1521/203
1601/203
1602/203
MATHEMATICS II
June/July 2021
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN ELECTRICAL AND ELECTRONIC TECHNOLOGY (POWER OPTION) (TELECOMMUNICATION OPTION) MODULE II

MATHEMATICS II

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Mathematical tables/calculator.
*Answer any **FIVE** of the **EIGHT** questions in the answer booklet provided.*
All questions carry equal marks.
All necessary working must be clearly shown.
*Maximum marks for **each** part of a question are as indicated.*
Candidates should answer all 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.

1. (a) Three currents I_1, I_2 and I_3 in amperes in an electric circuit satisfy the simultaneous equations

$$6I_1 + 3I_2 + 2I_3 = 15$$
$$-3I_1 + 2I_2 + 6I_3 = 10$$
$$2I_1 - 6I_2 + 3I_3 = 19$$

Use elimination to solve the equations. (11 marks)

(b) Solve the equation

$$2^{2x} + 14(2^x) + 45 = 0$$

giving the answer correct to three significant figures. (9 marks)

2. (a) Given the function $\phi(x, y) = \frac{x^3}{y}$, determine:

(i) $\frac{\partial^2 \phi}{dx^2}$;

(ii) $\frac{\partial^2 \phi}{\partial y^2}$

(4 marks)

(b) The dimensions of a solid cuboid are $x = 24$ cm, $y = 19$ cm and $z = 11$ cm. If x, y and z are increased by 0.1 cm, increased by 0.3 cm and decreased by 0.4 cm respectively, determine the change in its volume. (7 marks)

(c) Determine the stationary points of the function $f(x) = 2x^3 - 3x^2 - 36x + 7$ and classify them. (9 marks)

3. (a) Given that $\cosh x = \frac{e^x + e^{-x}}{2}$ and $\sinh x = \frac{e^x - e^{-x}}{2}$, prove that

(i) $\cosh^2 x + \sinh^2 x = \cosh 2x$

(ii) $\cosh^2 x - \sinh^2 x = 1$

(8 marks)

(b) Determine the values of constants M and N in the equation:

$$Me^x + Ne^{-x} = 10\cosh x + 4\sinh x$$

(4 marks)

(c) Figure 1 shows three forces F_1, F_2 and F_3 acting at a point O in a plane. Determine the:

(i) magnitude;
(ii) direction

of the resultant force. (8 marks)

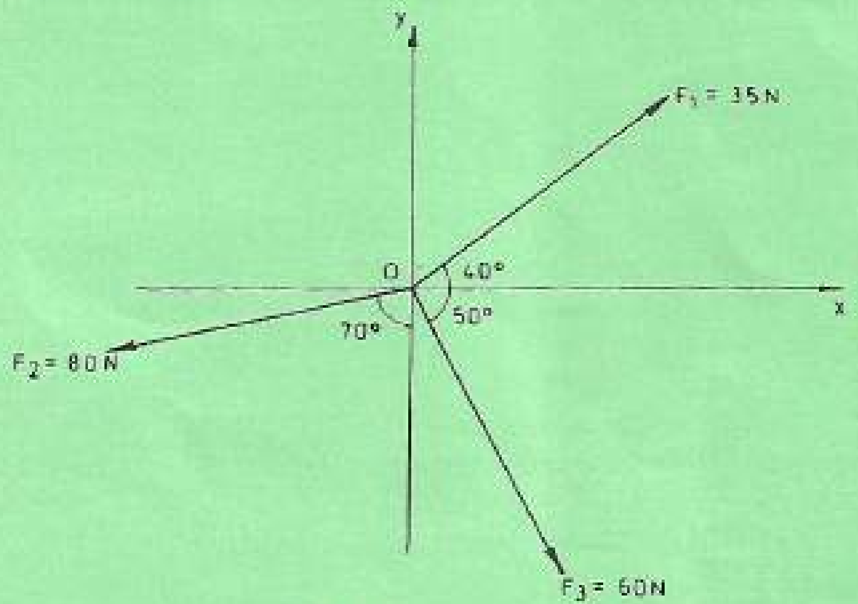

Fig. 1

4. (a) A right angled triangle ABC has $\angle B = 90°$, sides AB = 40 cm and AC = 58 cm. Determine the:

(i) angle $\angle A$;
(ii) length of BC.

(6 marks)

(b) Prove the identities;

(i) $\cos 4\theta + \cos 3\theta + \cos 2\theta = 2\cos 3\theta\,(1 + \cos\theta)$

(ii) $\cos 3\theta = 4\cos^3\theta - 3\cos\theta$

(8 marks)

(c) Solve the equation:

$\cos 2\theta + 4\sin\theta - 3 = 0$ for $0 \leq \theta \leq 90°$. (6 marks)

5. (a) Use substitution method to solve the simultaneous equations:

$$4x + y + 2z = 9$$
$$-x + y + 3z = -8$$
$$3x + 2y + z = 9$$

(10 marks)

(b) A right angled triangle has sides $(2x+2)\,cm, (2x+5)\,cm$ and $(x+7)\,cm$. Determine the:

(i) value of x;
(ii) length of each side.

(10 marks)

6. (a) Given the function $y = e^x \sin x$, show that:

$$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = 0$$

(5 marks)

(b) Determine $\frac{dy}{dx}$ for the function given by:

(i) $y = \sin(x^2 + 2)$

(ii) the parametric equation $x = 16\cos\theta,\ y = 9\sin\theta$.

(8 marks)

(c) Evaluate the integrals:

(i) $\int_1^2 x^3\,dx$

(ii) $\int_0^{\frac{\pi}{2}} (\cos x + \sin x)\,dx$

(7 marks)

7. (a) Given the vectors $\underset{\sim}{B} = 2\underset{\sim}{i} + 3\underset{\sim}{j} + \underset{\sim}{k}$ and $\underset{\sim}{I} = 4\underset{\sim}{i} + \underset{\sim}{j} - 2\underset{\sim}{k}$, determine the:

(i) angle between the vectors;
(ii) unit vector perpendicular to both vectors.

(10 marks)

(b) Given the vector field function $\underset{\sim}{E} = x^2y\underset{\sim}{i} + xy\underset{\sim}{i} - x^3z\underset{\sim}{k}$ and the scalar potential function $V = 4x^2z + 3yz^2$, determine at the point (1, 2, 1)

(i) $\nabla \cdot \underset{\sim}{E}$

(ii) $\nabla \times \underset{\sim}{E}$

(iii) ∇V

(10 marks)

8. (a) Given the matrices

$$A = \begin{pmatrix} -4 & 3 & 5 \\ 2 & 6 & -1 \\ 8 & 9 & -6 \end{pmatrix} \text{ and } B = \begin{pmatrix} 1 & 1 & 2 \\ 6 & 3 & 4 \\ 4 & 2 & 5 \end{pmatrix}, \text{ evaluate}$$

(i) 5A - 3B

(ii) BA

(6 marks)

(b) Given the matrix

$$M = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \\ 2 & 3 & 1 \end{pmatrix}$$

Determine its determinant using P.F Sarrus rule. (4 marks)

(c) Three currents I_1, I_2 and I_3 in amperes flowing in a multi-loop circuit satisfy the simultaneous equations.

$$2I_1 - 3I_2 = 13$$
$$-4I_1 + 5I_2 + I_3 = 22$$
$$6I_1 + 8I_2 = 22$$

Use Crammer's rule to solve the equations. (10 marks)

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