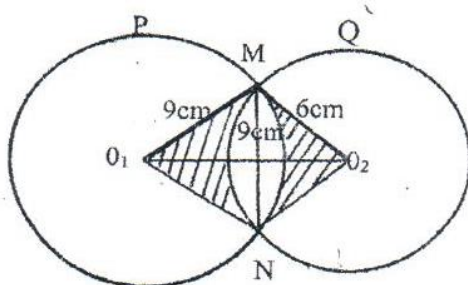
d) By drawing straight lines, use your graph to solve the equation.          (2 marks)

   i)      $x^3 - 2x^2 - 4x + 2 = 0$

   ii)     $x^3 - 2x^2 - 3x + 3 = 0$          (2 marks)

**24.** The following figure shows two circles P and Q with centre O1 and O2 respectively and their radii are 9 cm and 6 cm respectively. The common chord MN is 9 cm long. (Not drawn in scale).



a) Find the value of
    i.    Angle $MP_1N$.               (2 marks)

    ii.  Angle $MO_2N$               (2 marks)

b) Find the area of:
    i)   Triangle $MO_1N$              (2 marks)

    ii)  Triangle $MO_2N$              (1 marks)

c) Find the area of the shaded region.           (4 marks)

# GOLDLITE ONLINE EDUCATIONAL SERVICES
## Kenya Certificate of Secondary Education
# KCSE REPLICA SERIES 2 TERM 2 2023
## MAY-AUGUST 2023- 2 ½ Hours

NAME …………………………………………… ADMISSION NUMBER …………………

CANDIDATE'S SIGNATURE………………………………DATE……………………………………

# REPLICA 10

121/2
MATHEMATICS
PAPER 2

## INSTRUCTIONS TO CANDIDATES

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**Section I**          **FOR EXAMINER'S USE ONLY**

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|----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|-------|
| Marks    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |       |

**Section II**

| Question | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
|----------|----|----|----|----|----|----|----|----|-------|
| Marks    |    |    |    |    |    |    |    |    |       |

**Grand Total**

1. Make  t  the subject of the formula　　　　　　　　　　　　　**(3marks)**

$$s = \frac{wd}{t}\left(t - {}^{d}/_{2}\right)$$

2. a) Show that the circle with equation $(x - 3)^2 + (y - 4)^2 = 25$ passes through the origin.

   **(1mark)**

   b) Find the coordinates of another point (not the origin) where the circle cuts the $x$-axis.

   **(3marks)**

1. Make  t  the subject of the formula

$$s = \frac{wd}{t}\left(t - {}^{d}/_{2}\right)$$

**3.** A survey carried out in a rural town on the number of young people who went for HIV test was shown in the table below

| Percentage infected | $36-39$ | $40-43$ | $44-47$ | $48-51$ | $52-55$ | $56-59$ |
|---|---|---|---|---|---|---|
| No of people | 6 | 5 | 3 | 3 | 2 | 1 |

Calculate the quartile deviation of the data. **(4marks)**

**4.** A shear parallel to the *x*-axis (the invariant line) maps (1,2) onto point (5,2)

a)  Determine the shear factor. **(2marks)**

b)  Hence state the shear matrix. **(1mark)**

**5.** A colony of bees was found to have 250 bees at the beginning.  Thereafter the number of bees doubled every two days.  Find how many bees there were after 16 days **(3marks)**

**6.** Solve $2\sin^2 x - 3\sin x + 1 = 0$ for $0^0 \leq x \leq 360^0$ **(3marks)**

**7.** The circumference of the circle of latitude $x^0$ south is 3751nm. Find $x$ to the nearest whole number. **(3marks)**

**8.** a) Determine the turning point of the curve $y = x^3 - 3x^2 + 3x - 6$ **(2marks)**

b) State the nature of the point identified in a above, **(1mark)**

**9.** Nine men working 8 hours a day can weed a field in 15 days. How many hours a day must 27 men work in order to weed the same field in 5 days? **(2marks)**

**10.** Solve the equation below using the completing square method

$3x^2 - 7x + 2 = 0$ **(3marks)**

**11.** Given that $\tan \theta = x$ show that **(3marks)**

$$\frac{Cos\theta \sin^2 \theta + \cos^2 \theta}{Sin \theta} = {}^1/_x$$

**12.** (a) Expand and simplify the binomial expression $(2 - x)^6$ **(1 mark)**

(b) Use the expansion up to the term in $x^3$ to estimate $\left(1\dfrac{99}{100}\right)^6$ to 3 decimal places. **(2marks)**

