

1704/202
MATHEMATICS II
Oct./Nov. 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;

Non-programmable 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 7 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 following data shows the ages of 100 students taking a competency based course in a certain polytechnic.

Age	No. of students
20 - 24	9
25 - 29	17
30 - 34	59
35 - 39	10
40 - 44	5

Calculate the:

- (i) mean age;
- (ii) standard deviation;
- (iii) co-efficient of variation.

(10 marks)

- (b) A three digit number is formed randomly from 4, 7 and 8 without any of the digits occurring more than once.

- (i) Write down the possible numbers formed from this arrangement.
- (ii) Find the probability that the number is an even number.
- (iii) Find the probability that the number is an odd number.

(10 marks)

2.

- (a) Given that:

$$\sin(\theta + \alpha) = 2\cos(\theta - \alpha) \text{ show that}$$

$$\tan \theta = \frac{2 - \tan \alpha}{1 - 2 \tan \alpha}; \text{ hence solve the equation}$$

$$\sin(\theta + 45^\circ) = 2\cos(\theta - 45^\circ) \text{ for the values of } \theta \text{ between } 0^\circ \text{ to } 360^\circ \text{ inclusive.}$$

(6 marks)

(b) An investor bought a die stock from a hardware at Ksh. 5,600/=, the hardware makes 25% profit of the marked price. The investor later sells the die stock to a plumber at 15% profit. Calculate:

- (i) The marked price;
- (ii) The money the investor receives from the plumber;
- (iii) The investor's profit as a percentage of the marked price.

(7 marks)

(c) The following data represents the number of years employees have worked in a company.

12	14	2	13	10	16
30	17	29	23	17	9
4	14	13	17	27	6
34	11	18	12	26	45
22	20	5	14	31	14

- (i) Construct frequency table using the class interval of 6 starting from 1 - 7;
- (ii) Find the mean years;
- (iii) Find the modal class.

(7 marks)

3. (a) Solve the equation.

$$\cos 2\theta + \cos \theta = 0, \text{ for values of } \theta \text{ from } 0^\circ \text{ to } 360^\circ.$$

(7 marks)

(b) Prove the identity

$$\frac{\cos \theta}{1 - \sin \theta} + \frac{1 - \sin \theta}{\cos \theta} = 2 \sec \theta.$$

(4 marks)

(c) Given that $\cos A = \frac{3}{5}$ and $\tan B = \frac{12}{5}$

Where A and B are reflex angles. Find the values of:

- (i) $\sin(A - B)$;
- (ii) $\tan(A - B)$;
- (iii) $\cos(A + B)$.

(9 marks)

4. (a) Given that $A = \begin{pmatrix} 7 & 5 \\ 4 & 3 \end{pmatrix}$, $B = \begin{pmatrix} 1 & -1 \\ 1 & 1 \end{pmatrix}$ and $X = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ and that $AX = B$.

Find the values of a , b , c and d . (4 marks)

- (b) Matrix $A = \begin{pmatrix} 2 & 3 \\ 3 & 5 \end{pmatrix}$ and $B = \begin{pmatrix} 3 & 2 \\ 9 & 6 \end{pmatrix}$. Show that $AB \neq BA$. (7 marks)

- (c) Find the inverse of $M = \begin{pmatrix} 3 & 2 \\ 5 & 4 \end{pmatrix}$; hence solve the equation:

$$3x + 2y = 1$$

$$5x + 4y = 3$$

(4 marks)

- (d) Two sites A and B are managed by one foreman. In site A in six days, he pays Ksh. 36,600/= for 5 skilled labourers and 3 unskilled labourers, while in the same period in site B, he pays Ksh. 53,400/= for 7 skilled labourers and 5 unskilled labourers. Determine the wages for skilled and unskilled labourers using determinant method of matrix. (5 marks)

5. (a) In figure 1, $\vec{OA} = \underline{a}$, $\vec{OB} = \underline{b}$, $\vec{OC} = \frac{4}{3}\underline{b}$, $\vec{AP} = \frac{2}{3}\vec{AB}$ and that

$$\vec{AQ} = m\vec{AC} \text{ and } \vec{PQ} = n\vec{OP}.$$

Calculate the:

- (i) Value m and n ;
 (ii) Ratio of $\vec{AQ} : \vec{QC}$.

(6 marks)

