

071906T4AEN

Agricultural Engineering level 6

ENG/0S/AGR/CC/01/6/A

Apply Engineering Mathematics

July /Aug 2023



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION
COUNCIL (TVET CDACC)**

WRITTEN ASSESSMENT

Time: 3 hours

INSTRUCTIONS TO CANDIDATE

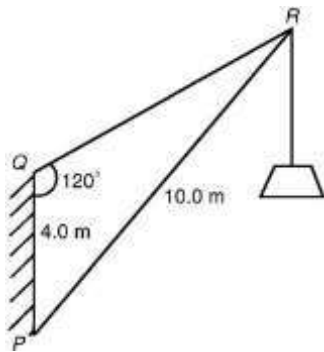
1. This paper has **two** sections **A** and **B**.
2. You are provided with a separate answer booklet.
3. Marks for each question are as indicated.
4. Do not write on the question paper.

This paper consists of 4 printed pages

**Candidates should check the question paper to ascertain that all
pages are printed as indicated and that no questions are missing**

SECTION A: (40 Marks)*Answer all questions in this section*

1. Use the quadratic formula to Solve $X^2 + 2X - 8 = 0$ (4 marks)
2. Solve the equation $8\sin^2\theta + 2\sin\theta - 1 = 0$ for all values of $0^\circ \leq \theta \leq 360^\circ$ (4 marks)
3. Prove that $\frac{1 + \cot\theta}{(1 + \tan\theta)} = \cot\theta$ (4 marks)
4. Determine the modulus and argument of the complex number $Z = 3 + j4$ and express Z in polar form (4 marks)
5. Given $Z_1 = 1 - j3$, $Z_2 = -2 + j5$ and $Z_3 = 3 - j4$, Determine $\frac{Z_1 Z_2}{Z_1 + Z_3}$ in the form $a + jb$ (4 marks)
6. The figure PQR represents the inclined jib of a crane. PR is 10.0m long, PQ is 4.0m long. Determine the inclination of the jib to the vertical and the length of tie QR



- (4 marks)
7. Using quotient rule, find the derivative of the function $y = \frac{te^{2t}}{2\cos t}$ (4 marks)
8. Derive the equation for the curve which satisfies the differential equation $xy = (1 + x^2) \frac{dy}{dx}$ and passes through the point (0, 1). (4 marks)
9. What is the Laplace transform of $6\sin 3t - 4\cos 5t$ (4 marks)
10. Determine the definite integrals of $\int_1^4 5t^3 dt$ (4 marks)

SECTION B: (60 Marks)*Answer ANY THREE questions in this section*

11. A d.c. circuit comprises three closed loops. Applying Kirchhoff's laws to the closed loops gives the following equations for current flow in milli-amperes:

$$2l_1 + 3l_2 - 4l_3 = 26$$

$$l_1 - 5l_2 - 3l_3 = 87$$

$$-7l_1 + 2l_2 + 6l_3 = 12$$

Use matrix method to solve for l_1 , l_2 and l_3 (20 marks)

12. (a) The following set of ungrouped data refers to the amount of money in £s taken by a news vendor for 6 days. {27.90, 34.70, 54.40, 18.92, 47.60, 39.68}.

Determine the

- i. mean, (3 marks)
- ii. median and (2 marks)
- iii. modal values of the set (1 marks)

- (b) The following data was recorded during an irrigation practical session conducted by an agricultural engineering trainee.

values recorded	Frequency
20.50-20.90	3
21.00-21.40	10
21.50-21.90	11
22.00-22.40	13
22.50-22.90	9
23.00-23.40	2

Determine:

- (a) the mean; (3 marks)
- (b) modal class; (1 Mark)
- (c) Standard deviation in 2 d.p. (10 Marks)

13. (a) The equation $2X^3 - 7X^2 - X + 12 = 0$ has a root near to $x=1.5$. use the Newton-Raphson method to find the root to 6 decimal places. (10 marks)

- (b) Given the following data, estimate $f_{2.5}$ using Newton –Gregory forward difference interpolation polynomial (10 marks)

X	F(x)
1	4
2	14
3	40
4	88
5	164
6	274

14. (a) Determine $A \times B$ and angle θ between the two vectors if

$$A = 3i - 2j + 4k \text{ and } B = 2i - 3j - 2k \quad (8 \text{ marks})$$

- (b) Find the directional derivative of the function

$$\phi = x^2z + 2xy^2 + yz^2 \text{ At point } (1, 2, -1) \text{ in the direction of the vector}$$

$$A = 2i + 3j - 4k \quad (8 \text{ marks})$$

- (c) if $A = 2i - 3j + k$; $B = i + 2j - k$; $C = 3i + j + 3k$;

$$\text{determine the Vector triple product } A \times (B \times C) \quad (4 \text{ mark})$$