**121/2**
**MATHEMATICS**
**PP2**
**TIME: 2 $^1/_2$ HOURS**

# KCSE 2023 TOP PREDICTION MASTER CYCLE 6

**NAME** …………………………………………………………… **ADM NO** ………………….

**DATE** ……………………………       **CANDIDATE'S SIGNATURE** …………………..

**INSTRUCTIONS TO CANDIDATES**

1. Write your name, admission number and school in the spaces provided.
2. This paper consists of two sections; **Section I** and **Section II.**
3. Answer ALL the questions in Section I and **ONLY FIVE** questions in Section II.
4. All answers and working must be written on the question paper in the spaces provided below each question.
5. Show all the steps in your calculations, giving your answer at each stage in the space provided below each question.
6. Marks may be given for correct working even if the answer is wrong.
7. Non programmable silent electronic calculators and **KNEC** mathematical tables may be used except where stated otherwise.
8. Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

**FOR EXAMINORS USE ONLY**

SECTION I

| 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 the spaces provided in this section.**

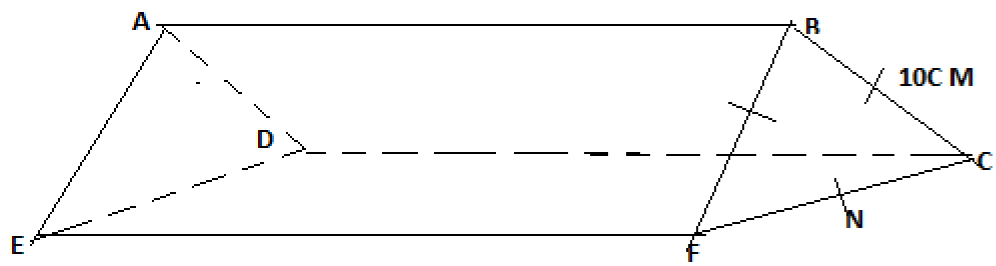
1. Solve for x in the equation (2 marks)

   $log\ (5x - 15) - log(2x - 3)\ = 1$

2. Given that z varies directly as the square of x and inversely as the square root of y. If $x = 2$, $y = 9$ when $z = 3$, find $z$ when $x = 3$ and $y = 4$. (3 marks)

3. Calculate the exact value of compound interest earned on Sh. 20 000 for $1\frac{1}{2}$ years at the rate of 12% p.a, compounded half yearly. (3 marks)

4. The triangular prism shown below has the sides AB =DC =EF = 12 cm. The ends are equilateral triangles of sides 1ocm. The point N is the midpoint of FC (3Marks)

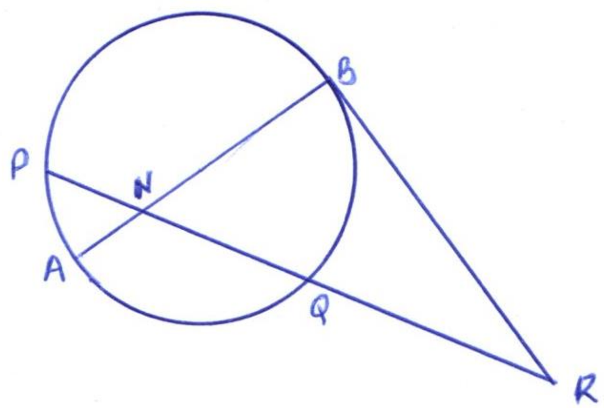



a) Find the length of BN (1 mark)

b) Find the angle between the line EB and the plane CDEF (2 marks)

5. Evaluate $\frac{1+\sqrt{5}}{2+\sqrt{5}}+\frac{1-\sqrt{5}}{2-\sqrt{5}}$ (3 marks)

6. In the figure below, AB is a diameter of the circle. Chord PQ intersects AB at N. A tangent to the circle at B and meets PQ produced at R.




Given that PN = 14 cm, NB = 4 cm and BR = 7.5 cm, calculate the length of;

a) NR (2 marks)

b) AN (2 marks)

7. Solve the quadratic equation by completing the square method. (3 marks)

$$2x^2 - 5x = -3$$

8. Mogutu and Onacha working together can do a piece of work in 6days. Mogutu working alone takes 5days longer than Onacha. How many days does it take Onacha to do the work alone? (3 marks)

9. In an experiment, water was heated and its temperature changes recorded at intervals of 2 minutes as shown in the table below.

| Time (Min) | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 25 | 35 | 42.5 | 50 | 60 | 67.5 | 77.5 | 85 | 92.5 |

a) On the grid provided, plot the points and draw the line of best fit. (3 marks)

b) Use the line of best fit to estimate the time taken for the temperature of the water to be 75°C. (1 mark)

10. State the amplitude and the phase angle of the curve $4y = \cos(5x - 40^0)$ (2 marks)

11. Calculate the semi-interquartile range of 3,4,1,2,3,6,8,5,7,9. (3 marks)

12. Points A and B lie on latitude 15°N andtheir longitudes differ by 25°. An aircraft takes 8 hours to fly between the points. Calculate its speed in knots. (3 marks)

13. Given the points P(-6,-3) , Q(-2,-1) and R(6,3) express Vectors $\overrightarrow{PQ}$ and$\overrightarrow{QR}$ as column vectors and hence show that the points P,Q and R are collinear (4 marks)

