

071906T4AEN

Agricultural Engineering Level 6

ENG/OS/AGR/CC/04/6/A

Apply Principles of Fluid Mechanics

July /Aug 2023



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

WRITTEN ASSESSMENT

Time: 3 hours

INSTRUCTIONS TO CANDIDATES

1. This paper has **two** sections **A** and **B**.
2. You are provided with a separate answer booklet.
3. Marks for each question are as indicated.
4. Do not write on the question paper.

This paper consists of 3 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)

Answer all questions in this section.

1. Define the following terms: (4 marks)
 - a) Discharge
 - b) Pump
 - c) Specific Volume;
 - d) Non-Newtonian fluid.
2. State FOUR minor head losses in pipes. (4 marks)
3. Using the M-L-T System, perform the dimension analysis of the following physical quantities. (6 marks)
 - (i) Discharge
 - (ii) Pressure
 - (iii) Specific weight
4. Show that Reynolds number $Re = \frac{\rho V d}{\mu}$ is dimensionless (3 marks)
5. Identify FOUR main components of a reciprocating pump. (4 marks)
6. Illustrate multistage pump with impellers in,
 - a. Series arrangement (2 marks)
 - b. Parallel arrangement (2 marks)
7. Outline FOUR differences between centrifugal pump and reciprocating pump (4 marks)
8. Identify FOUR types of fluid flows. (4 marks)
9. State THREE effects of cavitation in fluid flows. (3 marks)
10. Water flows through a 200 mm diameter pipe with an average velocity of 0.5 m/s. Determine the velocity of flow at the other end of the pipe if the diameter is gradually reduced to 100 mm. (4 marks)

SECTION B (60 Marks)**Answer three questions in this section**

11. (a) With the aid of a diagram, explain the working of a single-acting reciprocating Pump
(10 marks)
- (b) A single acting reciprocating pump having a cylinder diameter of 200 mm and stroke of 500 mm is used to raise the water through a height of 100 m. Its crank rotates at 60 rpm. Determine:
- The theoretical power required to run the pump (4 marks)
 - The theoretical discharge (3 marks)
 - The percentage slip. If actual discharge is 50 liters/second. (3 marks)
12. (a) Discuss FOUR causes of energy losses in fluid flowing in a pipe (8 marks)
- (b) The diameter of a pipe changes gradually from 200 mm at point A 6 m above datum to 100 mm at point B 3 m above datum. The pressure and velocity at point A are 900 kN/m^2 and 0.9 m/s respectively. Determine the pressure at point B, assuming the flowing liquid is water. (12 marks)
13. (a) A dashpot consists of a cylinder 7cm diameter in which slides a piston 8cm long having a radial clearance of 1mm. The cylinder is filled with oil of viscosity 0.1 Ns/m^2 Calculate the velocity of the piston when acted upon by a load having a mass of 18Kg. (8 marks)
- (b) Oil of viscosity 0.02 Ns/m^2 flowing between the stationary parallel plates 1m wide maintained 10mm apart. The velocity midway between the plates is 2m/s. Calculate;
- The pressure gradient along the flow. (4 marks)
 - The average velocity. (4 marks)
 - The discharge. (4 marks)
14. (a) Using a labelled diagram, explain the functions of the main parts of a centrifugal pump. (10 marks)
- (b) The impeller of a centrifugal pump had an external diameter of 450mm and internal diameter of 200mm and it runs at 1440 R.P.M. assuming a constant radial flow through the impeller at 2.5 m/s and that the vanes at exit are set back at an angle 25° , determine
- Inlet vane angle (4 marks)
 - The angle, absolute velocity of water at exit make with the tangent (4 marks)
 - The work done per speed of water (2 marks)