THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

121/2

MATHEMATICS Alt. A

Paper 2

Nov. 2023 – 2½ hours

Serial No.
19292330

Name: .... **Index Number:** ....

Candidate's signature: .... **Date:** ....

Instructions to Candidates

(a) Write your name and index number in the spaces provided above.
(b) Sign and write the date of examination in the spaces provided above.
(c) This paper consists of **two** sections: **Section I** and **Section II.**
(d) Answer **all** the questions in **Section I** and only **five** questions from **Section II.**
(e) **Show all the steps in your calculations, giving your answers at each stage in the spaces below each question.**
(f) Marks may be given for correct working even if the answer is wrong.
(g) **Non-programmable** silent electronic calculators and KNEC Mathematical tables may be used except where stated otherwise.
(h) **This paper consists of 19 printed pages.**
(i) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
(j) **Candidates should answer the questions in English.**

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Section I

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

Section II

17	18	19	20	21	22	23	24	Total

Grand Total	

317139

SECTION I (50 marks)

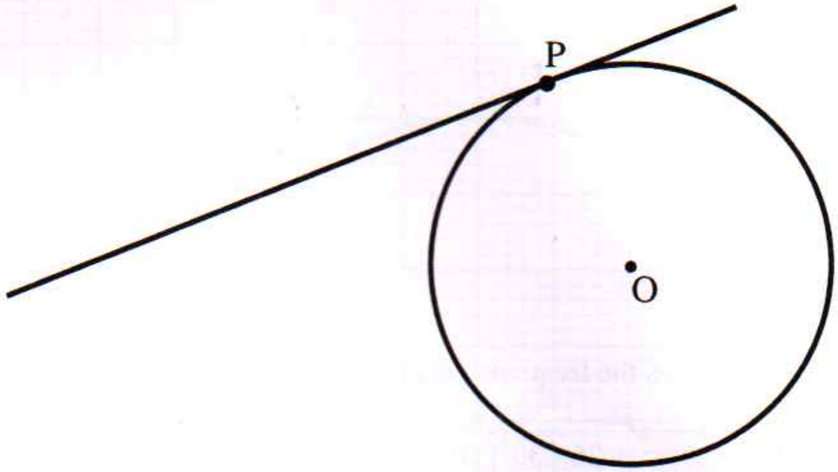
*Answer **all** the questions in this section in the spaces provided.*

1 Solve the equation $1 + \log(2x - 9) = \log(3x + 5) - \log 2$. (3 marks)

2 The masses of two students in a class were measured as 30.5 kg and 36.8 kg. Determine the least possible difference in the masses of the two students. (3 marks)

3 Make x the subject of the formula $a = \frac{bx}{\sqrt{x^2 - 9}}$. (3 marks)

4 In this question, use a ruler and a pair of compasses. The following figure shows a circle, centre O. A tangent to the circle at P is drawn.



Construct another tangent to the circle to intersect the drawn tangent at an angle of 60°. (3 marks)

5 A plane took 3 hours to fly from P(66.42°N, 30°E) to Q(66.42°N, 52.5°E). Determine the speed of the plane in knots correct to one decimal place. (3 marks)

