

1601/103
1602/103
MATHEMATICS I
Oct./Nov. 2021
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

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

MODULE I

MATHEMATICS I

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Mathematical tables/Non-programmable scientific calculator.

This paper consists of EIGHT questions.

Answer any FIVE questions in the answer booklet provided.

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) Given the matrices $A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 \\ 1 & 5 \end{bmatrix}$, determine:

(i) $4A - 3B$;

(ii) $(BA)^T + A$.

(7 marks)

(b) (i) Determine the inverse of the matrix $C = \begin{bmatrix} 3 & 2 \\ 4 & -1 \end{bmatrix}$

(ii) Hence, solve the simultaneous equations:

$$3E_1 + 2E_2 = 12$$

$$4E_1 - E_2 = 5$$

(7 marks)

(c) Determine the possible values of x for which the matrix $D = \begin{bmatrix} (x-3) & 2 \\ 2 & (x-3) \end{bmatrix}$ is singular.

(6 marks)

2 ✓

(a) Evaluate the expressions:

(i) $\frac{7}{15} \text{ of } (15 \times \frac{5}{7}) + (\frac{3}{4} \div \frac{15}{16})$

(ii) $\frac{(3^2)^{\frac{3}{2}} \times (8^{\frac{1}{2}})^2}{3^2 \times (4^3)^{\frac{1}{2}} \times 9^{-\frac{1}{2}}}$

(6 marks)

(b) Solve the equations:

(i) $\log_5(4t + 7) - \log_5 t = 2$

(ii) $\log_2 y = \frac{9}{\log_2 y}$

(7 marks)

(c) Simplify:

(i) $\log_4 8 - \log_{27} 3$

(ii) $\frac{\log_{10} 16 - \frac{1}{2} \log_{10} 256 + \frac{1}{2} \log_{10} 4}{\log_{10} 2}$

(7 marks)

Handwritten notes and calculations for question 2(b):
easyvet.com
 $\log_5(4t+7) - \log_5 t = 2$
 $\log_5 \frac{4t+7}{t} = 2$
 $\frac{4t+7}{t} = 5^2 = 25$
 $4t+7 = 25t$
 $7 = 21t$
 $t = \frac{7}{21} = \frac{1}{3}$
 $\log_2 y = \frac{9}{\log_2 y}$
 $\log_2 y^2 = 9$
 $\log_2 y = \frac{9}{2}$
 $y = 2^{\frac{9}{2}} = 2^4 \cdot 2^{\frac{1}{2}} = 16\sqrt{2}$

3 ✓

(a) Convert:

(i) 371_{10} to a binary number.

$$\begin{array}{r} 4t + 7 = 2t \\ \hline t = 7 \end{array}$$

(ii) 110101_2 to a denary number.

(4 marks)

(b) Solve the equations:

(i) $3^x = 5$, correct to 3 decimal places.

$$\begin{array}{r} 4t + 7 = 2t \\ 4t - 2t = 7 \\ 2t = 7 \\ t = \frac{7}{2} \\ t = 3.5 \end{array}$$

- (ii) $2^{2x+1} \times 4^{2x} = \frac{1}{16}$. (6 marks)
- (c) Use the inverse matrix method to determine the values of the currents I_1 and I_2 in the circuit figure 1. (10 marks)

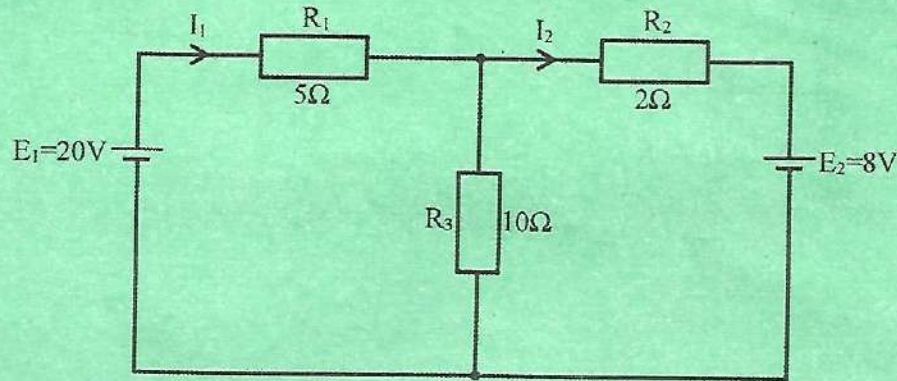


Fig. 1

- (a) The third and the seventh terms of an arithmetic progression are 6 and 14 respectively. Determine the:
- common difference;
 - first term. (6 marks)
- (b) The sum of the first 5 terms of an arithmetic progression is 125. The eighth term is five times the second term. Determine the first term. (9 marks)
- (c) On commencing employment, a craftsman is paid a basic salary of Ksh 144,000 per annum and an annual increment of Ksh 7,000. Determine the:
- salary in the ninth year;
 - total salary received in 10 years. (5 marks)

