



Q1-Multiple Choice Questions (Conceptual)

(15 Marks)

- 1. What is the primary reason for studying engineering fluid mechanics?**
 - a) To innovate and solve problems involving fluid systems
 - b) To understand solid mechanics.
 - c) To study the properties of gases only
 - d) To design electrical systems
 - Answer: a) To innovate and solve problems involving fluid systems**
- 2. What is the main characteristic of a fluid compared to a solid?**
 - a) Fluids have fixed shapes
 - b) Fluids flow easily under shear stress
 - c) Fluids cannot be compressed
 - d) Fluids have higher density than solids
 - Answer: b) Fluids flow easily under shear stress**
- 3. According to the continuum assumption, fluid properties such as density are considered:**
 - a) Discrete functions of position
 - b) Continuous functions of position
 - c) Constant throughout the fluid
 - d) Unrelated to the molecular structure
 - Answer: b) Continuous functions of position**
- 4. If a fluid flows through a pipe with a diameter of 0.5 m at an average velocity of 3 m/s, what is the volumetric flow rate?**
 - a) 0.196 m³/s
 - b) 0.785 m³/s
 - c) 0.589 m³/s
 - d) 1.178 m³/s
 - Answer: c) 0.589 m³/s**
- 5. The hydrostatic pressure in a fluid at rest varies with:**
 - a) Temperature
 - b) Flow rate
 - c) Viscosity
 - d) Depth
 - Answer: d) Depth**
- 6. In fluid mechanics, what is the term used to describe the random, chaotic movement of fluid particles?**
 - a) Laminar flow
 - b) Viscous flow
 - c) Turbulent flow
 - d) Steady flow
 - Answer: c) Turbulent flow**
- 7. Cavitation in a fluid occurs when:**
 - a) The fluid velocity is too high
 - b) The fluid temperature is too low
 - c) The local pressure drops below the vapor pressure
 - d) The fluid is too viscous
 - Answer: c) The local pressure drops below the vapor pressure**
- 8. What is the specific weight of a fluid?**
 - a) The ratio of the fluid's mass to its volume
 - b) The weight of the fluid per unit volume
 - c) The fluid's weight divided by the gravitational constant
 - d) The density of the fluid multiplied by its volume



- Answer: b) The weight of the fluid per unit volume**
9. Which property describes the internal resistance of a fluid to flow?
- a) Density
 - b) Viscosity
 - c) Surface tension
 - d) Pressure
 - Answer: b) Viscosity**
10. The continuity equation is derived based on the principle of:
- a) Conservation of energy
 - b) Conservation of momentum
 - c) Conservation of mass
 - d) Conservation of volume
 - Answer: c) Conservation of mass**
11. The ratio of the inertial forces to viscous forces within a fluid is known as the:
- a) Reynolds number
 - b) Froude number
 - c) Mach number
 - d) Euler number
 - Answer: a) Reynolds number**
12. Which fluid property causes a liquid to resist an increase in surface area?
- a) Viscosity
 - b) Density
 - c) Surface tension
 - d) Specific weight
 - Answer: c) Surface tension**
13. The principle that states the pressure exerted by a fluid in an open system is the same at all points at the same depth is known as:
- a) Pascal's principle
 - b) Archimedes' principle
 - c) Bernoulli's principle
 - d) Hydrostatic equilibrium
 - Answer: d) Hydrostatic equilibrium**
14. Which equation is used to describe the relationship between the pressure, velocity, and height of a fluid in motion, assuming incompressible and non-viscous conditions?
- a) Continuity equation
 - b) Navier-Stokes equation
 - c) Bernoulli's equation
 - d) Darcy-Weisbach equation
 - Answer: c) Bernoulli's equation**
15. In a fluid flow scenario, if the flow rate is doubled while keeping the pipe diameter constant, the velocity of the fluid will:
- a) Remain constant
 - b) Double
 - c) Quadruple
 - d) Halve
 - Answer: b) Double**



Q2- A tank contains water at a height of 5 meters. Calculate the velocity of water flowing out from a hole at the bottom of the tank, assuming the flow is ideal and the tank is open to the atmosphere at the top. Use Bernoulli's equation. (5 Marks)

Velocity of Water from a Tank:

$$P_1 + \frac{1}{2}\rho V_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho V_2^2 + \rho g h_2$$