6 Solve $6\cos^2 x = 5\sin x$ for $0 \leq x \leq 180°$. (4 marks)

7 The following table shows the frequency distribution of marks scored by 40 students in a test.

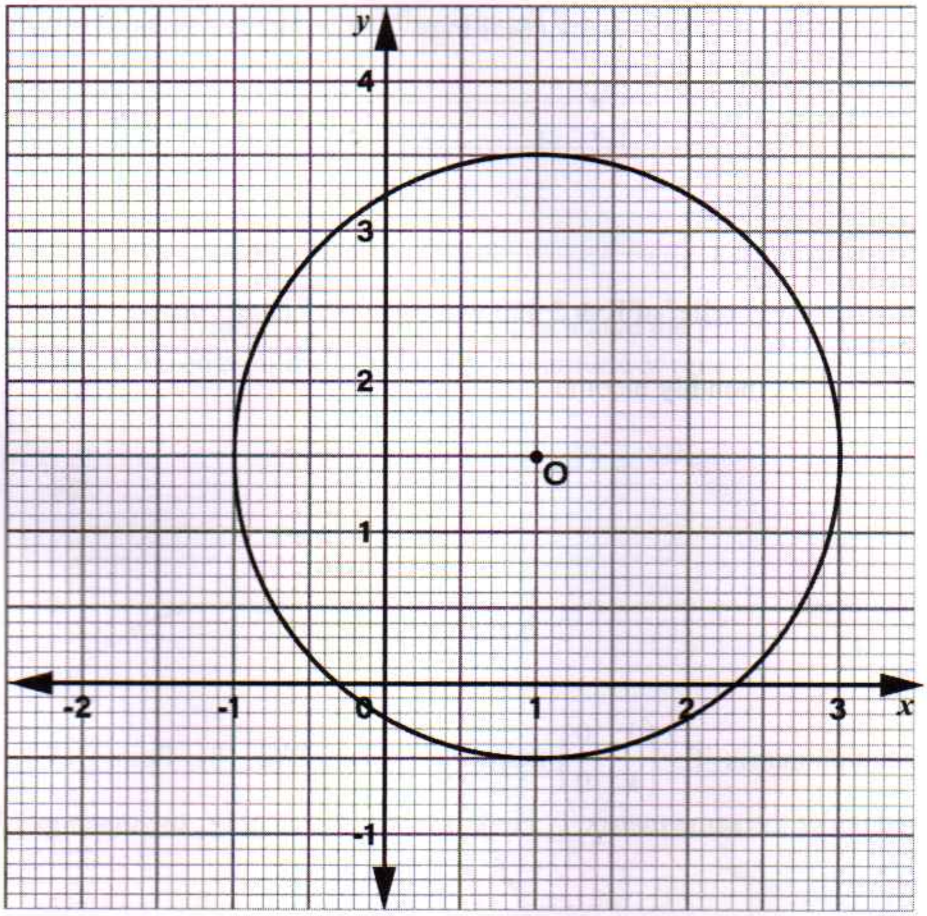
Marks	26 - 30	31 - 35	36 - 40	41 - 45	46 - 50
Frequency	4	10	13	8	5

Calculate the upper quartile mark. (3 marks)

8 Given that $\mathbf{p} = 5\mathbf{i} - \mathbf{j} + 3\mathbf{k}$, $\mathbf{q} = 8\mathbf{i} + \mathbf{j}$ and $\mathbf{r} = 2\mathbf{p} - \mathbf{q}$, determine the magnitude of $\mathbf{r}$.

(3 marks)

9 The following figure shows a circle centre O.



(a) Determine the equation of the circle. (2 marks)

(b) Use the equation in part (a) to determine the x-intercept of the circle correct to 3 decimal places. (2 marks)

10 The following table shows monthly income tax rates of a certain year.

Monthly Income in Kenya Shillings (Ksh)	Tax rate percentages (%) in each shilling
0 - 24 000	10
24 001 - 32 333	25
Above 32 333	30

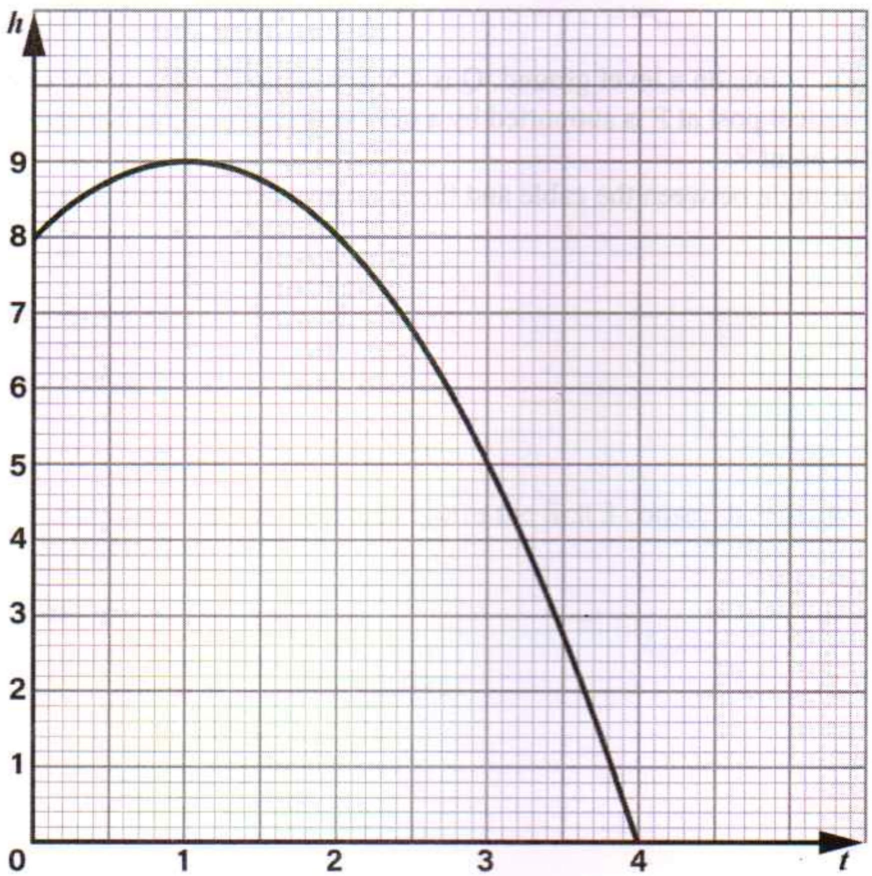
In that year, a monthly relief of Ksh 2 400 was allowed. The net tax on Lesianto's monthly income was Ksh 1 500.
Calculate Lesianto's monthly income. (3 marks

