

121/1
MATHEMATICS
PAPER 1
Time: 2¹/₂ hours
KCSE 2023 TOP PREDICTION MASTER CYCLE 10

Name Index Number.....

Candidate's Signature Date

Instructions to candidates

1. Write your name, admission number and class in the spaces provided above.
2. The paper contains two sections: **Section I** and **Section II**.
3. Answer **ALL** the questions in **Section I** and **ANY FIVE** questions from **Section II**.
4. All working and answers must be written on the question paper in the spaces provided below each question.
5. Marks may be awarded for correct working even if the answer is wrong.
6. Negligent and slovenly work will be penalized.
7. Non-programmable silent electronic calculators and mathematical tables are allowed for use.
8. *This booklet contains 17 printed pages. Please confirm that all the pages exist and are properly printed before starting the exam.*

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 %

Section I (50 marks)

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

1. Without using calculators evaluate $\frac{1}{3}$ of $(2\frac{3}{4} - 5\frac{1}{2}) \times 3\frac{6}{7} \div \frac{9}{4}$ (2 marks)

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

3. Solve for θ in the equation $6 \cos^2 \theta - \sin \theta - 4 = 0$ in the range $0^\circ \leq \theta \leq 180^\circ$. (3 marks)

4. The sides of a rectangle are x cm and $(x + 1)$ cm. A circle has radius of $(x + 2)$ cm. If the sum of the area of the rectangle and the circle is 184 cm^2 . Using π as $\frac{22}{7}$ find the value of x . (4 marks)

5. Use binomial expansion to evaluate $\left(2 + \frac{1}{\sqrt{2}}\right)^5 + \left(2 - \frac{1}{\sqrt{2}}\right)^5$ (3 marks)
6. A line L_1 passes through point $(1, 2)$ and has a gradient of 5. Another line L_2 is perpendicular to L_1 and meets it at a point where $x = 4$. Find the equation for L_2 in the form $y = mx + c$. (4 marks)

7. Find the value of x in the following equation. (3 marks)
 $9^x + 3^{2x} - 1 = 53$
8. The first and the last terms of an AP are 2 and 59 respectively. If the sum of the series is 610, find the number of terms in the series and the common difference. (4 marks)
9. The equation of a circle is $2x^2 + 2y^2 + 12x - 20y - 4 = 0$. Determine the coordinates of the centre of the circle and state its radius. (3 marks)
10. Make b the subject of the formula $a = \frac{bd}{\sqrt{b^2 - d}}$ (3 marks)

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

12. Solve for x given that $\log_2 5x - \log_4 2x = 3$ (3 marks)

13. A salesman earns a basic salary of sh. 9,000 per month. In addition he is also paid a commission of 5% for sales above sh. 15,000. In a certain month he sold goods worth sh. 120,000 at a discount of $2\frac{1}{2}\%$. Calculate his total earnings that month. (3 marks)
14. A small cone of height 8 cm is cut off from a bigger cone to leave a frustum of height 16 cm. If the volume of the smaller cone is 160 cm^3 , find the volume of the frustum. (3 marks)
15. Vector $\mathbf{OP} = 6\mathbf{i} + \mathbf{j}$ and $\mathbf{OQ} = -2\mathbf{i} + 5\mathbf{j}$. A point N divides \mathbf{PQ} internally in the ratio 3:1. Find \mathbf{PN} in terms of \mathbf{i} and \mathbf{j} . (3 marks)
16. Without using mathematical tables or calculators express in surd form and simplify
$$\frac{1 + \cos 30^\circ}{1 - \sin 60^\circ}$$
 (3 marks)

SECTION II (50 MARKS)

Answer any five questions in this section

17. Arc of a circle of radius 40cm subtends an angle of 126° at the centre of the circle.

(a) Calculate:

(i) the length of the arc.

