

NYAKKIMA JOINT EXAMINATION - 2023

Kenya Certificate of Secondary Education

121/2

Paper 2



MATHEMATICS



-Alt. A

March. 2023 – 2 Hours 30 Mins

Name: Index Number:

Student's Signature: Date: Class:.....

Instructions to candidates

- (i) Write your name, Index number and class in the spaces provided above.
- (ii) Sign and write the date of examination in the spaces provided above.
- (iii) This paper consists of **two** sections: **Section I** and **Section II**.
- (iv) Answer **all** the questions in **Section I** and only **five** questions from **Section II**.
- (v) **Show all the steps in your calculations, giving your answers at each stage in the spaces provided below each question.**
- (vi) Marks may be given for correct working even if the answer is wrong.
- (vii) **Non – programmable** silent electronic calculators and KNEC Mathematical tables may be used, except where stated otherwise.
- (viii) This paper consists of 16 printed pages. **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
- (ix) **Candidates should answer the questions in English.**

For Examiner's Use Only

Section I

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

Section II

17	18	19	20	21	22	23	24	Total

Grand Total

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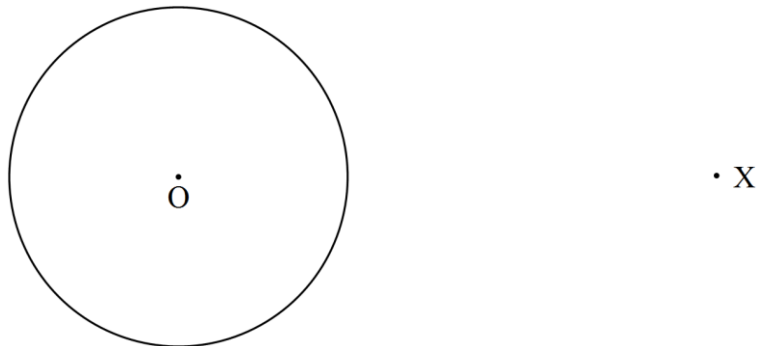
SECTION I (50 Marks)

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

1. The volume of a rectangular stone is 68.5 ml and its base area is 14.5 cm^2 both measurements correct to 3 significant figures. Find the limits within which its height lies. (2 marks)

2. Three grades of coffee A, B and C were mixed in the ratio 1:2:3. The cost per kg of each of the grades A, B and C were Kshs.700, Kshs.490 and Kshs.630 respectively. Calculate the selling price per kg if a profit of 20% is to be realized. (3 marks)

3. The figure below shows a circle centre O. A point X lies outside the circle.



- (a) Construct a tangent from point X to touch the circle on the upper side at point A. (2 marks)

- (b) Measure the size of angle AOX. (1 mark)

4. Simplify $(2 + \sqrt{3})(2 - \sqrt{3})$

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

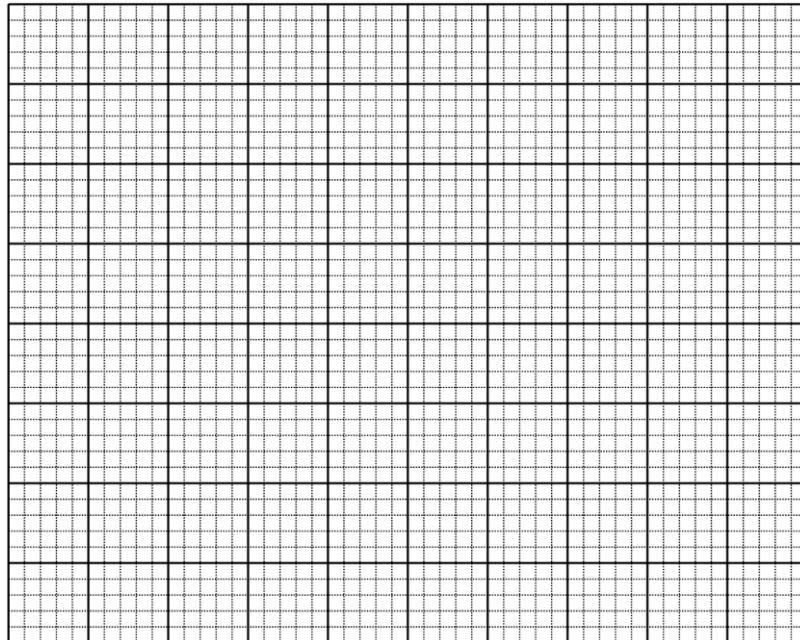
5. The cash price of a cooker is Kshs.48 000. It can also be purchased by paying a deposit of Kshs.6 000 followed by 12 equal monthly instalments of Kshs.4 200.