- At the surface ($P_1 = P_2 = 0$ assuming open tank, $V_1 \approx 0$):

$$\rho g h_1 = \frac{1}{2}\rho V_2^2$$

$$g h = \frac{1}{2} V_2^2$$



$$V_2 = \sqrt{2gh}$$

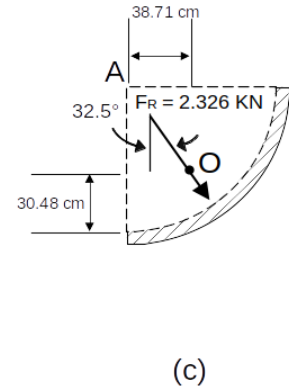
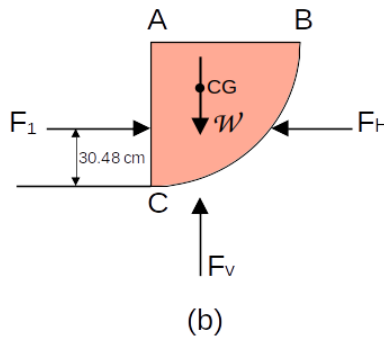
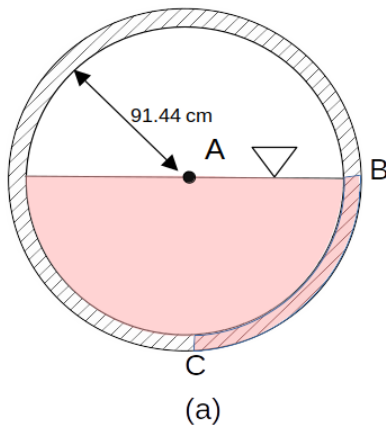
- For $h = 5 \text{ m}$:

$$V_2 = \sqrt{2 \cdot 9.81 \text{ m/s}^2 \cdot 5 \text{ m}} = \sqrt{98.1} \approx 9.9 \text{ m/s}$$

9.9 m/s



Q3- The 182.88 cm diameter drainage conduit of following Fig.a is half full of water at rest. Determine the magnitude and line of action of the resultant force that the water exerts on a 30.48 cm length of the curved section BC of the conduit wall. (10 Marks)



1. Given Data:

- Diameter of the conduit: 180 cm
- Radius of the conduit: 90 cm
- Length of the section BC: 30 cm

Steps:

2. Horizontal Force Component (F_H):

$$F_H = \gamma h_c A$$

Where:

- h_c is the depth to the centroid of the vertical projection.
- A is the area of the vertical projection.

For a quarter circle of radius 0.9 m (since 90 cm = 0.9 m):

$$h_c = \frac{4r}{3\pi} \approx \frac{4 \times 0.9}{3\pi} \approx 0.382 \text{ m}$$

$$A = r \times \text{length} = 0.9 \text{ m} \times 0.3 \text{ m} = 0.27 \text{ m}^2$$

Pressure at depth h_c :

$$p = \gamma h_c = 1000 \text{ kg/m}^3 \cdot 9.81 \text{ m/s}^2 \cdot 0.382 \text{ m} \approx 3744.42 \text{ Pa}$$

Horizontal force:

$$F_H = p \cdot A = 3744.42 \text{ Pa} \cdot 0.27 \text{ m}^2 \approx 1011 \text{ N}$$

3. Vertical Force Component (F_V):

- The vertical force component F_V is the weight of the water above the curved section BC.
- Volume of water above the curved section BC (a quarter circle):

$$V = \frac{1}{4} \pi r^2 \times \text{length} = \frac{1}{4} \pi (0.9)^2 \times 0.3 \approx 0.190 \text{ m}^3$$

Weight of water:

$$W = \gamma \cdot V = 1000 \text{ kg/m}^3 \cdot 0.190 \text{ m}^3 \cdot 9.81 \text{ m/s}^2 \approx 1864 \text{ N}$$

4. Resultant Force (F_R):

- Magnitude of the resultant force:

$$F_R = \sqrt{F_H^2 + F_V^2} = \sqrt{1011^2 + 1864^2} \approx 2110 \text{ N}$$

5. Line of Action:

- The vertical distance from the bottom:

$$y_R = \frac{F_H \cdot h_{F_H} + F_V \cdot h_{F_V}}{F_R} = \frac{1011 \cdot 0.382 + 1864 \cdot 0.9}{2110} \approx 0.745 \text{ m}$$

Summary:

- Magnitude of the resultant force: $F_R \approx 2110 \text{ N}$
- Vertical distance from the bottom (line of action): $y_R \approx 0.745 \text{ m}$

This method confirms the resultant force and its line of action on the curved section BC of the conduit wall.