

071606T4AMT

AUTOMOTIVE MECHATRONICS TECHNOLOGY LEVEL 6

ENG/OS/AMT/CC/06/6/A

APPLY FLUID MECHANICS PRINCIPLES

July /Aug 2023



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

WRITTEN

TEST

RS

Instructions to Candidates:

1. This paper consists of **TWO** sections; A and B
2. Attempt all the questions in section **A** and any **THREE** questions in section **B**.
3. Marks for each question are indicated in brackets ().
4. You are provided with a separate answer booklet.
5. Do not write on the question paper.
6. Take $g=9.81 \text{ N/kg}$

This paper consists of FIVE (5) printed pages

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

Turn over

SECTION A: 40 MARKS

Attempt all the questions in this section

1. Define the following terms used in fluid mechanics. (4 Marks)
 - i. A fluid
 - ii. Viscosity
 - iii. Specific volume
 - iv. Specific gravity
2. Calculate the specific weight and specific density of a liquid having a volume of 6m^3 and a weight of 44kN . (4 Marks)
3. There are **two** types of losses experienced by fluids flowing. State the two types of losses and give one cause for each loss. (4 Marks)
4. Define the following terms used in pump (2 Marks)
 - i. A pump
 - ii. Slip
5. State **two** scenarios that brings about negative slip in reciprocating pumps. (2 Marks)
6. Name **three** types of casings used in centrifugal pumps. (3 Marks)
7. List **two** criteria of classifying reciprocating pumps. (2 Marks)
8. Determine the dimensions of the quantities given below. (6 Marks)
9. Define the following terms used in centrifugal pumps. (4 Marks)
 - i. Mechanical efficiency
 - ii. Manometric efficiency

iii. Overall efficiency

iv. Suction head

10. List **three** types of fluids

(3 Marks)

11. Draw a centrifugal pump and label the main parts.

(6 Marks)

SECTION B: 60 MARKS

Attempt any three questions in this section

12. a) Find the expression for the power P , developed by pump when P depends upon the head H , the discharge Q and specific weight w of the fluid. (6 Marks)
- b) The efficiency η of a fan depends on density ρ , dynamic viscosity μ of the fluid, angular velocity ω , diameter D of the rotor and the discharge Q . Express η in terms of dimensionless parameters. Use Buckingham's π -theorem. (14 Marks)
13. a) A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the Reynold's numbers and the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. (10 Marks)
- b) Calculate the pressure gradient along the pipe, the average velocity, and the discharge for an oil of viscosity 0.02 Ns/m² flowing between two parallel plates 1 m wide maintained 10 mm apart. The velocity midway between the plates is 2 m/s. (10 Marks)
14. a) A centrifugal pump having outer diameter equal to two times the inner diameter and running at 1000 r.p.m. works against a total head of 40m. the velocity of flow through the impeller is constant and equal to 2.5 m/s. the vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500mm and width at outlet is 50mm, determine:
- i. Vane angle at inlet (3 Marks)
 - ii. Work done by the impeller on water per second (7 Marks)
 - iii. Manometric efficiency (3 Marks)
- b) A single-acting reciprocating pump running at 40 r.p.m delivers 0.01m³ per second of water. The diameter of the cylinder is 200 mm and the stroke length 400 mm. Determine:
- i. The theoretical discharge of the pump (3 Marks)
 - ii. Co-efficient of discharge (2 Marks)
 - iii. Slip and percentage slip of the pump (2 Marks)

15. a) An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a pipe of diameter 200 mm at the rate of 60 litres per second. Find the head lost due to friction for a 500 m length of pipe. Find the power required to maintain this flow. (8 Marks)
- b) Find the loss of head when a pipe of diameter 200 mm is suddenly enlarged to a diameter of 400 mm. the rate of flow of water through the pipe is 250 litres per second. (6 Marks)
- c) Find the head lost due to friction in a pipe of diameter 300 mm and length of 50 m, through which water is flowing at a velocity 3 metres per second using Darcy formula (6 Marks).

(Take kinematic viscosity, $\nu = 0.01$ stoke)