Calculate the monthly rate of compound interest charged on instalment buying. (3 marks)

6. Make K the subject of the formula; $m = \frac{d}{2\pi} \sqrt{\frac{4n - F}{K^2}}$ (3 marks)

7. Form a quadratic equation whose roots are $1+\sqrt{2}$ and $1-\sqrt{2}$ in the form $ax^2 + bx + c = 0$ where a, b and c are integers. (3 marks)

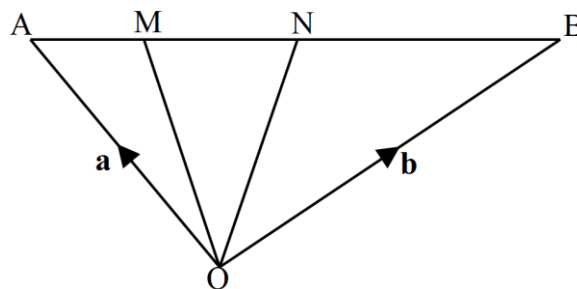
8. The vertices of a triangle ABC are $A(-8, 2)$, $B(-3, 2)$ and $C(-7, 5)$. Draw the triangle ABC on the grid provided hence find the area of its image under the transformation given by the matrix $\begin{pmatrix} 2 & 3 \\ 4 & 7 \end{pmatrix}$. (4 marks)



9. The sum of the third and fourth terms of a geometric progression is 24 while the sum of the fourth and fifth terms of the same G.P is 60. Determine the first term and the common ratio. (3 marks)

10. Given that $4\sin(2x+60^\circ) = -0.7764$, find x to the nearest degree for $-180^\circ \leq x \leq 180^\circ$. (3 marks)

11. In the figure below, $\mathbf{OA} = \mathbf{a}$, $\mathbf{OB} = \mathbf{b}$, $2\mathbf{AM} = \mathbf{MN}$ and $7\mathbf{AN} = 3\mathbf{AB}$.

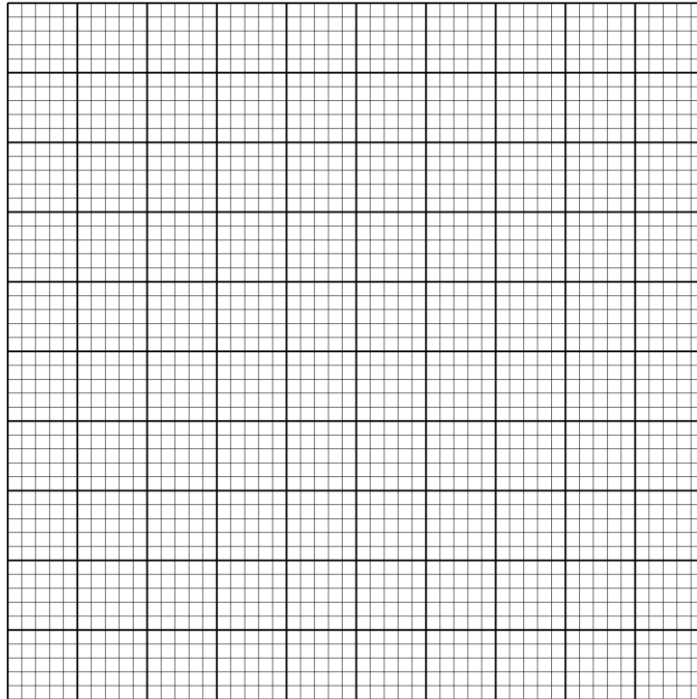


Express \mathbf{OM} in terms of \mathbf{a} and \mathbf{b} . (3 marks)

