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MATHEMATICS
June/July 2021
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN CARPENTRY AND JOINERY
CRAFT CERTIFICATE IN MASONRY
CRAFT CERTIFICATE IN PLUMBING
CRAFT CERTIFICATE IN ROAD CONSTRUCTION

MATHEMATICS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Mathematical tables/Non-programmable scientific calculator.

*This paper consists of **EIGHT** questions.*

*Answer any **FIVE** questions in the answer booklet provided.*

All questions carry equal marks.

Maximum marks for each part of a question are indicated.

Candidates should answer the questions in English.

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

1. (a) Simplify the following:

$$\frac{P^{n+2} \times P^{3-2n}}{P^{5+3n}}$$

(3 marks)

- (b) Solve the following equations:

(i) $2^x \times 4^{x+1} = 64$

(ii) $\log_{10}(x-5) = \log_{10}(x-1) + 2$

(8 marks)

- (c) Given that $\log_a 2 = 0.123$ and $\log_a 3 = 0.256$, calculate the following:

(i) $\log_a 12$

(ii) $\log_a \sqrt{6}$

(9 marks)

2. (a) The probability that student 'A' solves a problem in mathematics is $\frac{2}{5}$ and the probability that student 'B' solves it is $\frac{3}{8}$. If they try it independently, determine the probability that:

(i) both solve the problem;

(ii) at least one solves the problem.

(6 marks)

- (b) The price of a steel bar from 20 different shops is recorded in **table 1**.

Table 1: Price of steel bars

250	295	265	310	315	305	305	260	270	275
280	280	285	280	300	300	290	290	285	285

Form a frequency distribution for the prices starting from 250 - 259, 260 - 269, ---. Hence determine the:

(i) median;

(ii) mode.

(11 marks)

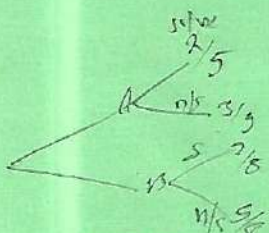
- (c) A plumber deposits Ksh 40,000 with a bank at simple interest rate of 3% per annum. Determine:

(i) amount in the bank after 5 years;

(ii) total interest earned in 5 years.

(3 marks)

price
250-270
270-



$$\frac{2}{5} \times \frac{3}{8} = \frac{6}{40} = \frac{3}{20}$$

$$\frac{3}{100} \times 40000 = 1200$$

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price
200-300

2

$$\sqrt{a^2 - b^2} = \sqrt{c^2 - c^2}$$

$$ab = bc$$

$$bc - ab = b = c - a$$

3. (a) Kendi is entitled to personal relief of Ksh 3,000 per month. PAYE (net tax) is Ksh 8,000 per month. She is also deducted NHIF of Ksh 300 per month, pension of Ksh 1,000 per month and loan of Ksh 500 per month.

Table 2: tax slab

Taxable income in Ksh p.a	Rate %
1 - 5000	10
5001 - 10,000	15
10,001 - 20,000	20
over 20,000	25

Using table 2, calculate Kendi's net salary per month.

(13 marks)

- (b) Given: $\underline{a} = 2i - 3j + k$; $\underline{b} = i + 5j + 2k$.

Determine:

- (i) $2a - b$
 (ii) $|2a - b|$ (4 marks)

- (c) Given that $P = (-3, 4)$; $Q(2, 7)$ and T divides QP in the ratio $-1 : 2$, obtain the co-ordinates of T . (3 marks)

4. (a) Plot the graph of $y = 5 + 2x - 4x^2$, $-3 \leq x \leq 3$. Hence solve the equations:

- (i) $0 = 4x^2 + 2x + 5$
 (ii) $0 = 4x^2 + 3x + 4$ (10 marks)

- (b) (i) The consecutive terms of an arithmetic progression are $2x$, $x + 4$ and $2x - 7$. Calculate the value of x . (6 marks)

- (ii) A geometric series has the first three terms as $2x$, $x + 4$ and $2x - 7$.

- I. Verify $x = 8$.
 II. Determine the sum to infinity of the series;
 III. Determine the other value of x . (4 marks)

5. (a) Make b the subject of the formulae:

$$a^2 = \frac{b^2 - c^2}{b^2} \quad (5 \text{ marks})$$

(b) Solve the following simultaneous equations using substitution method:

$$\begin{aligned} 7x + 2y &= 47 \quad \times 2 \\ 5x + 4y &= 1 \quad \times 1 \end{aligned}$$

$$7x + 2y = 47$$

$$5x + 4y = 1$$

(5 marks)

$$\begin{aligned} 14x + 4y &= 94 \\ 5x + 4y &= 1 \end{aligned}$$

(c) Solve the quadratic equation using completing square method.

$$2x^2 + 12x + 3 = 0$$

(d) Given:

$$A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 3 & 4 \end{bmatrix} \quad B = \begin{bmatrix} 2 & 5 \\ 6 & 1 \\ 4 & 3 \end{bmatrix}$$

(5 marks)

Determine:

(i) AB

(ii) $(AB)^{-1}$

(5 marks)

6. (a) Use Cramer's rule to solve the following simultaneous equations:

$$3x - 2y = 17$$

$$4x - 5y = -8$$

(6 marks)

(b) A man invested Ksh 1500 at a rate of $r\%$ per annum and Ksh 20,000 at a rate of $k\%$ per annum both simple interest. His investments earn him a total interest of Ksh 11,400 after three years. If he invested all his money at the average rate of $\left(\frac{r+k}{2}\right)\%$ per annum simple interest, his investment would have earned Ksh 150 more. Determine the value of r and k .

(7 marks)

(c) Solve the equation:

$$3\sin^2\theta + \cos\theta + 1 = 0 \text{ for } 0^\circ \leq \theta \leq 360^\circ.$$

(7 marks)

$$V = \frac{1}{3} \pi R^2 h$$

$$V = \frac{1}{3} \times \frac{22}{7} \times 18^2 \times 10 = 3394.29 \text{ cm}^3$$

7.

(a) The frustum of solid cone has top radius of 6 cm and a bottom radius of 18 cm. Its height is 10 cm. Calculate:

$$S.A = \frac{1}{3} \pi l (R^2 + r^2 + Rr)$$

- (i) the volume;
- (ii) the total surface area.

$$h = 5$$

$$H = 15$$

(10 marks)

(b) Prove the following trigonometric identities:

$$\frac{1}{3} \times \frac{22}{7} \times (18^2 \times 15 - 6^2 \times 5)$$

- (i) $\tan x + \cot x = \sec x \operatorname{cosec} x$
- (ii) $\sin x \cos x \tan x = 1 - \cos^2 x$

$$= 4902.86 \text{ cm}^2$$

(6 marks)

(c) A triangle has sides 7 cm, 18 cm and 20 cm. Calculate the area of the triangle.

(4 marks)

8. (a) (i) Express $4 \cos \theta - 3 \sin \theta$ in the form

$$R \cos(\theta + \alpha) \text{ where } R > 0 \text{ and } 0^\circ \leq \alpha \leq 90^\circ$$

(ii) Hence solve the equation $4 \cos \theta - 3 \sin \theta = 1$ for values of θ between 0° and 360° inclusive.

(12 marks)

(b) The time T seconds is the duration it takes a water heater to boil water in a jug & is directly proportional to the mass, m of water in kilogram and the time T seconds is inversely proportional to the power P watts of the water heater.

When $m = 250$, $T = 600$ and when $P = 1400$, $T = 360$, determine:

- (i) T when $m = 400$;
- (ii) value of T when P is 900.

(8 marks)

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