



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF TECHNICAL AND ENGINEERING EDUCATION AND TRAINING
ENGINEERING MATHEMATICS 1 PTE 1131

Main Examination Paper

NOVEMBER 2024

-This Examination Paper consists of pages 3

Time Allowed: 3 hours

Total Marks: 100

Internal Examiner: Ms L.Chimbani

External Examiner: Dr C.Kanhanji

INSTRUCTIONS

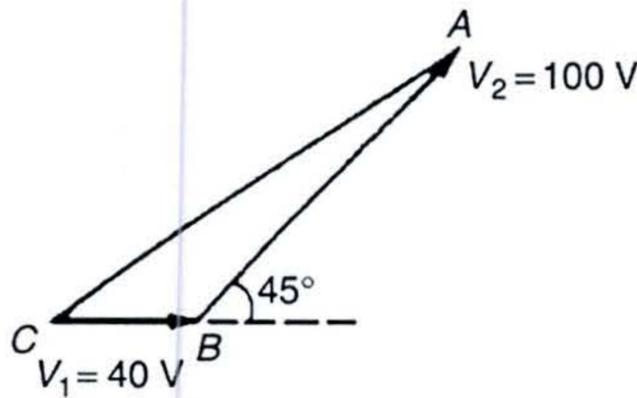
1. The paper consists of seven (7) questions. Answer any five questions in any order.
2. Each question carries 20 marks.
3. The use of calculators is permissible.
4. Show all workings.

MARK ALLOCATION

QUESTION	MARKS
1.	20
2.	20
3.	20
4.	20
5.	20
6.	20
7.	20

Question 1

- a. State two laws of indices and two laws of logarithms. [4 Marks]
- b. Evaluate $\frac{\log 25 - \log 125 + \frac{1}{2} \log 625}{3 \log 5}$ [4 Marks]
- c. Evaluate $\frac{4^{1.5} \times 8^{\frac{1}{3}}}{2^2 \times 32^{-\frac{2}{5}}}$ [2 Marks]
- d. The voltage phasors are shown in Fig Q1(b). If $V_1 = 40\text{V}$, and $V_2 = 100\text{V}$. Determine the value of their resultant and the angle the resultant makes with V_1 .



[10 Marks]

Figure Q1(b)

Question 2

- a. What is a unit matrix? [2 Marks]
- b. $f(x) = 6x^2 - 9x + 4$ [2 Marks]
- c. $\begin{pmatrix} 8 & 3 & 6 \\ 5 & 2 & 7 \\ 1 & 0 & 4 \end{pmatrix} - \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$ [2 Marks]
- d. A bricklayer estimates the number of bricks he will need to build a wall by dividing the area of the wall by the area of the brick. The wall is 16m long and 1.2m tall, while the dimensions of the brick are 25cm x 12cm. calculate and estimate for the number of bricks the bricklayer will need to build the wall. [4 Marks]
- e. $y = 2t^4 - 10t^2 + 13t$ [4 Marks]
- f. differentiate $f(x) = 10\sqrt[5]{x^3} - \sqrt{x^7} + 6\sqrt[3]{x^8} - 3$ [6 Marks]

Question 3

- a. Determine $\int \left(4 + \frac{3}{7}x - 6x^2 \right) dx$ [4 Marks]
- b. $\frac{3^2 \times 5^5 + 3^3 \times 5^3}{3^4 \times 5^4}$ [4 Marks]

- c. Calculate the resultant of the two forces shown in Fig Q3(a)

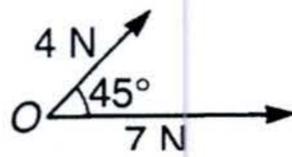


Fig Q3(a)

[6 Marks]

d.
$$\begin{vmatrix} 3 & 2 & 5 \\ 4 & 6 & 7 \\ 2 & 9 & 2 \end{vmatrix}$$

[6 Marks]

Question 4

- a. State Cramer's rule. [2 Marks]
- b. State the theorem of Pythagoras. [2 Marks]
- c. Solve $2x^2 + 9x + 8 = 0$ by completing the square. [6 Marks]
- d. Solve the following simultaneous equations using Cramer's rule:

$$x + 2y + 3z = 5$$

$$2x + 3y + z = 3$$

$$-3x + 4y + 5z = 3$$

[10 Marks]

Questions 5

- a. Given that $t = 2\pi \sqrt{\frac{l}{g}}$ find the value of g in terms of t , l and π . [2 Marks]
- b. Determine the roots of $x^2 - 6x + 9 = 0$ by factorisation. [2 Marks]
- c. Two aircrafts leave an airfield at the same time. One travels due north at an average speed of 300km/h and the other due west at an average speed of 220km/h. Calculate the distance apart after 4 hours. [4 Marks]
- d. Write $\log \frac{8 \times \sqrt[4]{5}}{81}$ in terms of \log_2 , \log_3 and \log_5 [4 Marks]
- e. Determine $\int \left(\frac{1+\theta^2}{\sqrt{\theta}} \right) d\theta$ [8 Marks]

Question 6

- a. Fig Q6(a) shows a water tank in the shape of a cylinder which is filled at a rate of 0.3litres per second. How long does it take to completely fill the tank?