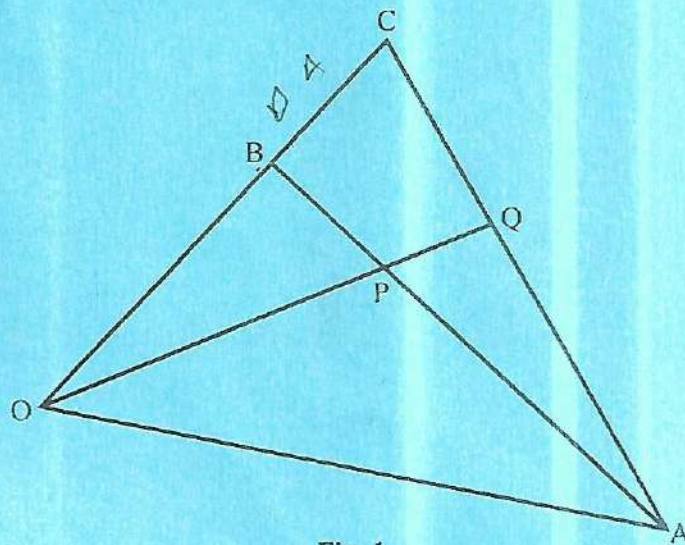


Fig. 1

- (b) If $p \begin{pmatrix} 3 \\ 5 \end{pmatrix} + q \begin{pmatrix} 2 \\ 1 \end{pmatrix} = \begin{pmatrix} 4 \\ 9 \end{pmatrix}$. Find the values of p and q . (4 marks)
- (c) Three points have the co-ordinates $A(3,4)$ and $B(6,9)$. Find the magnitude and direction of the vector \overline{AB} . (4 marks)
- (d) **Figure 2** represents a system of three forces acting on a particle. Determine the magnitude and direction of the resultant force. (6 marks)

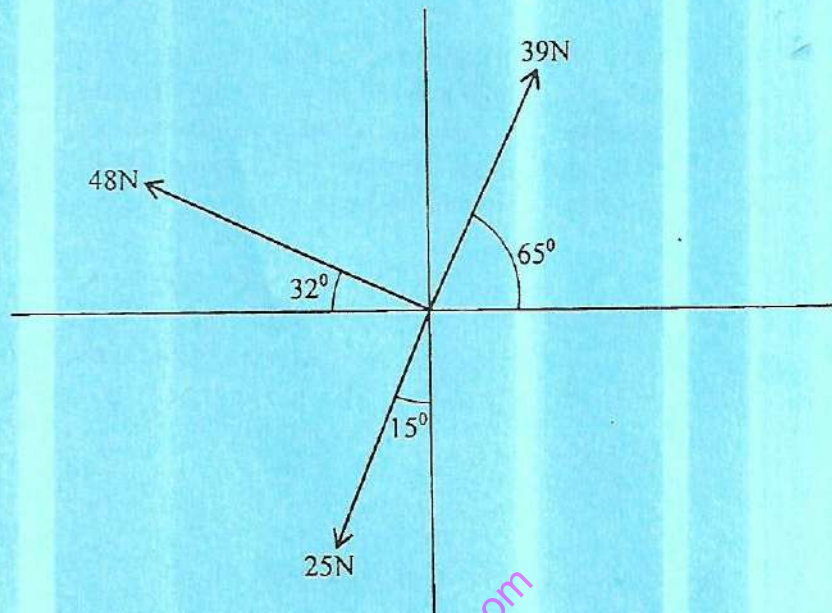


Fig. 1

- (a) A simple construction requires the following materials to a certain level of completion.

I	Cement	50 bags	@	Ksh. 650/= per bag
II	Sand	40 tonnes	@	Ksh. 1,100/= per tonne
III	Ballast	20 tonnes	@	Ksh. 1,400/= per tonne
IV	Timber	660 metres	@	Ksh. 90/= per metre
V	Steel bars / nails		@	Ksh. 15,000/=
VI	Iron sheets	150 square metres	@	Ksh. 300/= per square metre

- (i) Express the cost of cement as a percentage of the total cost of materials.
- (ii) Calculate the labour and profit cost at 47% of the total cost of materials.
- (iii) If profit is 17% of the cost of material charged within labour cost, calculate the profit.

(9 marks)

- (b) An investor bought a piece of land at Ksh. 220,000. If the land appreciates at the rate of 15% per annum. Calculate the:
- value of the land after three years;
 - number of years it will take for the value to appreciate to approximately Ksh. 546,000.
- (6 marks)
- (c) A prospecting student to a USA university exchanges Ksh. 150,000 to US\$ when the bank rates were buying at 108.00 and selling at 108.40. After three months the student changed her mind and studies at a Kenyan University and therefore exchanged the dollars to be Kenyan shillings, the rates were, buying 109.10 and selling 109.50. How much did she make in Kenyan shillings.
- (5 marks)

7. (a) Find dy/dx of the functions:

(i) $y = x^4 \sin x$;

(ii) $y = \frac{3 \cos x + 2 \sin x}{e^{3x}}$.

(8 marks)

(b) Given that $y = 7 \cos x + 12 \sin x$ show that $dy/dx + y = 0$

(5 marks)

(c) The volume of a cylinder is given by $\pi r^2 h$. Determine the approximate change in volume if the radius is reduced from 90 cm to 89.10 cm and the height is increased from 30 cm to 30.2 cm.

(7 marks)

8. (a) Given that $\frac{dy}{dx} = 3x - \frac{8}{x^2}$ and that $y = 1\frac{1}{2}$ when $x = 1$. Find y in terms of x . (5 marks)

(b) Find the area enclosed by the x -axis, $x = 1$, $x = 4$ and the curve $y = 6x^2 - 2$. (5 marks)

(c) Evaluate the definite integral: (5 marks)

$$\int_0^{\frac{\pi}{3}} 3 \cos 4x dx.$$

(4 marks)

(d) The velocity of a particle is given by

$$V = t^2 - 3t + 10$$

Find the distance travelled:

(i) after 5 seconds;

(ii) during the fifth second.

(6 marks)

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