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

Qualification Code	**:**	**071606T4MCT**
Qualification	**:**	**Mechatronics Technician Level 6**
Unit Code	**:**	**ENG/OS/MC/CC/07/6**
Unit of Competency	**:**	**Apply Fluid Mechanics Principles**

WRITTEN ASSESSMENT

INSTRUCTIONS TO CANDIDATE

1. You have **THREE** hours to answer all the questions.
2. Marks for each question are indicated in the brackets.
3. The paper consists of **TWO** sections: A and B.
4. Do not write on the question paper.
5. A separate answer booklet will be provided.
6. You are required to have a scientific calculator in this assessment.

This paper consists of FOUR (4) printed pages

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

SECTION A: (40 MARKS)

1. State two criteria of classifying reciprocating pumps (2 Marks)

2. List four types of fluids classified according to the presence of viscosity. (4 Marks)

3. List three applications of dimensional homogeneity (3 Marks)

4. Define Newtonian fluid and give two examples of Newtonian fluids (4 Marks)

5. Outline three types of casings adopted in centrifugal pumps (3 Marks)

6. Define the following terms used in centrifugal pumps (4 Marks)
   i. Suction head
   ii. Delivery head
   iii. Static head
   iv. Manometric head

7. Define dimensional analysis (2 Marks)

8. What is the importance of model analysis? (2 Marks)

9. which four forces act on a moving fluid moving through a pipe? (4 Marks)

10. State two types of energy loses experienced by fluids moving through pipes and their cause? (4 Marks)

11. Name two types of centrifugal pumps and one application for each? (4 Marks)

12. Compare the flow of fluids in series and parallel pipes (4 Marks)

SECTION B: (60 MARKS)

13.

a. A single acting reciprocating pump running at 50 r.p.m., delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and stroke length 400 mm. determine:

i. The theoretical discharge of the pump,

ii. Coefficient of the pump, and

iii. Slip and percentage slip of the pump

(10 Marks)

b. Briefly describe any two efficiencies of a centrifugal pump (4 Marks)

c. The double-acting reciprocating pump, running at 40 r.p.m., is discharging 1.0 m 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 required to drive the pump. (6 Marks)

14.

a. An oil of viscosity 0.1 Ns/m^2 and relative density 0.9 is flowing through a circular pipe of diameter 50 mm and of length 300 m. the rate of flow of fluid through the pipe is 3.5 litre/s. find the pressure drop in a length of 300 m and also shear stress at the pipe wall. (10 Marks)

b. Two tanks A and B have 70 m difference in water levels, and are connected by a pipe 0.25 m diameter and 6 km long with 0.002 friction coefficient. The pipe is tapped at its mid-point to leak out 0.04 m3 /s flow rate. Minor losses are ignored. Determine the discharge leaving tank A and the discharge entering tank B? (10 Marks)

15.

a. The internal and external diameter of an impeller of a centrifugal pump which is running at 1000 r.p.m., are 200 mm and 400 mm respectively. The discharge through pump is 0.04 m^3/s and velocity of flow is constant and equal to 2.0 m/s. the diameters of the suction and delivery pipes are 150 mm and 100 mm respectively and suction and delivery heads are 6 m (abs.) and 30 m (abs.) of water respectively. If the outlet vane angle is 45^o and power required to drive the pump is 16.186 kW, determine:

i. Vane angle of the impeller at inlet

ii. Overall efficiency of the pump
iii. Manometric efficiency of the pump

(14 Marks)

b. Find the diameter of a pipe of length 2000 m when the rate of flow of water through the pipe is 200 litres/s and the head lost due to friction is 4 m. take the value of C=50 in Chezy's formula

(6 Marks)

16. In the figure below, when a sudden contraction is introduced in a horizontal pipe line from 50 cm to 25 cm, the pressure changes from 10,500 kg/m^2 (103005 n/m^2) to 6900 kg/m^2 (67689n/m^2). Calculate the rate of flow. Assume the co-efficient of contraction of jet to be 0.65. Following this if there is a sudden enlargement from 25 cm to 50 cm and if the pressure at the 25 cm section is 6900 kg/m^2 (67689 n/m^2) what is the pressure at the 50 cm enlarged section? (20 Marks)