073206T4BLD

BUILDING TECHNICIAN LEVEL 6

CON/OS/BUT/CC/1/6

Apply Engineering Mathematics

July/August 2025



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

## WRITTEN ASSESSMENT

## TIME: 3 HOURS

### INSTRUCTIONS TO CANDIDATE

1. This paper consists of **TWO** sections: **A** and **B.**
2. You are provided with a separate answer booklet
3. Marks for each question are indicated in the brackets.
4. Do not write on the question paper

**This paper consists of FIVE (5) 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 from this section*

1. Given $Z1 = 2 + j4$ and $Z2 = 3 - j$ determine $Z1 + Z2$ and $Z1 - Z2$. Show the results on Argand diagram. (4 Marks)
2. If $\tan\theta = a$, show that. (4 Marks)

$$\frac{\cos\theta \sin^2\theta + \cos^3\theta}{\sin\theta} = \frac{1}{a}$$

3. Evaluate:

$$\int_0^{\pi} \sin^2 x dx$$

(4 Marks)

4. Simplify the following and express the answer with positive indices only. (3 Marks)

$$\frac{d^{\frac{2}{3}} e^2 f^{\frac{1}{2}}}{(d^{\frac{1}{3}} e f^{\frac{1}{2}})^2}$$

5. Determine the standard deviation from the mean of the set of numbers: {5, 6, 8, 4, 10, 3}, correct to 4 significant figures. (3 Marks)
6. Resolve the force vector of 80N at an angle of $55^0$ to the horizontal into its horizontal and vertical components. (4 Marks)
7. Write $\frac{1}{3}\log 64 + \frac{1}{2}\log 32 - 2\log 3$ as the logarithm of a single number. (3 Marks)
8. A rectangular piece of metal having dimensions 4 cm by 5 cm by 10 cm is melted down and recast into a pyramid having a rectangular base measuring 3 cm by 4 cm. Calculate the perpendicular height of the pyramid. (3 Marks)
9. The distance $x$ meters moved by a car in a time $t$ second is given by $x = 3t^3 - 2t^2 + 4t - 1$. Determine the velocity and acceleration when, $t = 1.5$ s. (4 Marks)
10. A batch of 40 components contains five which are defective. A component is drawn at random from the batch and tested and then a second component is drawn.

    Determine the probability that neither of the components is defective when drawn, with replacement. (2 Marks)

11. Find the value of $\begin{bmatrix} 1 & -4 & 3 \\ 5 & 2 & 6 \\ -1 & -4 & 2 \end{bmatrix}$. (3 Marks)

12. Find the derivative of $3\sqrt{x} + 2x - \frac{8}{x}$. (3 Marks)

## SECTION B (60 MARKS)

*This section contains Four questions, Attempt Any Three questions*

13.

a. Find the inverse of:

$$\begin{pmatrix} 1 & 5 & -2 \\ 3 & -1 & 4 \\ -3 & 6 & -7 \end{pmatrix}$$

(10 Marks)

b. Determine the volume and total surface area of a cone of radius 5 cm and perpendicular height 12 cm. (6 Marks)

c. Let $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$, Find all the eigen values of A. (4 Marks)

14.

a. Using Newton's backward difference formula, construct an interpolating polynomial of degree 3 for the data: $f(0.75) = 0.0718125$, $f(0.5) = 0.02475$, $f(0.25) = 0.3349375$, $f(0) = 1.10100$. Hence find $f(-1/3)$. (10 Marks)

b. A production department has 35 similar milling machines. The number of breakdowns on each machine averages 0.06 per week. Determine the probabilities of having:

i. One machine breaking down in any week. (7 Marks)

ii. Less than three machines breaking down in any week. (3 Marks)

15.

a. Locate the stationary points of $f(x, y) = x^4 + y^4 - 36xy$ (10 Marks)

b. Expand $f(z) = \sin(z)$ about $z = \frac{\pi}{3}$ using the Taylor series. (6 Marks)

c. The velocity of a vehicle is given by the formula $v = u + at$. If $v = 20$ when $t = 2$ and $v = 40$ when $t = 7$, form two simultaneous equations and solve them to find the initial velocity of the vehicle ($u$) and its acceleration ($a$). (4 Marks)

16.

a. The values of f(x) at certain points are given as follows:

| x | F(x) |
|---|---|
| 1 | 1 |
| 2 | 4 |
| 4 | 16 |

Use interpolation method to find the value of f (3). (10 Marks)

b. Determine the value of $5e^{0.5}$, correct to 5 significant figures by using the power series for $e^x$. (10 Marks)