1301/311   1305/311
1304/311   1309/311
MATHEMATICS
Oct./Nov. 2022
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;
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) Given the matrices

$$A = \begin{pmatrix} 1 & 2 \\ 4 & -1 \end{pmatrix}, \quad B = \begin{pmatrix} 4 & 1 \\ 3 & 2 \end{pmatrix} \quad \text{and} \quad C = \begin{pmatrix} 5 & 8 \\ 4 & 2 \end{pmatrix},$$

   Determine:

   (i) $5A + 2B$;

   (ii) BA;

   (iii) C^{-1}

   (12 marks)

   (b) Two forces F_1 and F_2 in kN acting on a structure satisfy the simultaneous equations.

   $$8F_1 - 5F_2 = 4$$
   $$4F_1 + 3F_2 = 24$$

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

2. (a) A minor segment is enclosed between a chord of length 7 cm and a circle of radius 6 cm. Determine its:

   (i) area;

   (ii) perimeter.

   (8 marks)

   (b) A frustum of a solid cone has end radii 4 cm and 12 cm. The ends are separated by a distance of 20 cm. Determine its:

   (i) volume;

   (ii) surface area.

   (12 marks)

3. (a) Prove the identities:

   (i) $\dfrac{\sin\theta}{1-\cos\theta} = \operatorname{cosec}\theta + \cot\theta$

   (ii) $\dfrac{\sin 2\theta + \cos\theta}{\sin^2\theta} = (2 + \operatorname{cosec}\theta)\cot\theta$

   (7 marks)

(b)   Given that $\sin A = \frac{15}{17}$ and $\cos B = \frac{12}{13}$ where A and B are acute angles, determine:

    (i) $\cos(B - A)$;

    (ii) $\sin(A + B)$

                                                                                   (6 marks)

(c)   Solve the equations:

    (i) $4\sin 2\theta + \sin \theta = 0$

    (ii) $2\cos^2 \theta - \cos \theta - 1 = 0$, for $0° < \theta < 360°$ **(7 marks)**

4.   (a)   There are 20 bolts in a box of which 4 are defective. If two bolts are picked at random from the box without replacement, determine the probability that:

    (i)   both are defective;

    (ii)   at most one is defective.

                                                                                      (7 marks)

(b)   Table 1 shows lengths of 100 iron bars sampled from a workshop.

Table 1

Length (cm)	40 - 45	45 - 50	50 - 55	55 - 60	60 - 65	65 - 70	70 - 75
No. of bars	7	16	20	16	19	17	5

Determine the:

    (i)   mean length;

    (ii)   standard deviation;

    (iii)   median.

                                                                                    (13 marks)

5.   (a)   The first and the last term of an arithmentic progression are 20 and 48 respectively. If the sum of all the terms is 272, determine the:

    (i)   number of terms in the series;

    (ii)   common difference;

    (iii)   fifth term.

                                                                                    (9 marks)

(b)   A six gear lathe machine has speeds which follow a geometric progression. If the third and fourth gears have speeds 337.5 rev/min and 506.25 rev/min, determine the other speeds.   (11 marks)

6.   (a)   (i)   Make T the subject of the formula

$$P = KA(T^4 - To^4)$$

    (ii)   Hence evaluate T, when A = 0.001, P = 36000, K = 0.06 and To = 300.   (5 marks)

(b)   Two forces $F = \begin{pmatrix} 8 \\ 7 \end{pmatrix}$ and $F = \begin{pmatrix} 4 \\ 28 \end{pmatrix}$

act simultaneously at a point. Determine the:

    (i)   magnitude;

    (ii)   direction of the resultant force.   (6 marks)

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

    (ii)   Hence solve the equation $x^2 - 4x + 1 = 0$.   (9 marks)

7.   (a)   Evaluate

$$\frac{\log_7 64 + \frac{1}{4}\log_7 256 - 3\log_7 4}{\log_7 32 + \log_7 \sqrt{16}}$$

    (4 marks)

(b)   Solve the equations:

    (i) $4 \times 32^{x+4} = 64^{x+2}$

    (ii) $\frac{7^{2x}}{12} = 5 \times 3^{x-1}$ (10 marks)

(c)   Solve the equation:

$$\log(x-5) + \log x = \log(x-8)$$

    (6 marks)

8.   (a)   The volume V of a gas is inversely proportional to its absolute pressure P. When P = 600, V = 4. Determine the value of P when V = 12.   (5 marks)

(b)   Given the currency exchange rates:

      1 US $ = Ksh 114
      1 STG pound = Ksh 154

Convert:

(i)   US $ 5540 to Ksh
(ii)   Ksh 1574650 to STG pound

(4 marks)

(c)   A man earns a basic monthly salary of Ksh 60,000. He is also paid house allowance and commuter allowance totalling to Ksh 36,000 per month. He pays income tax as per the schedule in **Table 2**.

Table 2

Income per month (f)	Tax in Ksh per f
1 - 500	2
501 - 1000	3
1001 - 1500	4
1501 - 2000	5
2001 and above	6

If he is entitled to as monthly tax relief of Ksh 1,200, determine his net monthly income.

(11 marks)

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