

07150654C

MECHANICAL PRODUCTION TECHNICIAN LEVEL 6**ENG/OS/MEM/CC/04/0****Apply Fluid Mechanics Principles****November/December 2025**

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

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Time: 3 HOURS**INSTRUCTIONS TO CANDIDATE**

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1. The paper consists of **TWO** sections **A** and **B**.
2. **Answers in Section A and Any THREE Questions in Section B.**
3. **Marks for each question are indicated in the brackets,**
4. **Candidates are provided with a separate answer book let.**
5. **DO NOT** write on this question paper,
6. **Use non-programmable scientificors.**

Take; Gravitation pull as $g = 9.81 \text{ m/s}^2$ **This paper consists of SIX (5) printed pages**Printed By: h Technical And Vocational College
Date: 25.11.2025 02:59 PM**ates 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***

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1. While working in a maintenance workshop, your supervisor asks you to explain how reciprocating pumps are categorized. State TWO main criteria you would use to classify reciprocating pumps. (2 Marks)

2. A mechnician was tasked with selecting suitable fluids for a hydraulic system.

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Mention FOUR categories of fluids that the technician identified based on viscosity behavior (4 Marks)

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3. During a pump installation task, you are asked to consider the role of casing in ensuring both efficiency and safety. State THREE casing types that are commonly applied in centrifugal pumps. (3 Marks)
4. During a performance evaluation of a centrifugal pump, a technician is tasked to describe important terminologies used in measuring head and determining the pump's work output. Define the following terms. (4Marks)

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- b. Delivery Head
- c. Static head
- d. Manometric head

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5. As an intern in the design office of a production plant, your supervisor asks you to apply dimensional analysis as part of problem-solving and equipment design. Briefly explain the follow as they are used in dimensional analysis (4Marks)

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- a. Geometric similarity
- b. Kinematic similarity

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6. In a design review session, you are asked to recall the basic elements applied in dimensional analysis. Mention THREE fun uanantities you would give. (3 Marks)

7. A processing plant is experiencing energy loss in its piping system. Identify FIVE possible causes of this loss. (5 Marks)

8. In practical engineering applications, dimensional analysis is used to simplify complex problems and ensure consistency in calculations. Define the following physical quantities as applied in dimensional analysis. (4 Marks)

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9. Viscous flow is an orderly state of flow in which macroscopic fluid particles move in parallel layers with no disruption between them. Identify FOUR applications of a viscous flow. (4 Marks)

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10. In a pipe of diameter 350 mm and length 75 m water is flowing at a velocity of 2.8m/s. Calculate the head lost due to friction using Darcy- Welsbach formula. (5 Marks)

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11. During a pipe flow experiment, you are required to observe the behavior of fluids under different conditions. Outline FOUR main characteristics you would observe when the flow is laminar. (4 Marks)

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SECTION B (60 MARKS)**Answer Any THREE Questions from This Section.**

12.

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- a. A single acting reciprocating pump running at 50 R.P.M., delivers $0.01 \text{ m}^3/\text{s}$ of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine;

- The theoretical discharge of the pump (4 Marks)
- Coefficient of discharge (4 Marks)
- Percentage slip of the pump. (4 Marks)

- b. A double-acting reciprocating pump, running at 50 R.P.M., is discharging 1.0 m^3 of water per minute. The pump has a stroke of 400mm. The diameter of the piston is 200 mm. The delivery of suction head are 20 m and 5 m respectively. Find the slip of the pump and the power required to drive the pump. (8 Marks)

13.

- a. During a laboratory test, water is passed through a horizontal pipe to study flow behaviour.

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Ex EE factors that influence the transition of flow from laminar to turbulent in the pipe. (6 Marks)

- b. The resistance R to motion of a motor vessel sailing in sea water depends on mass, density ρ , length of the vessel L, velocity of flow V, dynamic viscosity μ and gravitational acceleration g. Using Rayleigh's method show that:

$$R = \rho L^2 V^2 \phi \left[\frac{\mu}{\rho V L}, \frac{Lg}{V^2} \right], \text{ Where } \phi \text{ is 'function of'}$$
 (14 Marks)

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14.

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- a. In Bernoulli's equation, the sum of pressure energy, kinetic energy, and potential energy is constant along a streamline. Explain FIVE assumptions that are made in the derivation of Bernoulli's equation. (10 Marks)

- b. A water and Sewerage Company realized that there was low water pressure in their distribution system. They suspected that this was due to head lost due to friction in one of

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the horizontal pipes whose uniform cross section is given by, $h_f = \frac{4fLV^2}{d \times 2g}$

Calculate the head loss due to friction. (10 Marks)

Where h_f = loss of head due to friction,

v = velocity of flow, L = length of pipe,

g = gravitational acceleration,

d = diameter of the pipe,

f = coefficient of friction

15.

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- a. A reciprocating pump is a type of pump that uses a piston or plunger to move fluid back and forth, creating pressure and displacing a fixed amount. With the aid of a sketch,

explain the working principle of a single-acting reciprocating pump. (10 Marks)

- b. A pipe has oil of viscosity 0.048 kg/ms flowing through a 25 mm diameter pipe with a mean velocity of 0.3 m/s. calculate:

The pressure drop that occurs over a length of 30 m; (4 Marks)

- c. A dimensionless number is a number that represents a property of a physical system without being measured on a scale of physical units. Describe the following dimensionless numbers;

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- i. Mach's number;
- ii. Froude's number;
- iii. Reynolds number.

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