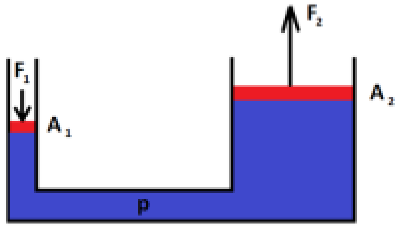
Q1.



Since we have: $F_2 = P = mg = 200 \times 9.8 = 1960$ (N)

Pascal's principle:

$$\frac{F_1}{A_1} = \frac{F_2}{A_2} \to F_1 = \frac{F_2 A_1}{A_2} = \frac{10 \times 10^{-4} \times 1960}{2} = 0.098 \text{ (N)}$$

Q2.

a)

Equation of continuity:

$$A_1 v_1 = A_2 v_2 \to v_2 = \frac{A_1 v_1}{A_2} = \frac{5 \times 2}{8} = 1.25 \text{ (m/s)}$$

b)

Bernoulli's equation:

$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$

$$\leftrightarrow 1.2 \times 10^5 + \frac{1}{2} \times 1000 \times 5^2 + 1000 \times 9.8 \times 10 = p_2 + \frac{1}{2} \times 1000 \times 1.25^2 + 0$$

$$\to p_2 = 1.32 \times 10^5 \text{ (Pa)}$$

Q3.

At 32°C, we have:

$$V_{glass} = V_{0glass}\left(1 + \beta_{glass}\Delta T\right) = 100\left(1 + 9.6 \times 10^{-6}(32 - 25)\right) = 100.00672 \text{ (cm}^3\text{)}$$

$$V_{gly} = V_{0gly}\left(1 + \beta_{gly}\Delta T\right) = 100\left(1 + 5.1 \times 10^{-4}(32 - 25)\right) = 100.35700 \text{ (cm}^3\text{)}$$

Therefore, the volume spill out is:

$$V = V_{gly} - V_{glass} = 100.35700 - 100.00672 = 0.35028 \text{ (cm}^3\text{)}$$

Q4.

Case 1: L_1 is the first layer:

$$k_1 A \frac{T_1 - T_{12}}{L_1} = k_2 A \frac{T_{12} - T_2}{L_2} \to 0.04 \frac{30 - T_{12}}{1.5} = 0.06 \frac{T_{12} - 22}{2.0}$$

$$\to T_{12} = 25.76 \text{ (°C)}$$

Case 2: L_2 is the first layer:

$$k_2 A \frac{T_1 - T_{12}}{L_2} = k_1 A \frac{T_{12} - T_2}{L_1} \to 0.06 \frac{30 - T_{12}}{2.0} = 0.04 \frac{T_{12} - 22}{1.5}$$

$$\to T_{12} = 26.24 \text{ (°C)}$$

Q5.

a)

$$n = \frac{pV}{RT} = \frac{5 \times 10^3 \times 2}{8.31 \times 300} = 4.01 \text{ (mol)}$$

b)

$$W = nRT \ln\frac{V_C}{V_B} = 4.01 \times 8.31 \times 300 \ln\frac{10}{2} = 16.09 \text{ (kJ)}$$