

071606T4AUT

AUTOMOTIVE TECHNOLOGY LEVEL 6

ENG/OS/AUT/CC/02/6

Apply Engineering Mathematics

March/April 2026



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

WRITTEN ASSESSMENT

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATE

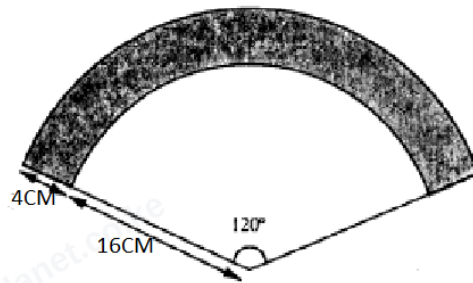
1. This paper consists of **TWO** sections: **A** and **B**.
2. Answer **ALL** questions in section A and **ANY THREE (3)** questions in section B.
3. Marks for each question are indicated in the brackets.
4. Candidates are provided with a separate answer booklet.
5. Do not write on the question paper.

This paper consists of SEVEN (7) printed pages

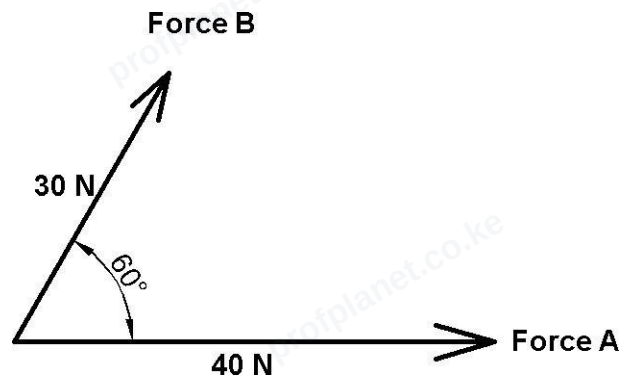
Candidate should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION A: (40 MARKS)*Answer ALL questions in this section*

1. The shaded region in the figure below shows an area wiped off by a windshield wiper. Calculate the area of the region. (4 Marks)



2. Find the values of a and b given that $(2 - j3)^2 = a + jb$. (4 Marks)
3. During a wheel alignment procedure on a vehicle, two forces act on a suspension component at the same point as shown in the figure below:



- Determine the horizontal force acting on the component. (1 Mark)
 - Determine the vertical force acting on the component. (1 Mark)
 - Using the horizontal and vertical components, calculate the magnitude of the resultant force acting on the component. (2 Marks)
4. Consider the differential equation:

$$2 \frac{d^2 y}{dx^2} + 5 \frac{dy}{dx} - 3y = 0$$

- Write the auxiliary (characteristic) equation for this differential equation. (2 Marks)

b) Solve the auxiliary equation. (2 Marks)

5. During engine assembly, an O-ring seal is selected to fit into a circular groove. The measured difference between the outer and inner circumferences of the O-ring is 44 mm. Calculate the thickness of the O-ring seal. (Take $\pi = 22/7$). (4 Marks)

6. Given that the series expansion relating $\cosh y$ and $\sinh y$ is given by;

$$e^y = \cosh y + \sinh y$$

Evaluate the logarithmic form of $\sinh^{-1} x$. Take $(\cosh^2 x - \sinh^2 x = 1)$. (4 Marks)

7. Below is a Maclaurin's theorem for series expansion of a function of x ;

$$f(x) = f(0) + f'(0)x + f''(0)\frac{x^2}{2!} + f'''(0)\frac{x^3}{3!} + \dots$$

Use it to expand $f(x) = e^x$ as far as the term in x^3 . (4 Marks)

8. Two points A and B on a plane are joined together by a vector $\tilde{a}$. Given that the coordinates of A = (4, -1, 3) and B = (2, 5, 0).

