Answer Key: Civil Engineering Licensure Exam – Mock Exam (Day 16: Flow of Fluids – Bernoulli's Equation and Flow Continuity)

February 24, 2025

Answer Key

Section A: Multiple Choice Solutions

1. Conservation of mass principle: **(b) The continuity equation**
2. Bernoulli's equation is derived from: **(c) Conservation of energy**
3. The continuity equation states that: **(a) Constant**
4. Bernoulli's equation applies to: **(b) Steady, incompressible, inviscid flows**
5. If velocity doubles, pressure: **(b) Decreases**

Section B: Problem-Solving Solutions

1. Velocity at section 2 using the continuity equation:

$$A_1 V_1 = A_2 V_2$$

$$\pi(0.3/2)^2 \times 3 = \pi(0.2/2)^2 \times V_2$$

$$0.0707 \times 3 = 0.0314 \times V_2$$

$$V_2 = \frac{0.212}{0.0314} = 6.75 \text{ m/s}$$

2. Velocity at the smaller section:

$$A_1 V_1 = A_2 V_2$$

$$\pi(0.4/2)^2 \times 2.5 = \pi(0.2/2)^2 \times V_2$$

$$V_2 = \frac{0.314}{0.0314} = 10 \text{ m/s}$$

3. Pressure at constriction using Bernoulli's equation:

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

$$150 + \frac{1}{2}(1000)(4^2) = P_2 + \frac{1}{2}(1000)(6^2)$$

$$150 + 8000 = P_2 + 18000$$

$$P_2 = 58 \text{ kPa}$$

4. Velocity of water exiting at ground level:

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

$$0 + 1000(9.81)(15) + 0 = 0 + 0 + \frac{1}{2}(1000)V^2$$

$$V = \sqrt{2 \times 9.81 \times 15} = \sqrt{294.3} = 17.16 \text{ m/s}$$

5. Pressure at point B:

$$P_A + \frac{1}{2}\rho V_A^2 = P_B + \frac{1}{2}\rho V_B^2$$

$$200 + \frac{1}{2}(850)(2^2) = P_B + \frac{1}{2}(850)(5^2)$$

$$200 + 1700 = P_B + 10625$$

$$P_B = 94.75 \text{ kPa}$$