(2 marks)

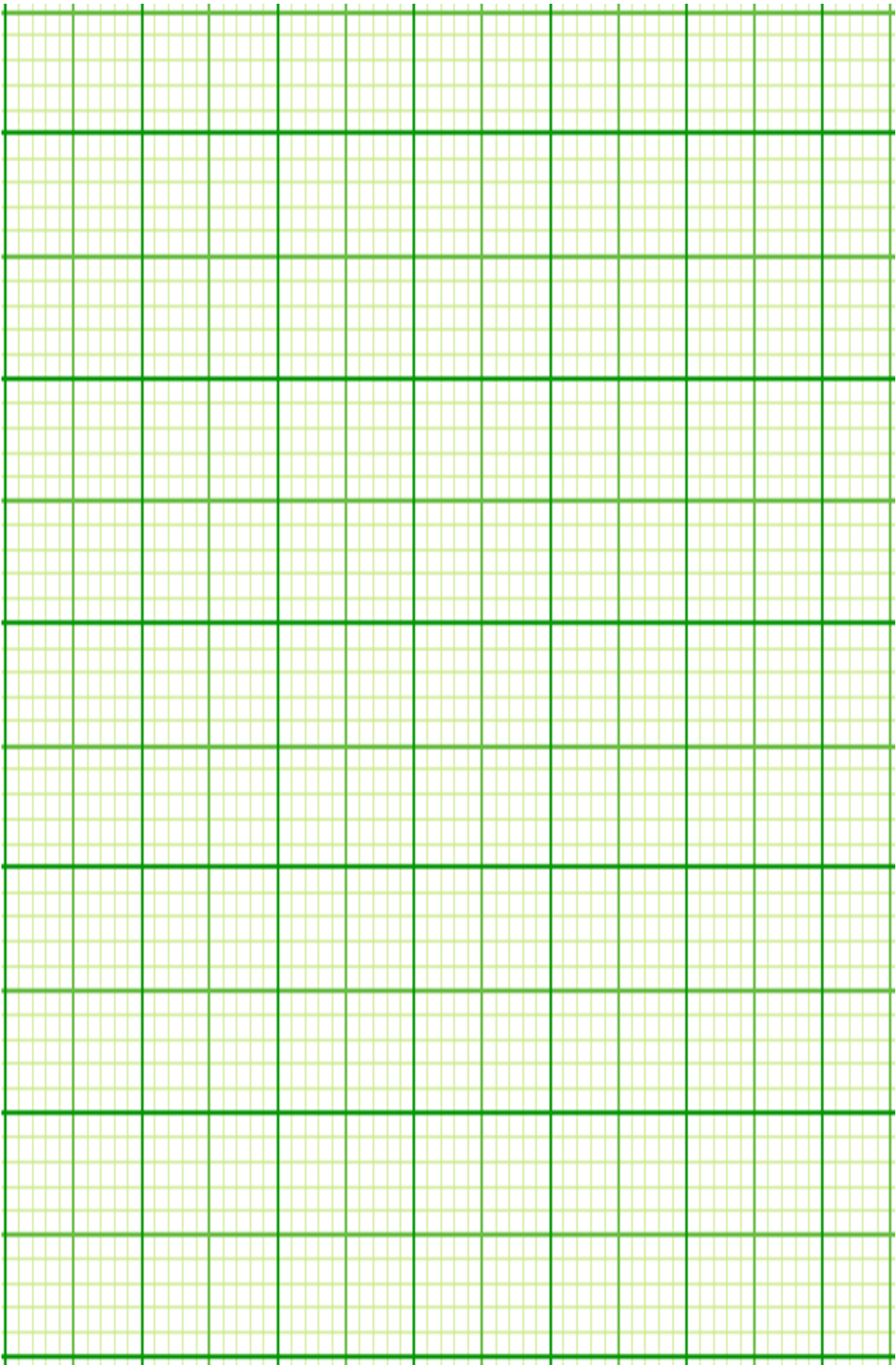
(ii) the area of the sector.

(2 marks)

- (b) The sector is folded to form a cone.
Calculate:
- (i) the radius of the base of the cone. (2 marks)
- (ii) the height of the cone. (2 marks)
- (iii) the capacity of the cone in litres. (2 marks)

18. On the graph paper provided, plot the triangle

- a) whose co-ordinates are A(1, 2) B(5, 4) and C(2, 6) (1 mark)
- b) On the same axes
- i) Draw the image $A^1B^1C^1$ of ABC under a rotation of 90° clockwise about origin. (2 marks)
- ii) Draw the image $A^{11}B^{11}C^{11}$ of $A^1B^1C^1$ under a reflection in the line $y = -x$. State the coordinates of $A^{11}B^{11}C^{11}$. (3 marks)
- c) $A^{111}B^{111}C^{111}$ is the image of $A^{11}B^{11}C^{11}$ under the reflection in the line $x = 0$. Draw the image $A^{111}B^{111}C^{111}$ and state its coordinates. (2 marks)
- d) Describe a single transformation that maps $A^{111}B^{111}C^{111}$ onto ABC. (2 marks)



