

1. correct answer: (b)

pail + H₂O → free fall ∴ no pressure difference between top of water level and level of the hole (or, "Mg" = 0 for the water above the hole level)

2. correct answer: (c)

since $A \cdot v = \text{constant}$, flow is faster in the 1-cm hose

$$3. P_{out} + \frac{1}{2} \rho_{air} v_{out}^2 + \cancel{\rho g y} = P_{in} + \frac{1}{2} \rho_{air} v_{in}^2 + \cancel{\rho g y}$$

$$\therefore \Delta P = P_{in} - P_{out} = \frac{1}{2} \rho_{air} v_{out}^2$$

$$v_{out} = \left(\frac{2 \Delta P}{\rho_{air}} \right)^{1/2} = \left(\frac{2 \cdot F/A}{\rho_{air}} \right)^{1/2}$$

$$\Rightarrow v_{out} = \left(\frac{2 \cdot 1.55 \times 10^5}{1.29 \cdot 10 \cdot 15} \right)^{1/2} = \underline{40 \text{ m/s}}$$

$$4. \text{Weight: } M_{total} g = \left[M_{chisel} + N \left(m_{balloon} + \rho_{He} \left(\frac{4}{3} \pi r_{balloon}^3 \right) \right) \right] g$$

$$= \left[32 + N \left(0.0035 + 0.18 \left(\frac{4}{3} \pi (0.21)^3 \right) \right) \right] (9.81)$$

$$= 314 + 0.10 N$$

$$F_B = N \rho_{air} \cdot \left(\frac{4}{3} \pi r_{balloon}^3 \right) g = 0.49 N$$

$$\therefore F_B = M_{total} g \Rightarrow 0.49 N - 0.10 N = 314$$

(exact answer is 806, but $\underline{N \sim 805}$ is acceptable)

$$5. V = (0.1)(0.04)(0.02) \text{ m}^3 = 8 \times 10^{-5} \text{ m}^3$$

$$V_u = (0.1)(0.04)(0.0165) \text{ m}^3 = 6.6 \times 10^{-5} \text{ m}^3$$

$$F_B = mg \Rightarrow \rho_F V_u g = \rho_w V g \Rightarrow \rho_w = \frac{V_u}{V} \rho_F$$

$$\therefore \rho_w = \frac{6.6}{8} \cdot 1000 \text{ kg/m}^3 = \underline{825 \text{ kg/m}^3}$$