1301/311 1305/311
1304/311 1309/311
MATHEMATICS
March/April 2023
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/scientific calculator;
Drawing instruments.
*This paper consists of **EIGHT** questions.*
*Answer **FIVE** questions.*
All questions carry equal marks.
Maximum marks for each part of the 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 the pages are printed as indicated and that no questions are missing.

Turn over

1. (a) Convert the numbers:

(i) 108_{10} to a binary number;

(ii) 11011101_2 to a denary number.

(6 marks)

(b) Simplify the expression:

$$\frac{a^{\frac{7}{2}} \div \sqrt{b^3} \times C^{-4}}{\sqrt{\left(\frac{a^9}{b^8 C^6}\right)}}$$

(6 marks)

(c) Solve the equation:

$$12 \times 4^{5x-2} = 15^{3x+4}$$

(8 marks)

2. (a) Given the vectors $\underset{\sim}{a} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$, $\underset{\sim}{b} = \begin{pmatrix} 7 \\ 1 \end{pmatrix}$ and $\underset{\sim}{c} = \begin{pmatrix} 4 \\ 5 \end{pmatrix}$

Determine:

(i) magnitude of $\underset{\sim}{b}$;

(ii) $4\underset{\sim}{a} - 2\underset{\sim}{b} + \underset{\sim}{c}$.

(5 marks)

(b) Solve the equation $6x^2 - 5x + 1 = 0$, by completing the square method. (4 marks)

(c) (i) Plot the graph of $y = 2 - 4x - x^2$ between $x = -5$ and $x = 1$.

(ii) Hence solve the equation $2 - 4x - x^2 = 0$.

(11 marks)

3. (a) The fourth term of an arithmetic progression is 27 and the sum of the first five terms is 105. Determine the:

(i) first term and common difference;

(ii) twelfth term;

(iii) sum of the first nine terms.

(8 marks)

(b) The fourth and sixth terms of a geometric progression are 27 and 3 respectively. Determine the:

(i) first term and common ratio;

(ii) ninth term;

(iii) sum to infinity.

(8 marks)

(c) A man deposits Ksh. 800,000 in a financial institution which pays simple interest at 8% per annum. Determine the interest earned after four years. (4 marks)

4. (a) Given the matrices $M = \begin{pmatrix} 6 & -1 \\ 2 & 7 \end{pmatrix}$ and $N = \begin{pmatrix} 8 & 7 \\ 2 & 3 \end{pmatrix}$.

Determine:

(i) $2M + \frac{1}{2}N$;

(ii) MN;

(iii) det M.

(8 marks)

(b) Solve the equation:

$$\begin{vmatrix} x & 3 \\ 1 & x+2 \end{vmatrix} = 0$$

(4 marks)

(c) Two reaction forces R_1 and R_2 acting on a horizontal beam satisfy the simultaneous equations.

$$R_1 + R_2 = 6$$

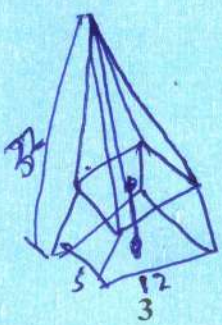
$$7R_1 + 5R_2 = 34$$

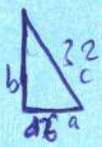
Use the inverse matrix method to solve the equations. (8 marks)

5. (a) A solid pyramid of height 32 cm has a rectangular base of dimensions 12 cm by 5 cm. Determine its:

(i) volume;

(ii) total surface area. (10 marks)





(b) Use Simpson's rule with six strips to determine the area under the curve $y = x^4$ between $x = 0$ and $x = 6$. (10 marks)

6. (a) Prove the identities:

(i) $\frac{1 + \text{Cos}\,\theta}{1 - \text{Cos}\,\theta} = (\tan\theta + \text{Cosec}\,\theta)^2$;

(ii) $Sin^4\theta = 1 - 2\,Cos^2\theta + Cos^4\theta$

(7 marks)

(b) Solve the equations:

(i) $15\,Sin^2\theta - Sin\theta - 2 = 0$;

(ii) $2\,Sin\,\theta + 5\,Sin2\,\theta = 0$.

for $0° \leq \theta \leq 360°$

(13 marks)

7. (a) Given the currency exchange rates:

1 Euro = Ksh. 129
1 US $ = Ksh. 114

Convert:

(i) 2,475 Euro to Ksh.;

(ii) Ksh. 113,430 to US $.

(4 marks)

(b) A retailer bought 200 pipes at Ksh. 450 each. He later sold each of the pipes at Ksh. 600. Calculate his:

(i) percentage profit;

(ii) total profit.

(5 marks)

(c) The value of a machine is Ksh. 250,000. If it depreciates at a rate of 12% per annum, determine its value after three years. (5 marks)

(d) An alloy consists of copper, zinc and tin in the ratio:

Copper : Zinc : tin = 16 : 3 : 1 by mass.

Determine the mass of each element in a block of the alloy weighing 50 kg.

(6 marks)

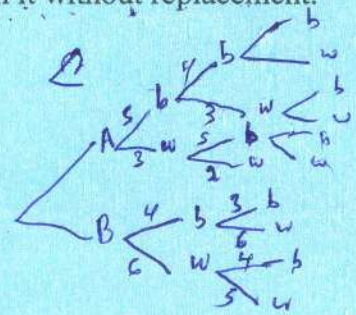
8. (a) Two identical bags A and B contain black and white balls of equal size. A contains 5 black and 3 white balls, while B has 4 black and 6 white balls. A bag is piacked at random and two balls picked from it without replacement.

Determine the probability that:

(i) they are of the same colour;

(ii) they are of different colour;

(iii) the first one is black.



(9 marks)

(b) **Table 1** shows the distribution of marks scored by 200 students in a Mathematics examination.

Determine the:

(i) mean;

(ii) interquartile range.

Table 1

Marks	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80
Number of students	9	25	32	40	44	30	28	12

(11 marks)

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