071606T4AUT

AUTOMOTIVE TECHNOLOGY LEVEL 6

ENG/OS/AUT/CC/2/6

Apply Engineering Mathematics

November/December 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. Answer **ALL** questions in section A and **ANY THREE (3)** questions in section B.
3. Marks for each question are indicated in the brackets.
4. Candidates are provided with a separate answer booklet.
5. Do not write on the question paper.

This paper consists of FOUR (4) printed pages

Candidate 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. Solve the equation: $\log_{10}(x-1) + \log_{10}(x+8) = 2\log_{10}(x+2)$. (4 Marks)

2. Solve the equation: $3^{2x} - 5(3^x) + 6 = 0$. (4 Marks)
3. If $y = x\sin x$ *show that* $x^2\frac{d^2y}{dx^2} - 2x\frac{\partial y}{\partial x} + (2+x^2)y = 0$. (4 Marks)

4. Show that $\sin 3\theta = 4\sin^3\theta$. (4 Marks)
5. Calculate the angle between vector $\vec{A}$ and $\vec{B}$, given that vector: (4 Marks)

$\vec{A} = 3\check{\imath} + 4\check{\jmath} - \check{k}, \vec{B} = 2\check{\imath} - \check{\jmath} + \check{k}$.

6. Given that complex numbers $z_1 = 2 + 3i$ *and* $z_2 = -1 - 2i$, Express the sum of z_1 *and* z_2 in polar form. (3 Marks)
7. Find the gradient of the curve $x^2 + 2xy - 2y^2 + x = 2$ *at a point* $(-4,1)$. (3 Marks)
8. Given that vector: $\vec{A} = \check{\imath} - 3\check{\jmath} + \check{k}$, $\vec{B} = -2\check{\imath} + 3\check{\jmath} + 2\check{k}$ and $\vec{C} = 3\check{\imath} + 4\check{\jmath} - \check{k}$, determine the magnitude of $\vec{D} = \vec{A} + 3\vec{B} - 2\vec{C}$. (3 Marks)

when $x = 3$ and $y = {}^{1}$. (3 Marks)

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9. Find the volume of the solid generated between the graphs $y = \frac{1}{5} + x^2$ *and* $y = x$. (4 Marks)

10. Determine the total surface area and volume of closed cone whose perpendicular height is 20cm and its base is made up of a circle of radius 7cm. (4 Marks)

SECTION B: (60 MARKS)

Answer ANY THREE questions in this section

a) Find Newton-Gregory forward difference interpolating polynomial for the following data.

(6 Marks)

x	0.	0.2	0.3	0.4
$y = f(x)$	1.40	1.56	1.76	2.00

b) Determine the binomial expansion of $\left(\frac{1-3x}{1+3x}\right)^{-2}$ as far as the term in x^2. By setting $x = \frac{1}{22}$ in the results in a) above, determine the value of $\sqrt{19}$ correct to four decimal places.

(7 Marks)

c) Use Maclaurin's series to find four non zero terms of a function $f(x) = sinhx$.

(7 Marks)

11.

a) The probability of brake shoes of a car failing in one year due to excessive temperature is $\frac{1}{20}$, due to excessive vibration is $\frac{1}{25}$ and due to excessive humidity is $\frac{1}{50}$. Determine the probability that during one year period, a brake shoes:

i) Fails due to excessive temperature and excessive (2 Marks)

ii) Fails due to excessive vibration or excessive humidity. (2 Marks)

iii) Will not fail because both excessive temperature and excessive humidity. (2 Marks)

b) Expand $f(x) = e^x$ as far as the term in x^3 using Maclaurin's theorem. (5 Marks)

c) Solve the differential equation $xy\frac{dy}{dx} = x^2 + y^2$ *given that when* $x = 1, y = 2$.

(9 Marks)

12.

a) Given the matrices $A = \begin{bmatrix} 4 & 3 & -1 \\ 2 & 7 & 1 \\ 1 & -1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 5 & 1 & 3 \\ 2 & 1 & 5 \\ -1 & 3 & 2 \end{bmatrix}$, determine:

i) $A+B$ (2 Marks)

ii) $A^T - B$ (3 Marks)

b)

i) Show that $\cosh^{-1} x = ln(x + \sqrt{x^2 - 1})$ hence evaluate $\cosh^{-1} 2$. (6 Marks)

ii) Evaluate c (2 Marks)

c) The distance x metres moved by a car in a time t seconds is given by the equation $x = 3t^3 - 2t^2 + 4t - 1$. Determine:

i) Velocity of the car at a time $t = 0$. (3 Marks)

ii) Acceleration of the car at time $t = 1.5s$. (3 Marks)

13.

a) The length distribution of welding rods is shown in the table below.

Length in cm	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39
No. of rods	3	4	5	2	7	1	9	6

Determine the:

i) Mean

ii) Median

ariance

iv) Quartile deviation. 10 Marks)

b) The mean mass of a set of components is 150kg and the standard deviation is 18kg. Assuming the masses are normally distributed, determine for a sample of 500 components, how many are likely to have masses of;

i) between 120kg and 160kg,

ii) more than 180kg,

iii) less than 125kg. (10 Marks)