1704/202
MATHEMATICS II
June/July 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN BUILDING TECHNOLOGY

MODULE II

MATHEMATICS II

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Scientific calculator/Mathematical tables;
Drawing instruments.
This paper consists of ***EIGHT*** *questions.*
Answer ***FIVE*** *questions.*
All questions carry equal marks.
Maximum marks for each part of a question are as 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.

1. (a) The marks of students were recorded in ascending order as follows:

$17,\ 22,\ 26,\ 29,\ 34,\ x,\ 42,\ 67,\ 70,\ y$

The mean was 42 and median 35. Determine value of x and y. (5 marks)

(b) The data in **table 1** shows the profit made by construction companies.

Table 1:

Profit (millions)	0 - 4	4 - 8	8 - 12	12 - 16	16 - 20
No. of companies	6	12	15	5	2

(i) On the same axis plot a histogram and frequency polygon.

(ii) Determine the mode from the histogram.

(6 marks)

(c) Four bags of water proof cement are found to be defective from a batch of ten. Two bags are selected at random without replacement and tested:

(i) Plot a probability tree.

(ii) Determine the probability of:

(I) exactly two defective;
(II) one defective and one not defective;
(III) at least one defective.

(9 marks)

2. (a) Given the matrix:

$$A=\begin{bmatrix}2 & -1 & 3\\ 1 & 4 & 5\end{bmatrix} \quad B=\begin{bmatrix}4 & -5\\ -1 & -2\\ 0 & 3\end{bmatrix}$$

Determine:

(i) AB;
(ii) $(AB)^T$.

(5 marks)

(b) Use inverse matrix method to solve the following simultaneous equations.

$5x+2y=47$

$7x+3y=67$

(8 marks)

(c) A surveyor on a level ground sight the top of a building at an angle of 30°. After moving 50 m closer, the angle is 40°. Determine:

(i) height of the building;

(ii) the distance between the surveyor and the building.

(7 marks)

3. (a) Solve for x, between $0 \leq x \leq 360°$:

(i) $\cos\frac{x}{2} = \frac{-1}{2}$;

(ii) $\tan 2x = \sqrt{3}$.

(6 marks)

(b) Proof the following trigonometrical identities:

(i) $\frac{1}{\tan} + \tan x = \frac{1}{\sin x \cos x}$;

(ii) $\frac{1 - \sin x}{\cos x} = \frac{\cos x}{1 + \sin x}$. (8 marks)

(c) Solve the following trigonometrial equation.

$$\tan x + \sec^2 x = 3 \text{ between } 0° \leq x \leq 360°.$$

(6 marks)

4. (a) In **figure 1**, PQR is a triangle. The mid points of line PQ is W, X is the point on line QR such that QX:XR = 2:1. PRY is a straight line, $\underset{\sim}{PW} = a$ and $\underset{\sim}{PR} = \underset{\sim}{b}$.

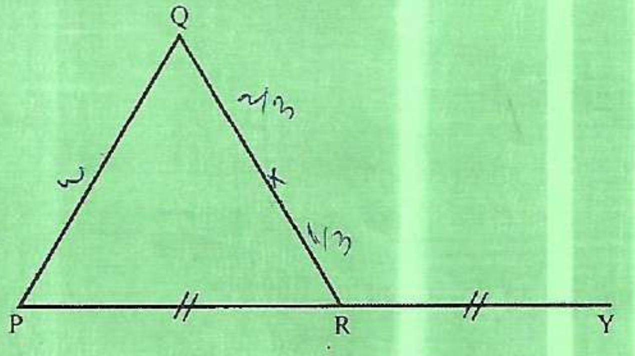

Fig. 1

(i) Determine in terms of $\underset{\sim}{a}$ and $\underset{\sim}{b}$:

(I) QR;
(II) QX;
(III) WX.

(ii) Use vectors to show that WXY is a straight line.

(10 marks)

(b) Two points A and B have position vectors $2\underset{\sim}{i}+6\underset{\sim}{j}-\underset{\sim}{k}$ and $3\underset{\sim}{i}+4\underset{\sim}{j}+\underset{\sim}{k}$ respectively. A line passes through the point A and B. Determine:

(i) vector $\widetilde{AB}$;

(ii) the equation of any point on the line.

(5 marks)

(c) Using vector method calculate value of x given vector $\begin{pmatrix}2\\8\end{pmatrix}$ is parallel to $\begin{pmatrix}-4\\x+3\end{pmatrix}$.

(5 marks)

5. (a) A construction deposited Ksh 40,000 with a commercial bank at a rate of 3% per annum simple interest.

(i) How much will the company have in the bank after five years?

(ii) How much interest will the company have earned in a total of five years?

(iii) How long will it take for the initial deposit to double?

(8 marks)

(b) Chopkomoi bought a new washing machine for Ksh 420,000. Its depreciation rate for the first five years was 15%, 13%, 12%, 9% and 7%. For the next 6 years depreciation remained constant at 5% then 4% for the remaining time. How long will it take for the value to be $\frac{1}{3}$ of the original value. (8 marks)

(c) In a class, 40% of the students study maths and science, 60% of the students study maths. What is the probability of a student studying science given that he/she is already studying math. (4 marks)

6. (a) Determine the derivative of

$f(x)=3x^2+4x$ from first principle. (6 marks)

(b) Determine $\frac{dy}{dx}$ of the following functions:

(i) $y=(x^3-2x^2+7x-3)^4$;

(ii) $y=(x+1)(x^2+3)$.

(7 marks)

(c) Determine the equation of the tangent and the normal, at the point $x=-z$.

(7 marks)

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7. (a) Integrate the following functions:

(i) $\int_1^4 x^{\frac{1}{2}}\,dx$;

(ii) $\int \frac{x+1}{\sqrt{x}}\,dx$.

(6 marks)

(b) Evaluate the following integrals:

(i) $\int x\sin(x^2)\,dx$;

(ii) $\int x^2 e^{-x}\,dx$.

(9 marks)

(c) Determine the area of the region bounded by $y = 4x^2$, and $y = x^2 + 3$. (5 marks)

8. (a) Determine the unit vector in the direction of $2\underset{\sim}{i} + 3\underset{\sim}{j} + \underset{\sim}{k}$. (3 marks)

(b) Show that points with position vectors $\underset{\sim}{i} + 2\underset{\sim}{j} + 7\underset{\sim}{k}$, $2\underset{\sim}{i} + 6\underset{\sim}{j} + 3\underset{\sim}{k}$ and $3\underset{\sim}{i} + 10\underset{\sim}{j} - \underset{\sim}{k}$ are collinear. (6 marks)

(c) Integrate:

(i) $\int \frac{dx}{x^2} - g$;

(ii) $\int_0^{\frac{\pi}{4}} \sec^2 x \tan^2 x\,dx$ (11 marks)

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