14. During inter-school competitions, rugby and football teams from Ranje sec school took part. The probability that the rugby would win their first match was $\frac{1}{8}$ while that the handball team could lose was $\frac{4}{7}$. Find the probability that at least one team won the first match. (3 marks)

15. The original area of an object after two successive transformations given by $\begin{bmatrix} 2 & 1 \\ 3 & 5 \end{bmatrix}$ and $\begin{bmatrix} 3 & 1 \\ 0 & 1 \end{bmatrix}$ in that order becomes 168 square units. Find the original area of the object. (3 marks)

16. Evaluate $\int_{-1}^{3}(3x+1)(2x-2)$ (4 marks)

**SECTION II (50 Marks)**

**Answer ONLY FIVE questions in this section**

17. An arithmetic progression of 41 terms is such that the sum of the first five terms is 560 and the sum of the last five terms is -250. Find:

    a) The first term and the common difference (5 marks)

b) The last term (2 marks)

c) The sum of the progression (3 marks)

18. A pavement is of length $(x-1)m$ and width $(x-8)m$. The area of the pavement is $4.56\ m^2$.

a) (i) Write a quadratic equation for the area of the pavement in the form $ax^2+bx+c=0$ where a, b and c are constants. (2 marks)

(ii) Using the method of completing square, find the actual length and width of the pavement. (6 marks)

b) The pavement is covered with rectangular tiles measuring 0.4 m by 0.3 m. determine the number of tiles used to cover the pavement completely. (2 marks)

19. The table below shows the masses measured to the nearest Kg of 200 people.

| Mass kg | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 | 90-99 | 100-109 |
|---|---|---|---|---|---|---|---|
| No of people | 9 | 27 | 70 | 50 | 26 | 12 | 6 |

a) Draw a cumulative frequency curve for the data above. (4 marks)

b) Use your graph to estimate

i. The median mass. (1 mark)

ii. The number of people whose mass lies between 70.5 kg and 75.5 kg (1 mark)

c) From your graph find

i. The lower quartile (1 mark)

ii. the upper quartile (1 mark)

iii. the interquartile range (2 marks)

20. Without using a protractor, construct line XY = 8cm

a) Construct the locus of all points R such that $\angle XRY = 60°$ (4 marks)

b) Construct the locus of all points P such that the area of triangle XPY is 16 $cm^2$.(3 marks)

c) Mark all the points where the locus of R intersects the locus of P with the letters A,B,C and D (3 marks)

21. Given that $y = 2\sin 2x$ and $y = 3\cos(x + 45°)$;

a) Complete the table below

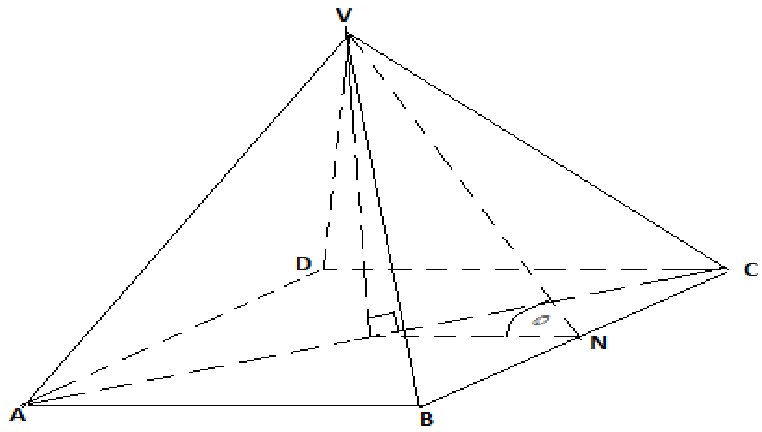
| $x°$ | 0 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 |
|---|---|---|---|---|---|---|---|---|---|---|
| $2\sin 2x°$ | 0.00 | | 1.97 | | 1.68 | $-0.68$ | $-1.73$ | | $-1.28$ | 0.00 |
| $3\cos(x + 45°)$ | 2.12 | 1.27 | | $-0.78$ | | $-2.46$ | | | $-2.72$ | $-2.12$ |

b) Use the data to draw the graphs of $y = 2\sin 2x°$ and $y = 3\cos(x + 45°)$ for $0° \leq x \leq 180°$ on the same axes. (3 marks)

c) State the amplitude and period of each curve. (2 marks)

d) Use the graph to solve the equation $2\sin 2x - 2\cos(x + 45°) = 0$ for $0° \leq x \leq 180°$. (2 marks)

22. The figure below shows a right pyramid standing on a rectangular base ABCD. AB = 8cm, BC = 15cm and each slant edge is 12 cm long M is the midpoint of BC.




Calculate to one decimal place

a) the vertical height of the pyramid (3 marks)

b) the volume of the pyramid (2 marks)

c) the angle between plane VBC and the base (3 marks)

d) the angle between line VA and the plane ABCD (2 marks)

23. 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 family 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 (3 marks)

24. Radon Company has two types of machines A and B for juice production. Type A machine can produce 800 litres per day while type B machine can produce 1 600 litres per day. Type A machine needs four operators and type B need seven operators. At least 8 000 litres must be produced daily and the total number of operators should not exceed 41. There should be two or more machine of each type.

Let $x$ be the number of machines of type A and $y$ for type B.

a) Form all inequalities in $x$ and $y$ to represent the above information. (4 marks)

b) In the grid provided below, draw the inequalities and shade the unwanted region. (4 marks)

c) Use the graph in (b) above to determine the least number of operators required for maximum possible production. (2 marks)

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