**13.** Without using calculators or mathematical tables simplify **(3marks)**

$$\dfrac{\sqrt{63} + \sqrt{72}}{\sqrt{32} + \sqrt{28}}$$

**14.** A line $L_1$ has the equation $x+2y = 4$. The line $L_2$ is perpendicular to $L_1$ and passes through the origin

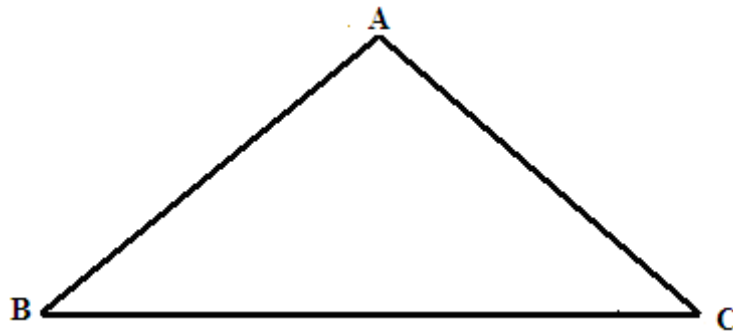(a) Determine the equation of $L_2$. **(1mark)**

(b) Find using matrix method the co-ordinates of the intersection point of the two lines.

**(2marks)**

**15.** By correcting each number to one significant figure, approximate the value of $788 \times 0.006$. Hence calculate the percentage error arising from this approximation. **(3marks)**

**16.** The diagram below represents a garden ABC.



(i)   Draw the locus of points equidistant from sides AB and AC.

(ii)  Draw the locus of points equidistant from points A and C

(iii) A bead is lost within a region which is nearer to point A than to point C and closer to side AC than to side AB. Show by shading the region where the bead can be located.   **(3marks)**

**17.** A bag contains 3 black balls and 6 white balls. If two balls are drawn from the bag one a time, find the:-

    (a) Probability of drawing two white balls

        (i)  with replacement                                               **(2marks)**

        (ii) without replacement                                     **(2marks)**

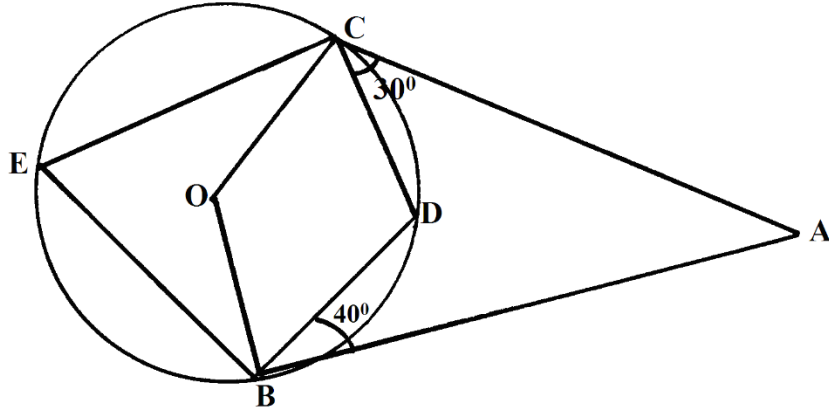    (b) Probability of drawing a black ball and white ball.

        (i)  with replacement                                               **(3marks)**

        (ii) without replacement                                       **(3marks)**

**18.** In the figure below, O is the centre of the circle AB and AC are tangents. Angle $ABD = 40^0$ and $ACD = 30^0$. Find:



(i)  Angle CEB                                                                                                **(6marks)**

(ii) Angle OCB                                                                                               **(2marks)**

(iii)Angle CAB                                                                                               **(2marks)**

**19.** Income rates for income earned were charged as follows.

| Income in sh. per month | Rate in Ksh. per sh.20 |
|---|---|
| 1 – 8, 400 | 2 |
| 8401 – 18, 000 | 3 |
| 18001 – 30, 000 | 4 |
| 30, 001 – 36, 000 | 5 |
| 36, 001 – 48, 000 | 6 |
| 48, 001 and above | 7 |

A civil servant earns a monthly salary of ksh.19, 200. His house allowance is ksh.12, 000 per month. Other allowances per month are transport ksh.13, 000 and medical allowance ksh.2, 300. He is entitled to a personal relief of ksh.1, 240 per month. Determine

(a) (i) His taxable income per month **(2 marks)**

    (ii) Net tax **(5 marks)**

(b) In addition, the following deductions were made.