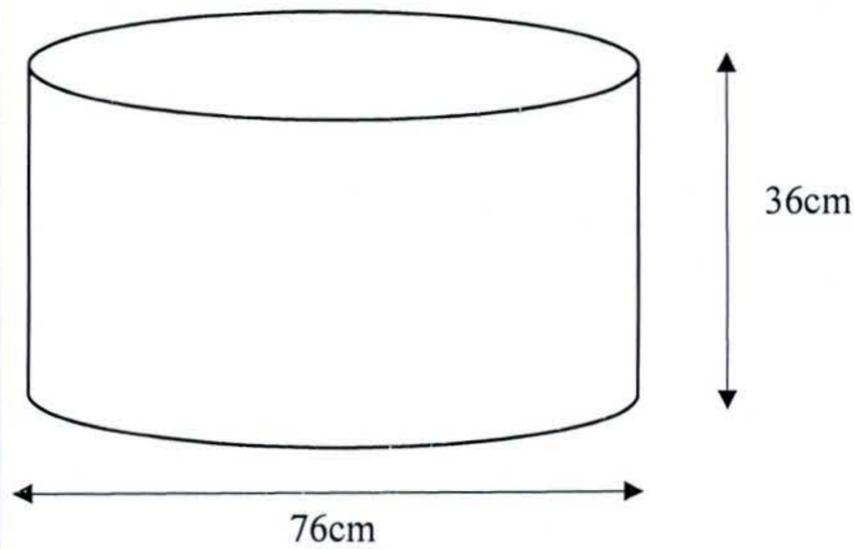


Fig Q6(a)

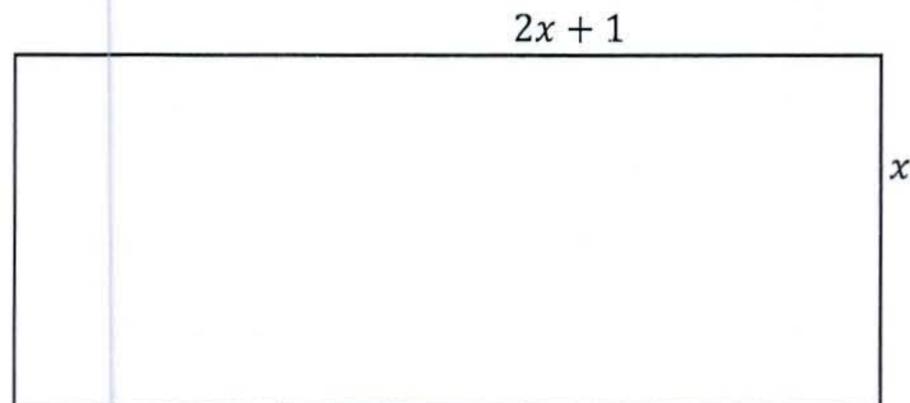
b. If $A = \begin{pmatrix} 3 & 4 & 0 \\ -2 & 6 & -3 \\ 7 & -4 & 1 \end{pmatrix}$ $B = \begin{pmatrix} 2 & -5 \\ 5 & -6 \\ -1 & -7 \end{pmatrix}$ Find $A \times B$ [4 Marks]

c. Evaluate $\begin{bmatrix} 1 & 4 & -3 \\ -5 & 2 & 6 \\ -1 & -4 & 2 \end{bmatrix}$ [6 Marks]

d. Find the differential coefficient of $y = \frac{2}{5}x^3 - \frac{4}{x^3} + 4\sqrt{x^5} + 7$ [6 Marks]

Question 7

a. P is the perimeter of the rectangle shown in Fig Q7(a).



i. Show that $P = 6x + 2$ [2 Marks]

ii. Express x in terms of P. [2 Marks]

b. Show how to calculate area of a sector of a circle. [2 Marks]

c. Find the inverse of $\begin{pmatrix} 1 & 5 & -2 \\ 3 & -1 & 4 \\ -3 & 6 & -7 \end{pmatrix}$ [8 Marks]

d. Calculate the diameter of a solid cylinder which has a height of 82.0cm and a total surface area of 2.0cm^2 . [6 Marks]

END OF EXAMINATION PAPER