11 A transformation matrix $\mathbf{T} = \begin{pmatrix} 1 & 0 \\ k & 0 \end{pmatrix}$ maps $\mathbf{P}(2, 3)$ onto $P'(2, 10)$. Point $Q(-4, 4)$ is transformed under the same matrix **T**. Find the coordinates of Q', the image of Q. (3 marks

12 The length and width of a rectangular floor of a room are 10 m and 7 m respectively. A rectangular carpet of area 28 m^2 is placed on the floor. The carpet leaves a uniform space of x m with each of the walls of the room.
Form a quadratic equation in x and hence solve for x. (3 mark

13 A quantity v varies directly as the square of u and inversely as the cube root of w. When u = 5 and w = 8, the value of v = 375. Find the value of v when u = 8 and w = 125. (3 marks)

14 A stone was thrown upwards from a point 8 metres above the ground. The following graph shows the height, h metres of the stone above the ground at time t seconds in the interval $0 \leq t \leq 4$.



Determine the rate of change of h at $t = 2$ seconds. (3 marks)

15 The gradient function of a curve is given by $\frac{dy}{dx} = 3 - 4x$. If the curve passes through the point $(-1, 10)$, find the equation of the curve. (3 marks)

16 P, Q and R are points on a level ground. Q is 4.5 m south of P. R is to the east of P and 5.3 m from Q. A vertical post at P is supported by a cable of length 3.5 m. The cable joins the top T of the post to point R.
Calculate the angle between the cable and the level ground correct to 2 decimal places. (3 marks)

SECTION II (50 marks)

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

17 The first term of an arithmetic progression (A.P.) is *a* and the common difference *d*. The 7th term of the A.P. is 11. The sum of the first 12 consecutive terms of the A.P. is 123.

(a) (i) Form two simplified equations involving *a* and *d* to represent the information. (2 marks)

(ii) Find the values of *a* and *d*. (3 marks)

(b) The 1st, 3rd and 8th terms of the A.P. form the first 3 consecutive terms of a geometric progression (G.P.).

Calculate:

(i) the 6th term of the G.P. (3 marks)

(ii) the sum of the first 6 terms of the G.P. (2 marks)

18 A welfare group invested Ksh 75 000 in shares and another Ksh 75 000 in a piece of land for a period of 5 years. The shares appreciated in value at a rate of 6% per annum (p.a) for a period of 3 years. In the remaining period of 2 years, the shares appreciated in value at a rate of 4.5% every 6 months.

During the 5 years, the piece of land appreciated in value at a constant annual rate. At the end of the 5^{th} year, the values of the two investments were equal.

(a) Determine:

(i) the value of the shares at the end of the 5^{th} year. (4 marks

(ii) the annual rate of appreciation in the value of the piece of land over the period of 5 years. (3 mark

(b) After the 5 year period, the shares depreciated in value at a rate of 3.5% p.a. for n years The shares lost 10% of their value during this period. Determine the value of n correct to 2 decimal places. (3 mark

19 (a) A number is selected at random from the numbers 90, 91, 92, 93 and 94. A second number is then selected at random from the numbers 2, 3, 4 and 5. Afterwards a quotient is obtained by dividing the first number selected by the second number.

(i) Complete the probability space in the following table.

1st number (across); 2nd number (down)

$\div$	90	91	92	93	94
2				$46\frac{1}{2}$	
3			$30\frac{2}{3}$		
4		$22\frac{3}{4}$			
5	18				

(2 marks)

(ii) Determine the probability that the quotient obtained is a whole number. (2 marks)

(iii) Determine the probability that the quotient obtained is a recurring decimal. (1 mark)

(b) In a shooting practice the probability that a soldier will hit the target in his first attempt is 60%. This probability increases by 10% in the second attempt. The soldier shoots at the target twice. Determine the probability that:

(i) the soldier will miss the target only once. (3 marks)

(ii) the soldier will miss the target in both attempts. (2 marks)

20 (a) The table below shows values of x and some values of y for the curve $y = 14 + 10x - 8x^2 - 4x^3$.