        NHIF sh.230
        Service charge ksh.100
        Loan repayment ksh.4, 000
        Cooperative shares of ksh.1, 200

Calculate his net salary per month **(3marks)**

**20.** The figure below represents a model of a tower VPQR. The horizontal base PQR is an equilateral triangle of sides 9cm. The length of the edges are VP = VQ = VR = 20.5cm. Point M is the mid-point of PQ and VM = 20cm. Point N is on the base and vertically below V
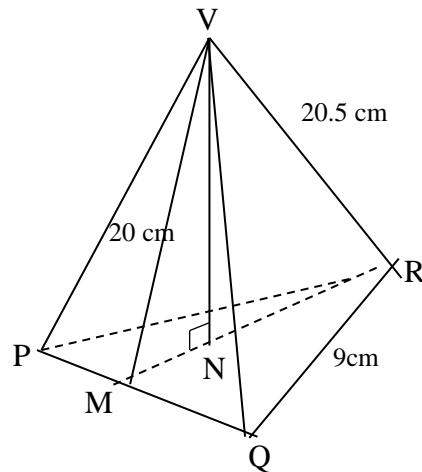


Calculate

(a) The length RM                                                                                    **(2marks)**

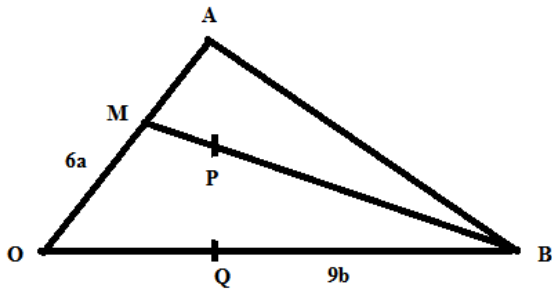(b) The length of the model.                                                                        **(4marks)**

(c) The angle between

    (i) Plane VPR and the base                                                               **(2marks)**

    (ii) Line VR and the base                                                                  **(2marks)**

**21.** In ΔAOB, **OA** = 6**a** **OB** = 9**b**.  M is the midpoint of OA and P lies on MB such that MB = 5MP



a)  Express in terms of **a** and **b** the following vectors; giving your answer in its simplest form.

   (i) **MB**

   (ii) **AB**

   (iii) **AB**

   (iv) **AP**                                                                                    **(6 marks)**

b)  Given that Q lies on OB such that **OQ** = 3**b** express **AQ** in terms of **a** and **b**       **(1 mark)**

c)  Hence show that A, P and Q are collinear.                                          **(3 marks)**

**22.** A tailor makes two types of garments A and B. Garment A requires 3m of material while B requires 2 ½ m of material. The tailor uses not more than 600m of material daily in making both garments. The tailor must make not more than 100 garments of type A and not less than 80 of type B each day.

(a) Write down four inequalities from this information. **(4 marks)**

(b) Draw a graph for the inequalities shading the unwanted regions. **(4 marks)**

(c) If the tailor makes a profit of sh.80 on garment A and a profit of sh. 60 on garment B, how many garments must she make in order to maximize her total profit if all the garments are sold at once.

**(2 marks)**

**23.** (a) Using the trapezium rule, estimate the area enclosed by the curve $y = x^2$, the x-axis and the line $x = 5$ and $x = 2$ taking 7 ordinates. **(3 marks)**

(b) Find the exact area. **(3 marks)**

(c) Find the % error in using trapezium rule. **(2 marks)**

(d) Estimate the area using mid-ordinate rule. **(2 marks)**

**24.** A publisher employs two agents John and James. John is paid at a rate of sh.240 per week.  James is paid at the rate ofsh. 185 per week.  John earns no commission on the first 1800 books sold and a commission at a rate of 5% on each extra book sold.  James earns a commission of 2.5% on each book sold.In a certain year, each sold a total of 15000 books at the rate of sh. 83.50.

a)  Find who earned more money and by how much.  *(assume 1 year has 52 weeks)*  **(7 marks)**

b)  In another year James earned a total of sh. 51370.  Calculate the number of books he sold that year.

**(3marks)**