MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

SECOND YEAR SPECIAL / SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 202: FLUID MECHANICS I

DATE: 26/8/2022 **TIME: 2.00-4.00 PM**

INSTRUCTIONS:

- *This paper comprises of FIVE questions. Answer **THREE** questions*
- *Question one is **compulsory** and carry 30 marks*
- *Answer any other **TWO** questions*

QUESTION ONE (30 MARKS)

a) Explain what is meant by the following terms as applied to fluid mechanics giving SI units where necessary: (15 marks)

i. Mass density

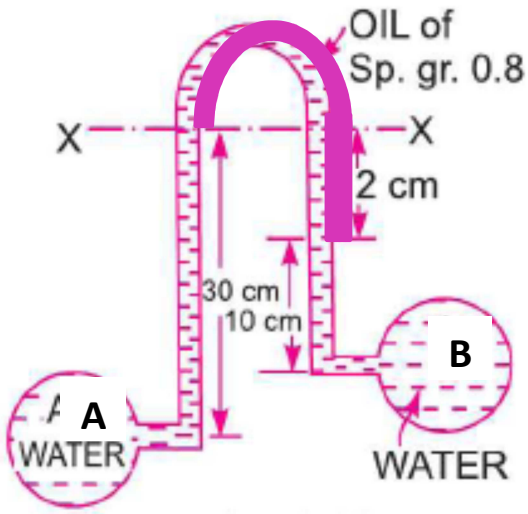
ii. Specific weight

iii. Specific gravity

iv. The coefficient of dynamic viscosity

v. Kinematic viscosity

b) Water is flowing through two different pipes to which a differential manometer having an oil of specific gravity of 0.8 is connected as shown below. The pressure head in pipe A is 2m of water. Find the pressure in pipe B for the manometer readings shown. (15 marks)



QUESTION TWO (20 MARKS)

a) Define the following terms. (8 marks)

i. Pressure Intensity

ii. Total Pressure

iii. Centre of pressure (Ħ)

iv. Buoyancy

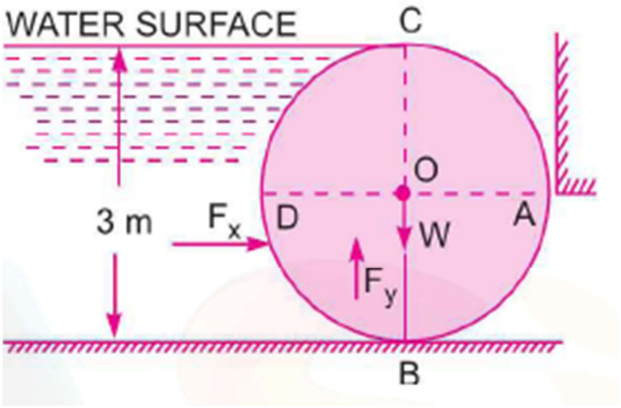
v. Buoyant force (or Upthrust)

vi. Centre of buoyancy

vii. Metacentre

viii. Metacentric height

b) A cylinder with a diameter of 3 m and 4 m long retains water on one side. The cylinder is supported as shown in the figure below. Determine the total pressure on the cylinder and the direction of the total pressure. (12 marks)



QUESTION THREE (20 MARKS)

a) Explain what is meant with the following terms. (5 marks)

i. Small orifice

ii. Large orifice

iii. Coefficient of contraction

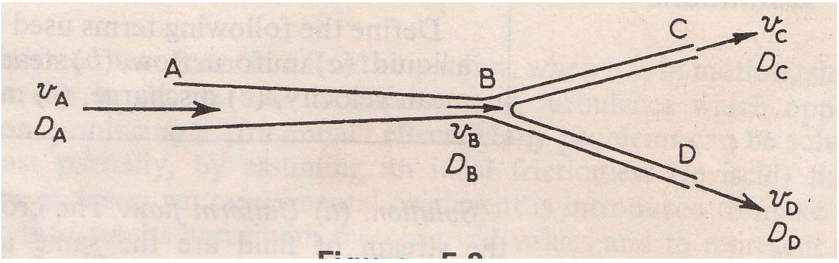
iv. Coefficient of velocity

v. Coefficient of discharge

b) Derive experimentally an expression for the Coefficient of Velocity, C_v. (5 marks)

c) What is continuity of flow as applied to fluid mechanics? (2 marks)

d) Oil flows through a pipeline which contracts from 450 mm diameter at A to 300 mm diameter at B and then forks such that one branch is 150 mm diameter discharging at C and the other branch is 225 mm diameter discharging at D as shown in the figure below. If the velocity at A is 1.8 m/s and the velocity at D is 3.6 m/s, what will be the discharges at C and D, and the velocities at B and C? (8 marks)



QUESTION FOUR (20 MARKS)

a) State three forms of energy that a liquid in motion possesses. (3 marks)

b) State Bernoulli's equation defining each term. (3 marks)

c) From first principles derive the expression for the actual discharge of water flowing through a horizontal venturi-meter. (10 marks)

d) A venture meter has an area ratio of 9 to 1, the larger diameter being 30 cm. During flow, the recorded pressure head in the larger section is 6.5 m, and that at the throat is 4.25 m. If the meter coefficient, $C_d = 0.99$. Compute the discharge through the meter in m^3/s. (4 marks)

QUESTION FIVE (20 MARKS)

a) Define vortex flow as applied to rotational flow in liquids, and state types of vortex flow. (6 marks)

b) An open cylindrical tank 2 m high and 1 m in diameter is placed with its axis vertical, and is filled with water up to a height of 1.5 m. If the cylinder rotates about its geometric axis, find the constant angular velocity that can be attained without spilling any water. (4 marks)

c) The velocity of water at the outer edge of a whirlpool where the water level is horizontal and in the same plane as the bulk of the liquid is 2 m/s and the diameter 50 cm. Calculate the depth of the free water surface at a radius of 5 cm from the eye of the whirlpool. (10 marks)