12. In an experiment involving two variables, time (t) in hours and height (h) in centimetres, the following results were obtained.

Time (t) hrs	0	2	4	6	8	10	12	14	16
Height (h) cm	80	60	46	35	35	20	16	14	13

- (a) On the grid provided below, draw the graph of height against time. (2 marks)



- (b) Determine the rate of change between $t = 2.4$ s and $t = 13.2$ s. (2 marks)

13. Evaluate the logarithmic expression: $\frac{1}{2} \log_3 729 + \frac{2}{5} \log_5 3125$. (3 marks)

14. Tap A can fill an empty tank in 10 minutes, tap B can fill the same tank in 20 minutes and tap C can empty the tank when full in 30 minutes. The three taps are left open for 5 minutes after which tap A is closed. How much longer does it take to fill the tank?
(3 marks)

15. (a) Expand $(a + b)^5$ up to the term containing b^3 . (2 marks)

- (b) Use your expansion to estimate 3.96^5 . (2 marks)

16. Two straight lines $x + 2y = -1$ and $2x + 3y = 3$ intersect at R. Find the equation of the circle centre R and radius 5 units. Give your answer in the form $x^2 + y^2 + ax + by + c = 0$ where a , b and c are integers. (3 marks)

SECTION II (50 Marks)

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

17. The table below shows tax rates in Kenya in the year 2022.

Monthly income in Kenya Shillings (KSh)	Percentage rate of tax in each shilling
1 – 9 860	10%
9 861 – 18 700	15%
18 701 – 27 820	20%
27 821 – 37 140	25%
37 141 and above	30%

In a certain month of that year, Mr Shikuku earned a basic salary of Kshs.31 200, a house allowance of Kshs.12 000, a hardship allowance of Kshs.11 200 and a commuter allowance of Kshs.3 040. He was entitled to a personal tax relief of Kshs.1 056 in that month. Mr Shikuku also had a life assurance policy for which he paid a premium of Kshs.7 200, and which entitled him to a further relief of 15% of the premium paid.

(a) Determine:

(i) Mr Shikuku's taxable income in that month. (2 marks)

(ii) Income tax paid. (5 marks)

(b) Apart from the income tax, Mr Shikuku paid the following from his salary:

Cooperative loan Ksh 16 000, WCPS 2% of his basic salary, NHIF Ksh 2 240.

Calculate his net monthly salary. (3 marks)

