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MECHANICAL PRODUCTION TECHNOLOGY LEVEL 5

ENG/OS/ME/CC/05/5

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Apply Mechanical Science Principles

November/December 2025

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

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WRITTEN ASSESSMENT

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TIME: 3 HOURS

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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.

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This paper consists of FIVE (5) printed pages

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

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SECTION A (40 MARKS)

Answer All questions in this section

1. Friction is a force that resists the relative motion of two surfaces in contact. State FOUR disadvantages of this force in engineering. (4 Marks)
2. A technician is required to identify different ways energy can be stored for use in mechanical systems. List FOUR forms he identified. (4 Marks)
3. Pressure in mechanical engineering can be measured using several devices. Outline FOUR of these devices. (4 Marks)
4. A gas occupies a volume of $0.10\ m^3$ at a pressure of $1.8\ MN/m^2$. Calculate:
   a. Pressure if the volume is changed to $0.06\ m^3$ at constant temperature; (2 Marks)
   b. Volume if the pressure is changed to $2.4\ MN/m^2$ at constant temperature (2 Marks)
5. Distinguish between the triangle law and polygon law of forces. (4 Marks)
6. A uniform beam of length $5\ m$ and weight $200\ N$ is supported at its ends. A load of $300\ N$ is placed at a distance of $2\ m$ from the left support. Using the principle of moments, calculate the reactions at the supports. (4 Marks)
7. Which are the FOUR main equations of linear motion? (4 Marks)
8. Identify TWO classes of levers used in mechanical applications and give an example of each. (4 Marks)
9. Define the following terms as used in heat transfer:
   i. Latent heat of fusion (2 Marks)
   ii. Latent heat of vaporization (2 Marks)
10. List FOUR practical applications of density in mec. (4 Marks)

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SECTION B (60 MARKS)

Answer THREE questions in this section

11.

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a. Water at a temperature of 100^0C is heated by an immersion heater of 2 kW in 10 Minutes. If the final temperature of water is 90^0C, Determine the mass of the water. Take specific heat capacity of water $= 4200$ J/kg/K (5 Marks)

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b. A lorry having a mass of 2.5 tonnes is travelling along a level road at 72 Km/h. When the brakes are applied, the speed decreases to 18 Km/h. Determine the change in kinetic energy of the lorry. (5 Marks)

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c. A body weighs 2.760 N in air and 1.925 N when completely immersed in water of density 1000 kg/m^3. Taking the gravitational acceleration as 9.81 m/s^2. Calculate:

i. Volume of the body (4 Marks)

ii. Density of the body (3 Marks)

iii. Relative density (3 Marks)

12.

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a. An object of mass 2.5 kg at a height of 600 cm above the ground level is set to undergo free fall. Determine the:

i. Potential energy possessed by the object (3 Marks)

ii. Velocity of the object just before it hit (3 Marks)

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iii. Time taken to hit the ground (3 Marks)

b. State the following gas laws:

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i. Charles' law (2 Marks)

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ii. Pressure law (2 Marks)

c. A pulley system consists of two blocks, each containing three pulleys and connected as shown below. An effo N is required to raise a load of 1500 N.

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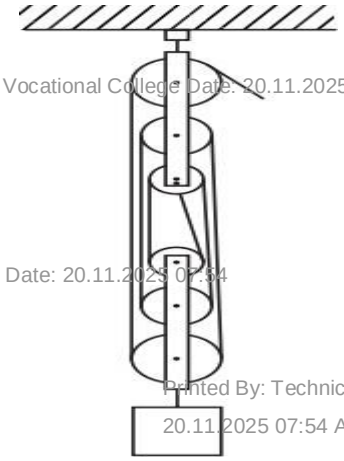

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Determine:

i. The mechanical advantage (3 Marks)

ii. The velocity ratio (1 Mark)

iii. The efficiency of the pulley system. (3 Marks)

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13.

a. A metal block lined with an abrasive material and 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)

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b. The air pressure at the base of a mountain is 75.0 cm of mercury and 60.0 cm of mercury at the top. Given that the average density of air is 1.25 Kg/m^3 and the density of mercury is 13 600 Kg/m^3, calculate the height of the mountain. (5 Marks)

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c. Determine the amount of heat energy needed to change 400 g of ice, initially at −20 °C, into steam at 1 atm. Given: 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 $kJ/(kg\,°C)$, specific heat capacity of water = 4.2 $kJ/(kg\,°C)$ and specific heat capacity of steam = 2.01 $kJ/(kg\,°C)$ (10 Marks)

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14.

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a. A road wheel of diameter 560 *mm* turns through an angle of 150^0. Calculate the distance moved by a point on the wheel. (4 Marks)

b. There are factor the coefficient of friction between two surfaces. Explain FOUR of these factors. (8 Marks)

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c. Application of Moments in mechanical systems has several advantages. Discuss FOUR of these advantages. (8 Marks)

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