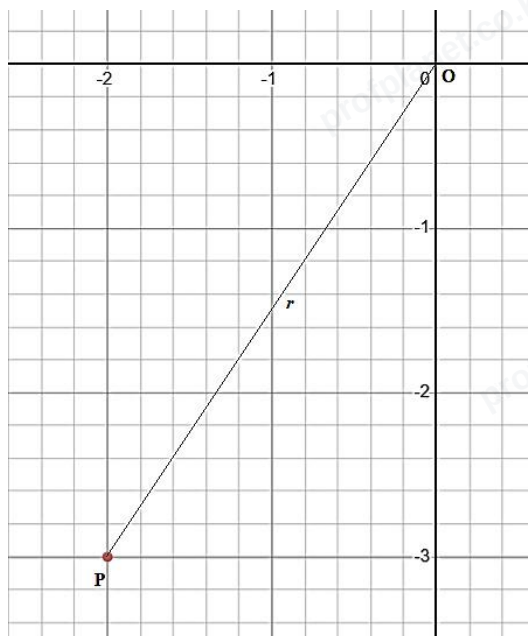
a) Find the vector $\tilde{a}$ joining point A to B. (2 Marks)

b) Find the magnitude (length) of the vector. (2 Marks)

9. By using the general solution of integrals of the form ax^n , prove that;

$$\int \sqrt{x} dx = \frac{2}{3} \sqrt{x^3} + C \quad (4 \text{ Marks})$$

10. The position of point P (-2, -3) is shown on the Cartesian plane below.



- a) Determine the value of r , the distance of point P from the origin O. (2 Marks)
- b) Determine the direction of P, defined as the angle that the line OP makes with the positive x – axis, measured anticlockwise. (2 Marks)

SECTION B: (60 MARKS)

Answer ANY THREE questions in this section

11.

- a) Use the Quotient rule to differentiate $y = \sec ax$ with respect to x given that

$$\sec ax = \frac{1}{\cos ax} \quad (4 \text{ Marks})$$

- b) The product rule of differentiation states that if $y = f(x) \cdot g(x)$, then

$$\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx} \text{ where } u = f(x) \text{ and } v = g(x). \text{ Given that } y = 2xe^{-3x},$$

$$\text{show that } \frac{d^2y}{dx^2} + 6 \frac{dy}{dx} + 9y = 0. \quad (6 \text{ Marks})$$

- c) Evaluate the following, taking positive square roots only. (6 Marks)

$$\int_1^4 \left(\frac{t+2}{\sqrt{t}} \right) dt$$

- d) Determine $\int \left(\frac{2m^2+1}{m} \right) dm$. (4 Marks)

12.

- a) Determine the coordinates of the maximum and minimum values of the graph

$$y = \frac{x^3}{3} - \frac{x^2}{2} - 6x + \frac{5}{3}. \quad (6 \text{ Marks})$$

- b) Use the method of bisection to find the positive root of the equation $5x^2 + 11x -$

$$17 = 0 \text{ correct to 3 significant figures.} \quad (14 \text{ Marks})$$

13.

- a) Table 1 shows the number of overtime hours claimed in a certain year by production workers in a tire factory.

Table 1

55	25	57	34	84	18	52	23	29	40
18	20	68	48	56	67	45	44	33	36
64	60	35	37	69	61	71	31	36	48
43	32	63	53	65	24	80	50	46	42
38	30	78	28	75	44	66	48	57	41

- i) Construct a frequency distribution table starting from 15 to 25. (2 Marks)
 - ii) Using the result in a) i) above, draw a histogram, hence determine the modal value. (6 Marks)
- b) Table 2 shows the scores distribution of the candidates interviewed to join a mechanical engineering class.

Table 2

Scores	No. of Candidates
10 – 20	60
20 – 30	80
30 – 40	90
40 – 50	110
50 – 60	60
60 – 70	50
70 – 80	40

Determine the;

- i) Mean number of candidates
- ii) Median
- iii) Mode
- iv) Standard deviation.

(12 Marks)

14.

- a) By reducing the following trigonometric identities to sines and cosines where possible, show that;

(5 Marks)

$$\frac{\tan x + \sec x}{\sec x \left(1 + \frac{\tan x}{\sec x}\right)} = 1$$

- b) Given that $\cos^2 t + \sin^2 t = 1$, solve the equation $5 \cos^2 t + 3 \sin t - 3 = 0$ for values of t from 0° to 360° .

(8 Marks)

- c) The double angle for $\sin(A + B) = \sin A \cos B + \cos A \sin B$. Use the formula to prove that $\sin 3\theta = 3 \sin \theta - 4 \sin^3 \theta$.

(7 Marks)