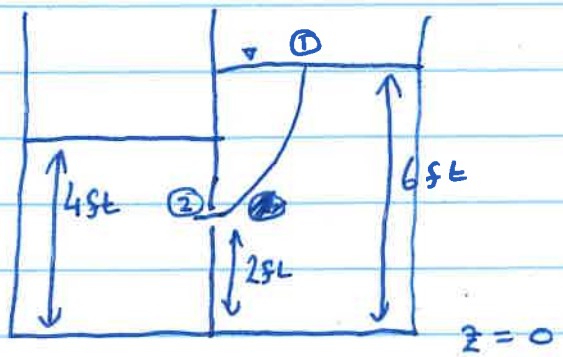
Sample Problem 4



Bernoulli

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g z_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g z_2$$

$P_2 = \rho g (4-2)$ [manometer / hydrostatic pressure on left side]

$P_1 = 0$ (atmospheric)

$v_1 \approx 0$ (negligible large free surface)

$v_2 = ?$

$z_1 = 6ft$

$z_2 = 2ft$

$$\therefore \quad 0 + 0 + 6\rho g = 2\rho g + \frac{1}{2}\rho v_2^2 + 2\rho g$$

$$\therefore \quad v_2 = \sqrt{4sg}$$

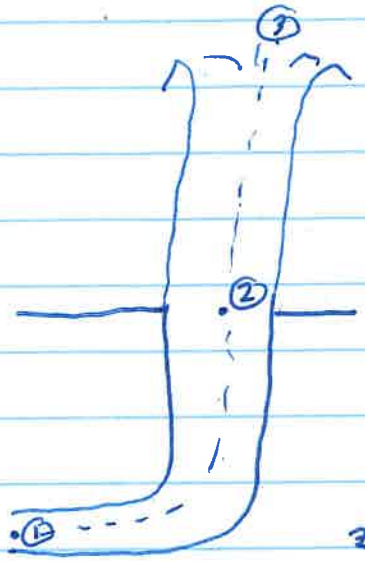
$$Q = v_2 A_2 = v_2 A_h C_c$$

$$= \sqrt{4sg}\left(\frac{\pi}{4}\right)\left(\frac{3}{12}\right)^2 0.63$$

$$= \sqrt{(4)(32.2)(1.94)}\left(\frac{\pi}{4}\right)\left(\frac{1}{4}\right)^2 0.63$$

$$= 0.49 \ ft^3/s$$

Sample Problem 5



$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g z_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g z_2 = p_3 + \frac{1}{2}\rho v_3^2 + \rho g z_3$$

$p_2 = p_3 = 0$ (atmospheric)

$v_2 = 16$ ft/s

$z_1 = 0$

$z_2 = 8$

$z_3 = h + 8$

$$Q = v_1 A_1 = v_2 A_2 \Rightarrow v_1 = v_2 \frac{A_2}{A_1} = v_2 \frac{D_2^2}{D_1^2}$$

$$\therefore v_1 = (16)\frac{6^2}{4^2} = 36 \text{ ft/s}$$

$$p_2 + \tfrac{1}{2}\rho v_2^2 + \rho g z_2 = p_3 + \tfrac{1}{2}\rho v_3^2 + \rho g z_3$$

$$0 + \tfrac{1}{2}\rho (16)^2 + 8\rho g = 0 + 0 + (8+h)\rho g$$

$$\therefore \quad h = \frac{16^2}{(2)g} = \frac{16^2}{2(32.2)} = 4 \text{ ft}$$

$$p_1 + \tfrac{1}{2}\rho v_1^2 + \rho g z_1 = p_3 + \tfrac{1}{2}\rho v_3^2 + \rho g z_3$$

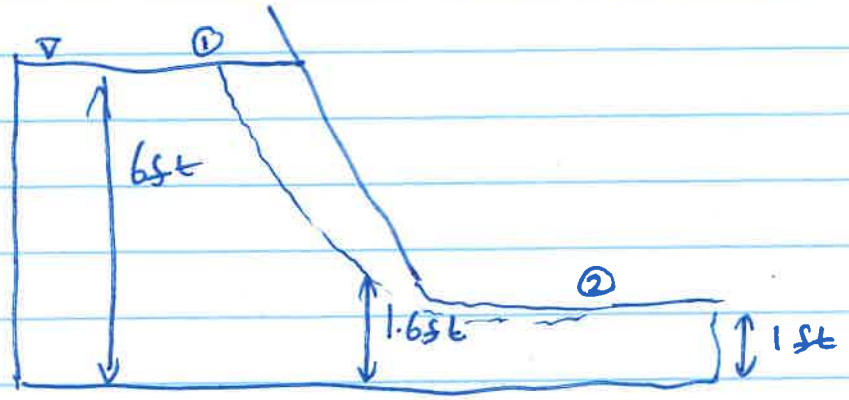
$$p_1 + \tfrac{1}{2}\rho (36)^2 + 0 = 0 + 0 + 12\rho g$$

$$p_1 = 12\rho g - \frac{(36)^2 \rho}{2}$$

$$= (12)(1.94)(32.2) - \frac{(36)^2 (1.94)}{2}$$

$$= -510 \text{ lb/ft}^2$$

Sample Problem 6



$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g z_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g z_2$$

Recognize this is the same as vertical sluice gate

$$p_1 = p_2 = 0$$

$$v_1 = \frac{Q}{A_1} = \frac{Q}{(6)(8)}$$

$$v_2 = \frac{Q}{A_2} = \frac{Q}{(1)(8)}$$

$$z_1 = 6$$

$$z_2 = 1$$

$$\therefore \quad 0 + \frac{1}{2}\rho\left(\frac{Q}{48}\right)^2 + \rho g 6 = 0 + \frac{1}{2}\rho\left(\frac{Q}{8}\right)^2 + \rho g$$

$$\therefore \quad \frac{Q^2}{48^2} + 12g = \frac{Q^2}{8^2} + 2g$$

$$10g = \frac{35Q^2}{48^2}$$

$$Q = \sqrt{\frac{(48^2)\,10\,g}{35}} \qquad = 145.67 \text{ ft}^3/\text{s}$$