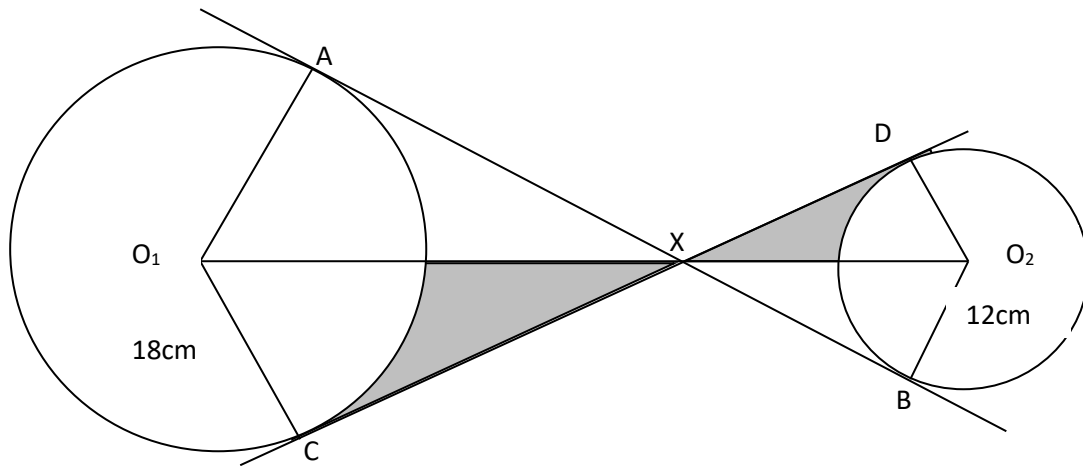
18. (a) Production of bolts in Mashujaa steel company in Nairobi increases every minute in an arithmetic progression. The number of bolts produced in 13th minute is four times the number of bolts produced in the third minute. The total number of bolts produced in the first nine minutes is 144.

(i) Find the number of bolts produced in the first minute. (3 marks)

(ii) The least time to the nearest minute required to fulfil an order of 36 900 bolts. (3 marks)

(b) An increasing arithmetic progression has the third, ninth and twenty fifth terms forming the first three consecutive terms of a geometric progression. If the sum of the seventh term and twice the sixth term of the arithmetic progression is 78, calculate the first term and the common difference. (4 marks)

19. The figure below shows two transverse tangents AB and CD. The circle centre O_1 has a radius of 18cm while the centre O_2 has a radius of 12cm. The tangents intersect at X and the distance between the centers is 40cm.



Calculate;

- (i) Length of the tangent AB; (3 marks)

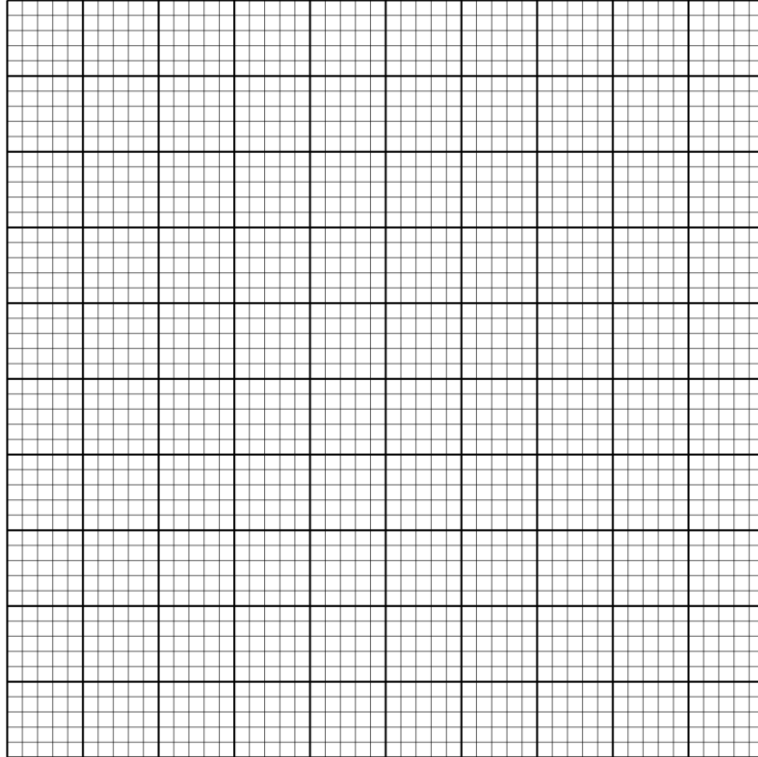
- (ii) Angle AOC (2 marks)

- (iii) Area of the shaded region (5 marks)

20. (a) Complete the table below for $y = x^3 + 4x^2 - 5x - 5$ in the range $-5 \leq x \leq 2$. (2 marks)

