

071606T4IMT

INDUSTRIAL MECHATRONICS TECHNOLOGY LEVEL 6

ENG/OS/IMT/CC/02/6

Apply Engineering Mathematics

November/December 2025



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

WRITTEN

TEST

INSTRUCTIONS TO CANDIDATE

1. Marks for each question are indicated in the brackets.
2. The paper consists of **TWO** sections: **A** and **B**.
3. Attempt **ALL** questions in section **A**
4. Attempt **THREE** questions in section **B**
5. Candidates are provided with a separate answer booklet
6. **DO NOT** write on this question paper.

This paper consists of FOUR (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 the questions in this section.*

1. Evaluate $4a^2bc^3 - 2ac$ when $a = 2$, $b = \frac{1}{2}$ and $c = 1\frac{1}{2}$ (4 Marks)
2. The roots of a quadratic equation are $\frac{1}{3}$ and -2 . Determine the equation in x . (4 Marks)
3. A copper wire has a length (l) of 1.5km , a resistance (R) of 5Ω and a resistivity (ρ) of $17.2 \times 10^{-6}\Omega \text{ mm}$. find the cross-sectional area, (a), of the wire given that $R = \rho l/a$. (4 Marks)
4. Find the smallest positive root of the equation $\sin(2x + 50)^\circ = 0.1$ (4 Marks)
5. Using the law of cosines prove that $4m_a^2 = 2(b^2 + c^2) - a^2$, where m_a is the length of the median corresponding to the side of a length. (4 Marks)
6. Find the sum of the first 12 terms of the series $5, 9, 13, 17, \dots$ (4 Marks)
7. A force of 4N is inclined at an angle of 45° to a second force of 7N , both forces acting at a point. Find the magnitude of the resultant of these two forces and the direction of the resultant with respect to the 7N force using the triangle method. (4 Marks)
8. Find the derivative of $y = (x^2 + 1)$ (4 Marks)
9. If the Laplace transform of $f(t)$ is $\frac{1}{s+1}$ then, find the Laplace transform of $f(2t)$ (4 Marks)
10. To obtain Grade A, Ben must achieve an average of at least 70 in five tests. If his average mark for the first four tests is 68, determine the lowest mark he can get in his fifth test and still obtain Grade A (4 Marks)

SECTION B (60 MARKS)

Answer Any **THREE** Questions in This Section

11. A matrix is a rectangular array of numbers, symbols, or expressions arranged in rows and columns.

a. Determine the inverse of the matrix $\begin{bmatrix} 3 & 4 & -1 \\ 2 & 0 & 7 \\ 1 & -3 & -2 \end{bmatrix}$ (10 Marks)

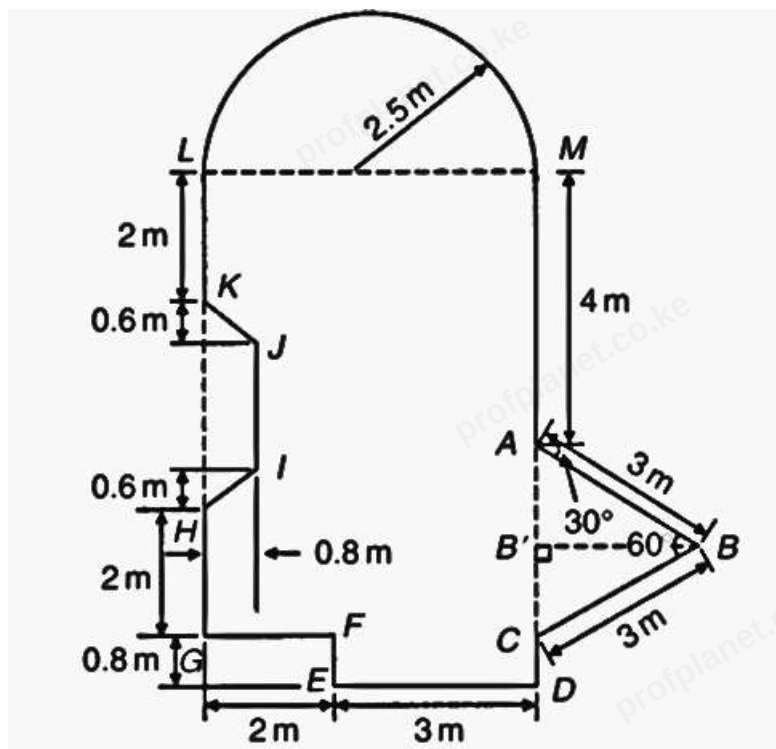
b. Use matrices to solve the simultaneous equations: (10 Marks)

$$3x + 5y - 7 = 0 \dots (1)$$

$$4x - 3y - 19 = 0 \dots (2)$$

12. Mensuration is a branch of mathematics concerned with the determination of lengths, areas, and volumes.

a. The figure below shows a plan of a floor of a building that is to be carpeted. Calculate the area of the floor in square metres. Calculate the cost, correct to the nearest pound, of carpeting the floor with carpet costing £16.80 per m^2 , assuming 30% extra carpet is required due to wastage in fitting. (10 Marks)



b. A pyramid has a rectangular base 3.60cm by 5.40cm. Determine the volume and total surface area of the pyramid if each of its sloping edges is 15.0cm. (10 Marks)

13. Binomial expansion is the expression of $(a + b)^n$ as a sum of terms using binomial coefficients.

- a. The radius of a cylinder is reduced by 4% and its height is increased by 2%. Determine the approximate percentage change in its volume and curved surface area (neglecting the products of small quantities). (10 Marks)
- b. The second moment of area of a rectangle through its centroid is given by $\frac{bl^3}{12}$. Determine the approximate change in the second moment of area if b is increased by 3.5% and l is reduced by 2.5%. (10 Marks)
14. A complex number is a number that combines a real part and an imaginary part, expressed in the form $a + jb$, where $j^2 = -1$
- a. Convert $4\angle 30^\circ$ into $a + jb$ (4 Marks)
- b. Solve the quadratic equation $x^2 + 2x + 5 = 0$ and express the final answer as a complex number. (8 Marks)
- c. Determine the magnitude and direction of the resultant of the three coplanar forces given, when they act at a point. Force A, 10N acting at 45° from the positive horizontal axis. Force B, 8N acting at 120° from the positive horizontal axis. Force C, 15N acting at 210° from the positive horizontal axis. (8 Marks)