Complete the table.

x	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5
$y = 14 + 10x - 8x^2 - 4x^3$		-6		0		14		12	

(2 marks)

(b) On the grid provided, draw the graph of $y = 14 + 10x - 8x^2 - 4x^3$ for $-2.5 \le x \le 1.5$.
Use the scale: 1 cm represents 0.5 units on x-axis.
2 cm represents 5 units on y-axis (3 marks)

(i) Use the graph to solve the equation $14 + 10x - 8x^2 - 4x^3 = 0$. (1 mark)

(ii) By drawing a suitable line graph on the same grid, solve the equation $4x^3 + 8x^2 - 5x - 4 = 0$. (4 marks)

21 An express train operates between two towns. The train pulls x coaches on first class and y coaches on economy class. Each first class coach can hold 72 passengers while each economy class coach can hold 120 passengers.

(a) Write down the inequalities that express the following conditions for a trip made by the train where the:

(i) total number of coaches used was less than 10.

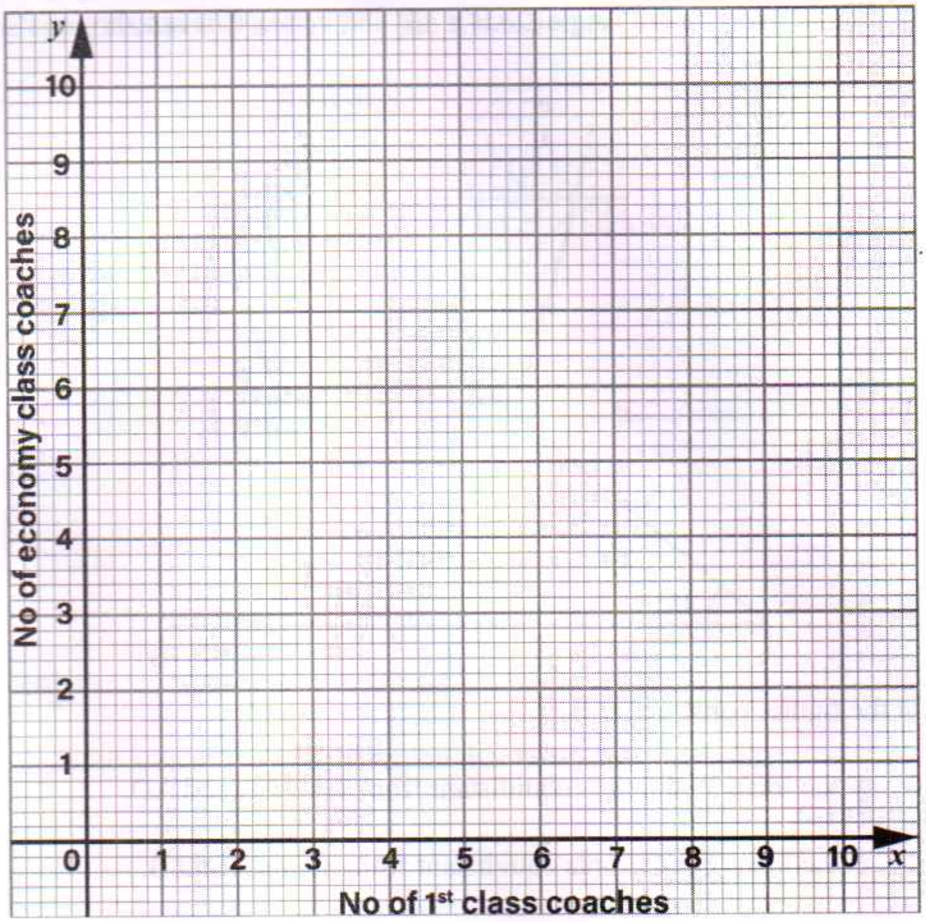
(ii) train was pulling at least one first class coach.

(iii) number of economy class coaches was more than the number of first class coaches.

(iv) total number of passengers exceeded 360.