19. A bus left Kitale at 10.45 a.m and travelled towards Nairobi at an average speed of 60 km/h. A Nissan left Kitale on the same day at 1.15 p.m and travelled along the same road at an average speed of 100 km/h. The distance between Kitale and Nairobi is 500 km.

a) Determine the time of the day when the Nissan overtook the bus. (6 marks)

b) Both vehicles continued towards Nairobi at their original speed. Find how long the Nissan had to wait in Nairobi before the bus arrived. (4 marks)

20. The table below shows how income tax was charged in a certain year.

| (Kenya pounds) | (Ksh. per Kenya pound) |
|-----------------|------------------------|
| 1 – 3630 | 2 |
| 3631 - 7260 | 3 |
| 7261 - 10890 | 4 |
| 10891 - 14520 | 5 |
| 14521 - 18150 | 6 |
| 18151 - 21780 | 7 |
| 21781 and above | 7.5 |

During the year Mwadime earned a basic salary of Ksh. 25,200 and a house allowance of Ksh. 12,600 per month. He was entitled to a personal tax relief of Ksh. 1,162 per month.

- a) Calculate:

i) Mwadime's taxable income in Kenya pounds per annum. (2 marks)

ii) The net tax he pays per month. (6 marks)

- b) Apart from income tax he also contributes monthly NHIF Ksh. 1600, WCPS Ksh. 1000. Calculate his net monthly pay. (2 marks)

21. X, Y and Z are three quantities such that X varies directly as the square of Y and inversely as the square root of Z.

a) Given that $X = 18$ when $Y = 3$ and $Z = 4$, find X when $Y = 6$ and $Z = 16$. (5 marks)

b) If Y increases by 10% and Z decreases by 19%, find the percentage increase in X. (5 marks)

- 22(a) A port B is on a bearing 080° from a port A and a distance of 95 km. A Submarine is stationed at a port D, which is on a bearing of 200° from A, and a distance of 124 km from B. A ship leaves B and moves directly Southwards to an Island P, which is on a bearing of 140° from A. The Submarine at D on realizing that the ship was heading to the Island P, decides to head straight for the Island to intercept the ship. Using a scale of 1 cm to represent 10 km, make a scale drawing showing the relative positions of A, B, D and P. (4 marks)

Hence find:

- b) The distance from A to D. (2 marks)
- c) The bearing of the Submarine from the ship when the ship was setting off from B. (1 mark)
- d) The bearing of the Island P from D. (1 mark)
- e) The distance the Submarine had to cover to reach the Island P. (2 marks)

23. The data below represent the heights taken to the nearest centimeters of 40 lemon trees in a garden. (NB: A = Assumed mean)

| Height (cm) | f | x | d = x - A | fd | d ² | fd ² |
|-------------|----|---|-----------|----|----------------|-----------------|
| 131 – 140 | 3 | | | | | |
| 141 – 150 | 4 | | | | | |
| 151 – 160 | 7 | | | | | |
| 161 – 170 | 11 | | | | | |
| 171 – 180 | 9 | | | | | |
| 181 – 190 | 5 | | | | | |
| 191 – 200 | 1 | | | | | |

- a) Complete the table. (6 marks)
- b) Using 165.5 as the assumed mean, calculate the mean height. (2 marks)
- c) Calculate the standard deviation of the distribution. (2 marks)

24. The line segment $BC = 7.5$ cm long is one side of triangle ABC.
- a) Use a ruler and compasses only to complete the construction of triangle ABC in which $\angle ABC = 45^\circ$, $AC = 5.6$ cm and angle BAC is obtuse. (3 marks)
- b) Draw the locus of a point P such that P is equidistant from a point O and passes through the vertices of triangle ABC. (3 marks)
- c) Locate point D on the locus of P equidistant from lines BC and BO. Q lies in the region enclosed by lines BD, BO extended and the locus of P. Shade the locus of Q.

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