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

(b) On the grid provided, draw the graph of $y = x^3 + 4x^2 - 5x - 5$ for $-5 \leq x \leq 2$. Use the scale of 1 cm to represent 1 unit on the horizontal axis and 1 cm to represent 5 units on the vertical axis. (3 marks)



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

(ii) By drawing a suitable straight line on the graph, solve the equation $4x^3 + 16x^2 - 20x - 20 = -5x + 7$ (3 marks)

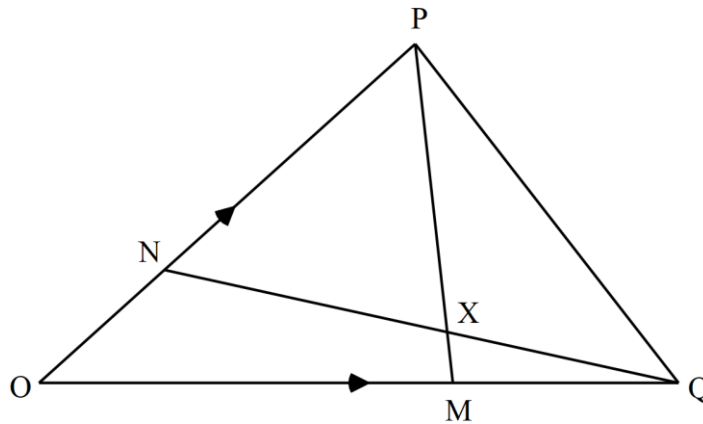
21. (a) Three quantities P, Q and R are such that P varies directly as the square of Q and inversely as the square root of R. Given that $P = 20$ when $Q = 5$ and $R = 9$, find:

(i) The equation connecting P, Q and R. (3 marks)

(ii) The percentage change in P when R is increased by 21%. (3 marks)

(b) The cost, Sh C, of hiring a taxi is partly constant and partly varies as the distance, D km covered. The cost is Sh 755 for a distance of 4 km and Sh 875 for a distance of 5 km. Calculate the cost for a distance of 6 km. (4 marks)

22. The figure below shows triangle OPQ in which $\overrightarrow{OP} = \underline{p}$ and $\overrightarrow{OQ} = \underline{q}$. M and N are points on \overrightarrow{OQ} and \overrightarrow{OP} respectively, such that $ON : NP = 1 : 3$ and $OM : MQ = 2 : 1$ lines PM and QN intersect at x .



- (a) Express the following in terms of vectors \underline{p} and \underline{q}
- (i) \overrightarrow{PM} (1 mark)
- (ii) \overrightarrow{QN} (1 mark)
- (b) Given further that $\overrightarrow{PX} = h\overrightarrow{PM}$ and $\overrightarrow{QX} = k\overrightarrow{QN}$,
- (i) Express \overrightarrow{OX} in terms of h , \underline{p} and \underline{q} (2 marks)
- (ii) Express \overrightarrow{OX} in terms of k , \underline{p} and \underline{q} (2 marks)
- (iii) Hence, find the value of h and k . (3 marks)
- (c) \overrightarrow{OX} produced meets \overrightarrow{PQ} at Y such that $PY : YQ = 3 : 2$. Using ratio theorem or otherwise, find OY in terms of \underline{p} and \underline{q} . (1 mark)

23. (a) Gekano, a decathlon athlete, while preparing for 2020 Olympics, either does pole vault, jogging or sprints in the morning. He decides on what to do by throwing a tetrahedron. The tetrahedron is marked 1, 2, 2 and 3. If the score is 1, he goes for pole-vault, if the score is 2, he goes for jogging while if the score is 3, he goes for sprints. Find the probability that:

(i) On a given morning, he goes for sprints of jogging. (2 marks)

(ii) On two consecutive mornings, he goes for pole-vault. (2 marks)

(iii) On any morning, he does not go for jogging. (2 marks)