5. (a) Simplify:

(i) $\sqrt{a^4} \times a^{\frac{3}{2}} \div (a^2)^{\frac{1}{3}}$

$\sqrt{a^4} \times a^{\frac{3}{2}} \div (a^2)^{\frac{1}{3}}$

$a^2 \times a^{\frac{3}{2}} \div a^{\frac{2}{3}}$

(ii) $\frac{\left(\frac{4}{3}\right)^3 \times \left(\frac{3}{5}\right)^{-2}}{\left(\frac{2}{5}\right)^3}$

$\sqrt{a^2} \times 2\sqrt{a^3} \div 3\sqrt{a^2}$

(11 marks)

- (b) The time of swing t seconds of a simple pendulum is given by $t = 2\pi\sqrt{\frac{l}{g}}$. Determine the length, l if the time, t is 6.95 seconds (Take $g = 9.81 \text{ m/s}^2$). (5 marks)

$\frac{D}{2} = (2a + (n-1)d)$

(c) Express as a single logarithm:

(i) $\frac{1}{2} \log_{10} x + \frac{1}{3} \log_{10} y - \frac{1}{4} \log_{10} z$

(ii) $2 \log_{10} x^2 + 3 \log_{10} y^2 - 4 \log_{10} z^2$ $\log_{10} (x^2)^2 + \log_{10} (y^2)^3$ (4 marks)

6. (a) In a geometric progression, the sixth term is 8 times the third term and the sum of the seventh and eighth terms is 192.

Determine the:

(i) common ratio;

(ii) second term;

(iii) sum of the first 10 terms.

a $6 =$
 a, ar, ar^2, \dots
 $ar^5 = 8ar^2 \Rightarrow r^3 = 8 \Rightarrow r = 2$
 $a + ar^7 + ar^8 = 192$
 $a(1 + 2^7 + 2^8) = 192$
 $a(1 + 128 + 256) = 192$
 $a(385) = 192 \Rightarrow a = \frac{192}{385}$
 $(ar^2)^8 = 3/2$

(8 marks)

(b) The sum of the second and third terms of a geometric progression is 12 and the sum of the fifth and the sixth terms of the same series is $\frac{3}{2}$. Determine the:

(i) common ratio;

(ii) fourth term.

$(ar^2)^8$
 $(5ar^2)$

(8 marks)

(c) An electrician earned Ksh 20,000 from a contract. Determine the number of years he should invest the amount if he is to get Ksh 200,000 at a compound interest of 5% per annum.

(Give your answer correct to 1 decimal place)

(4 marks)

7. (a) Simplify the expression.

$(x^2 y^{\frac{1}{2}})(\sqrt{x} \sqrt[3]{y^2})(x^2 \sqrt{y})(\sqrt{x} \sqrt{3y^2})$
 $\frac{(x^2 y^{\frac{1}{2}})(\sqrt{x} \sqrt[3]{y^2})(x^2 \sqrt{y})(\sqrt{x} \sqrt{3y^2})}{\sqrt{(x^5 y^2)^{\frac{1}{2}}}}$ (5 marks)

(b) The resistance R ohms of an electric conductor at any temperature $t^\circ \text{C}$ is given by $R = R_0(1 + \alpha t)$ where R_0 is the initial resistance and α is the temperature coefficient. If $R = 25\Omega$ at $t = 50^\circ \text{C}$ and $R = 30\Omega$ at 100°C , determine the values of α and R_0 .

(8 marks)

(c) A wireman spent $\frac{1}{3}$ of his salary on food and $\frac{1}{4}$ of the remainder on rent. If he remained with Ksh 10,000, determine:

(i) his salary;

(ii) money spent on:

I. food;

II. rent.

$\frac{1}{3} \Rightarrow \text{food}$
 $\frac{1}{4} \Rightarrow \text{rent}$
 $200,000 = 20,000 (1 + \frac{0.05}{12})^n$
 $(1.05)^n$
 $\times 1.05^n$
 $\frac{200,000}{20,000} = \frac{21,000n}{20,000}$
 $0.105 = n$

(7 marks)

8. (a) Table 1 shows the distribution of marks scored by 100 students in a mathematics test.

Table 1

Marks	Frequency
60 - 62	5
63 - 65	18
66 - 68	42
69 - 71	25
72 - 74	8
75 - 77	2

Using the data in Table 1, determine:

- (i) median;
- (ii) mean;
- (iii) standard deviation.

(10 marks)

- (b) Table 2 gives the distribution of time taken to carry out an installation work by trainees.

Table 2

Time (minutes)	Frequency
40 - 49	3
50 - 59	9
60 - 69	15
70 - 79	15
80 - 89	12
90 - 99	6

Determine the:

- (i) lower quartile;
- (ii) upper quartile;
- (iii) semi-interquartile range.

(10 marks)

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