

2. $A = .45 \text{ m}^2$

$h = .9 \text{ m}$

$\rho_L = 997 \text{ kg/m}^3$

$\rho_V = .74 \text{ kg/m}^3$

Sol:

$$(h/3)(A)(\rho_L) + (h-h/3)(A)(\rho_V) = m_{\text{tot}}$$

$m_{\text{tot}} = 134.79 \text{ kg}$

$$\rho_f = \frac{m_{\text{tot}}}{(h A)} = 332.83 \frac{\text{kg}}{\text{m}^3}$$

$$P_i = (h/3)(A)(\rho_L)(9.81)\left(\frac{h/3}{2}\right) +$$

$$(h-h/3)(A)(\rho_V)(9.81)\left(\frac{h-h/3}{2}\right)$$

$$P_{\text{diff}} = P_f - P_i = \frac{m_{\text{tot}}}{A}(9.81)(h/2) - P_i = \underline{\underline{396.39 \text{ J}}}$$

3. $m = 1.2 \text{ kg}$

$\rho = 1000 \text{ kg/m}^3$

$v_z = 10 \text{ m/s}$

$h = 5 \text{ m}$

Sol:

$$\frac{1}{2}(1.2)(10)^2 + 1.2(9.81)(5) = U$$

$U = 118.86 \text{ J}$

- no energy loss to heat

4. $\dot{q} = -k \frac{dT}{dx} \Rightarrow \frac{dT}{dx} = -\dot{q}/k$

$\Rightarrow T(x) = -\dot{q}/k + C$

$S_1 + S_2 = 25 \text{ mm}$

$T_h - T_c = 50 \text{ K}$

$\dot{q} = 175 \text{ W/m}^2$

$k_1 = 81 \text{ W/mK}$

$k_2 = 98 \text{ W/mK}$

Sol: $T(0) = T_h = C_1 \quad T(0) = T_j = C_2$

$$T(S_1) = -\dot{q}/k_1(S_1) + T_h = T_j$$

$$T(S_2) = -\dot{q}/k_2(S_2) + T_j = T_c$$

$$\Rightarrow T_h - T_c = 50 = \dot{q}/k_2(25 - S_1) + \dot{q}/k_1(S_1)$$

$$\Rightarrow S_1 = \underline{14.29} \Rightarrow S_2 = \underline{10.71}$$

$$T_j - T_c = \dot{q}/k_2(10.71) = \underline{19.125}$$

$$T_h - T_j = \dot{q}/k_1(14.29) = \underline{30.873}$$

5.

$$m = 200 \text{ kg}$$

$$\dot{q} = 3.4$$

$$A = 2 \text{ m}^2$$

$$T_{\text{sys}} = 306.15 \text{ K}$$

$$T_{\text{out}} = 296.15 \text{ K}$$

sol:

$$\begin{aligned} \dot{Q} &= 3.4(2)(306.15 - 296.15) \\ &= 54.4 (3000) = \underline{\underline{46.807 \text{ kcal}}} \end{aligned}$$

6.

$$T_{\text{sys}} = 500 \text{ K}$$

$$L = .75 \text{ m}$$

$$D = .23 \text{ m}$$

$$\omega = 4000 \text{ rpm}$$

$$\tau = 5.1 \text{ Nm}$$

$$h = 45 \text{ W/m}^2 \text{ K}$$

sol:

$$\dot{Q} = h(L(\pi(D/2)^2))(T_{\text{sys}} - T_{\text{out}}) = \tau \frac{\omega}{60}$$

$$T_{\text{out}} = \underline{\underline{45.56 \text{ K}}}$$