

071505T4MTP

MECHANICAL PRODUCTION TECHNOLOGY LEVEL 5

ENG/OS/ME/CC/05/5

Apply Mechanical Science Principles

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. Attempt **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 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)

Attempt ALL the questions in this section.

1. A body is uniformly accelerated from rest to a final velocity of 100 ms^{-1} in 10s.
Calculate the distance covered. (4 Marks)
2. There are various types of forces. Identify FOUR of these types. (4 Marks)
3. State any FOUR fundamental laws of friction. (4 Marks)
4. State the Pascal's principle of transmission of fluid pressure. (2 Marks)
5. The knowledge of simply supported beams with point loading can be applied in various areas in engineering. List TWO areas of application. (2 Marks)
6. A road wheel of diameter 560 mm turns through an angle of 150° . Calculate the distance moved by a point on the tyre tread of the wheel. (3 Marks)
7. The following terms are applied in Mechanical Science. Provide a definition for each one of them giving the respective SI unit for each. (4 Marks)
 - a. Work
 - b. Power
8. The behavior of bodies under action of forces was observed by sir Isaac Newton where he came up with laws. State the following of laws; (4 Marks)
 - a. Newton's second law of motion
 - b. Newton's third law of motion
9. Gas laws describe the relationships between pressure, volume, temperature, and the amount of gas. State the following gas laws:
 - a. Boyle's law (2 Marks)
 - b. Charles' law (2 Marks)
10. Radiation is a mode of heat transfer. Explain THREE practical applications of radiation. (3 Marks)
11. Fluid pressure in engineering systems can be applied in several areas. Name THREE of these areas. (3 Marks)
12. A block of metal of volume 60 cm^3 weighs 4.80 N in air. Determine its weight when fully submerged in a liquid of density $1,200 \text{ kgm}^{-3}$. (Take $g = 10 \text{ m/s}^2$) (3 Marks)



SECTION B (60 MARKS)

Attempt any THREE questions in this section

13.

- a. Friction is a force that plays a crucial role in our daily lives. Explain FIVE of its advantages (5 Marks)
- b. A stone is released from the top of a cliff 180 m high. Calculate:
(Take $g = 10 \text{ m/s}^2$)
 - i. time it takes to hit the water, (4 Marks)
 - ii. velocity with which it hits the water. (3 Marks)
- c. There are various forms of energy in the field of engineering. Explain FOUR forms (8 Marks)

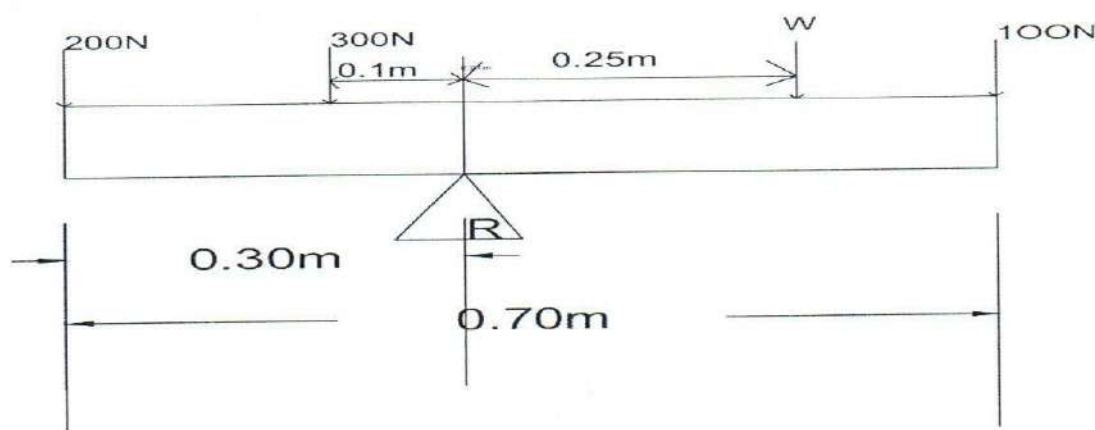
14.

- a. 0.02 m^3 of a gas at 27°C is heated at constant pressure until the volume is 0.03 m^3 . Calculate the final temperature of the gas in $^\circ\text{C}$. (5 Marks)
- b. When dealing with problems involving a number of forces acting at a point, the following terms are frequently used. Provide an explanation for each of them. (5 Marks)
 - i. Equilibrium
 - ii. Resultant
 - iii. Equilibrant
 - iv. Coplanar forces
 - v. Concurrent forces
- c. Determine the amount of heat energy needed to change 400 g of ice, initially at -20°C , into steam at 120°C . Assume the following: latent heat of fusion of ice = 335 kJ/kg , latent heat of vaporisation of water = 2260 kJ/kg , specific heat capacity of ice = $2.14 \text{ kJ/(kg }^\circ\text{C)}$, specific heat capacity of water = $4.2 \text{ kJ/(kg }^\circ\text{C)}$ and specific heat capacity of steam = $2.01 \text{ kJ/(kg }^\circ\text{C)}$ (10 Marks)

15.

- a. A uniform horizontal lever is supported on a fulcrum and loaded as shown below.





Calculate:

- i. The magnitude of the load W required to maintain equilibrium (6 Marks)
 - b. A hand operated lifting machine in a repair shop raises an engine of 260 kg by means of an effort of 210 N at the handle. If the effort moves through a distance of 13.5 m in raising the engine 450 mm , Calculate;
 - i. Mechanical advantage (2 Marks)
 - ii. Velocity ratio (2 Marks)
 - Efficiency of the machine (2 Marks)
 - c. Archimedes principle and relative density can be applied in several areas in engineering. Explain FOUR of these areas. (8 Marks)
- 16.
- a. A metal block lined with an abrasive material having a mass of 4.8 kg requires a horizontal pull of 17 N to move it at a steady speed along a horizontal steel surface. Calculate the coefficient of friction for the abrasive material on Steel. (5 Marks)
(Take $g \doteq 9.81\text{ m/s}^2$)
 - b. With the aid of a sketch, describe how a mercury barometer works. (5 Marks)
 - c. A compressed air cylinder has a volume of 0.6 m^3 and contains air at a pressure of 1.2 MPa absolute and a temperature of 37°C . After use the pressure is 800 kPa absolute and the temperature is 17°C . Calculate the mass of air removed from the cylinder. (10 Marks)