(b) In preparation for a relay race, there are 7 boys and 6 girls but only 4 can run the race. Find the probability that:

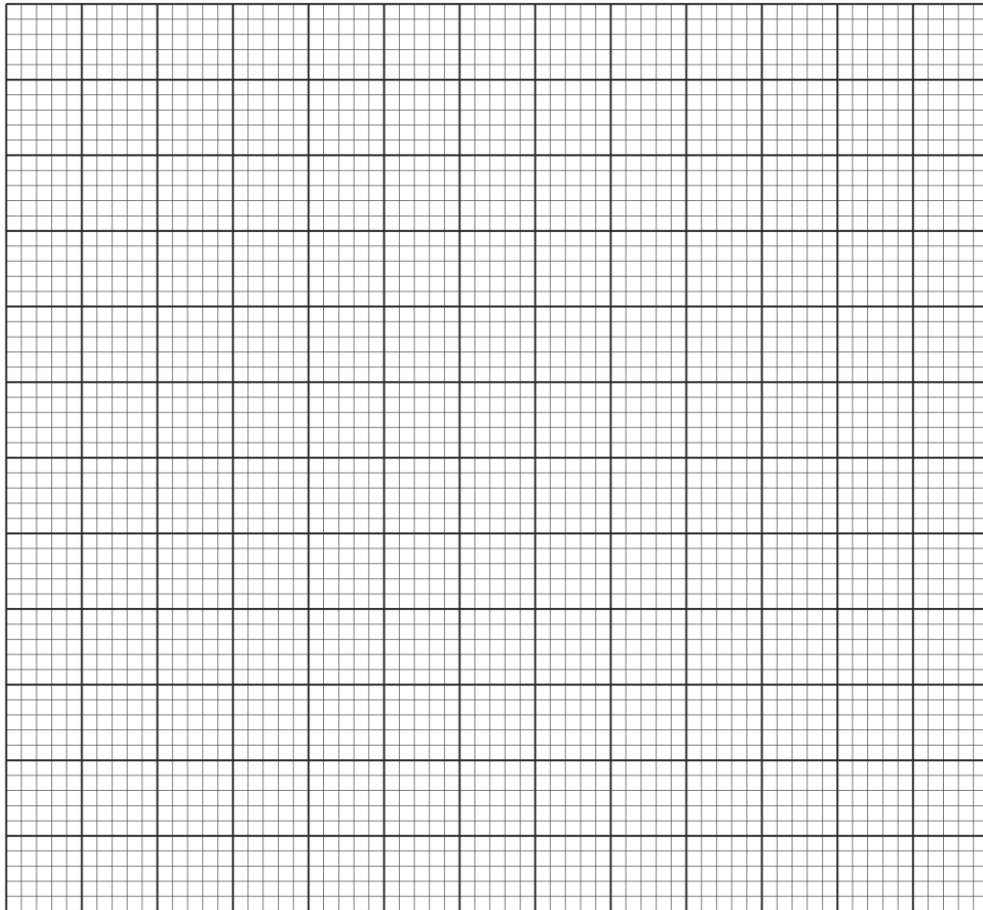
(i) The race is only run by boys. (2 marks)

(ii) Two of the participants in the race are girls. (2 marks)

24. OABC is a parallelogram with vertices $O(0,0)$, $A(2,0)$, $B(3,2)$ 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) (i) Find the coordinates of $O'A'B'C'$ (2 marks)

(ii) On the grid provided, draw OABC and $O'A'B'C'$ (2 marks)



(b) (i) Find $O''A''B''C''$ the image of $O'A'B'C'$ under the transformation matrix $\begin{pmatrix} 1 & 0 \\ 0 & -2 \end{pmatrix}$. (2 marks)

(ii) On the same grid, draw the image of $O''A''B''C''$ (1 mark)

(c) Find the single matrix that maps $O''A''B''C''$ onto OABC. (3 marks)

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