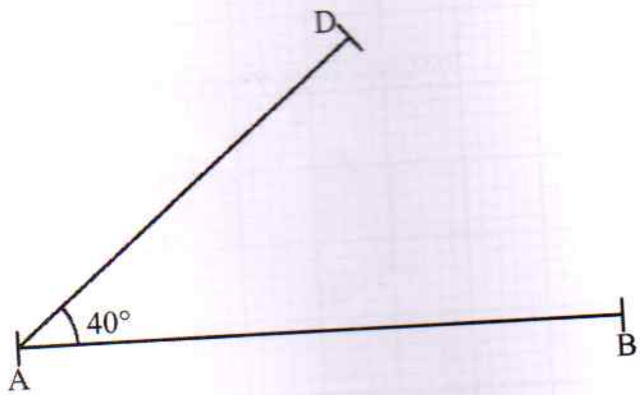
(4 marks)

(b) Represent the inequalities in (a) on the grid provided. (4 marks)



(c) The coaches for the trip were all fully booked. Each first class ticket costs Ksh 3000 while each economy class ticket costs Ksh 1000.
Determine the maximum possible amount realised from the sale of tickets for the trip. (2 marks)

22 In this question, use a ruler and a pair of compasses only.
The following figure is drawn to scale. It shows sides AB and AD of a trapezium ABCD in which AB and DC are parallel. Angle DAB = 40° and vertex C is not shown.



(a) On the figure, construct:

(i) the locus P of points equidistant from sides AB and AD. (1 mark)

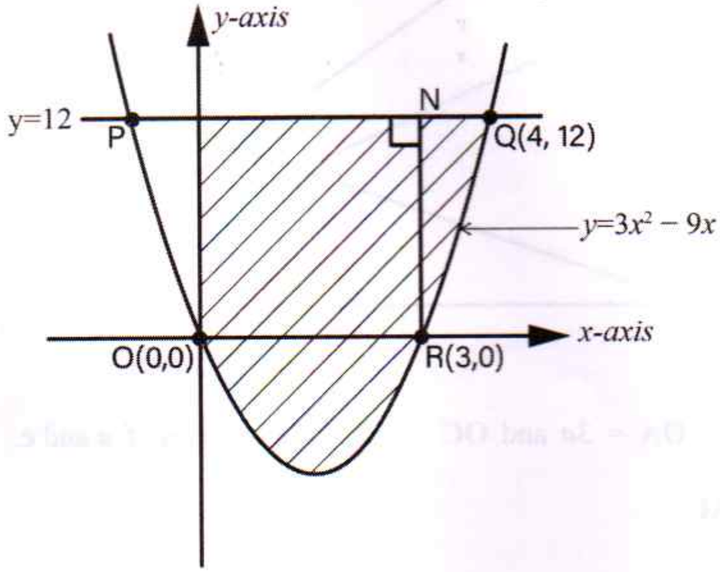
(ii) the locus Q of points equidistant from points A and B. (1 mark)

(iii) the locus R of points such that $\angle ARB = 70^\circ$. (2 marks)

(b) Vertex C is such that $\angle ACB = 70^\circ$ Locate vertex C and hence complete the trapezium ABCD. (3 marks)

(c) Calculate the area of trapezium ABCD. (3 marks)

23 The following figure is a sketch of a curve whose equation is $y = 3x^2 - 9x$. The curve cuts the x-axis at O(0, 0) and at R(3, 0). The curve cuts the line $y = 12$ at P and Q. The coordinates of Q is (4, 12). Line RN is perpendicular to PQ at N.



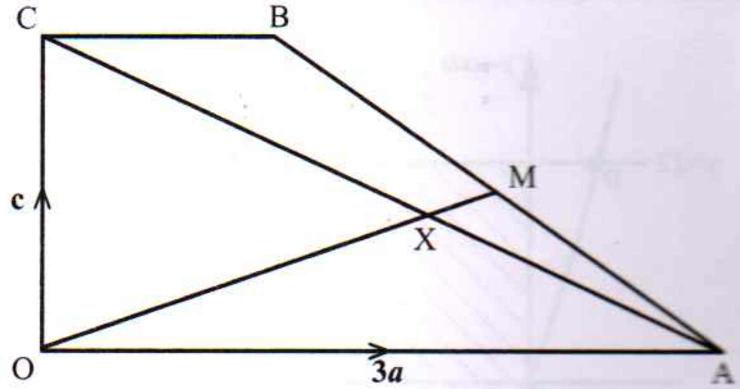
(a) Calculate:

(i) the area of the shaded region that lies below the x-axis. (4 marks)

(ii) the area of the shaded region that lies to the right of line RN. (4 marks)

(b) Hence calculate the total area of the shaded region. (2 marks)

24 In the following figure OABC is a trapezium. OA is parallel to CB and OA = 3 CB. M is the midpoint of AB.



(a) Given that **OA** = 3***a*** and **OC** = **c** express in terms of ***a*** and **c**.

(i) **AC** (1 mark)

(ii) **AB** (2 marks)

(iii) **OM** (2 marks)

(b) Lines AC and OM intersect at X such that **OX** = h **OM** and **AX** = k **AC** where h and k are scalars. Determine the values of h and k. (5 marks)