

Camron Sitter and Shawn Newman

HW 3.4

14.17.) Air $T = 20^\circ\text{C}$

$$P = 85 \text{ kPa}$$

$$\phi = 85\%$$

$$P_g = P_{\text{sat}} = 2.3392 \text{ kPa}$$

$$h_g = 2537.4 \text{ kJ/kg}$$

a.) $P_a = P - P_v$

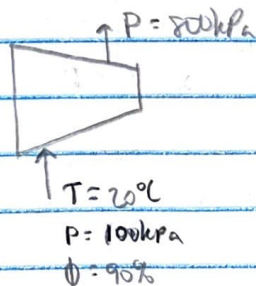
$$P_v = \phi P_g = (0.85)(2.3392) = 1.988 \text{ kPa}$$

$$P_a = 85 - P_v = \boxed{83.012 \text{ kPa}}$$

b.)
$$\omega = \frac{0.622 P_v}{P - P_v} = \frac{(0.622)(1.988)}{85 - 1.988} = \boxed{0.015 \text{ kg H}_2\text{O/kg dry air}}$$

c.)
$$h = h_a + \omega h_v \cong c_p T + \omega h_g = (1.005)(20) + (0.015)(2537.4) = \boxed{58.161 \text{ kJ/kg dry air}}$$

14.18.) Humid air



$$P_{g1} = P_{\text{sat},1} = 2.3392 \text{ kPa}$$

$$P_a = P - P_v$$

$$P_v = \phi P_g = (0.90)(2.3392) = 2.105 \text{ kPa}$$

$$P_a = 100 - 2.105 = 97.89 \text{ kPa}$$

$$w_1 = \frac{0.622 P_{v1}}{P_1 - P_{v1}} = \frac{0.622 (2.105)}{100 - 2.105} = 0.0134 \text{ kg H}_2\text{O/kg dry air}$$

$$w_1 = w_2$$

$$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1} \right)^{\frac{k-1}{k}}$$

$$T_2 = \left(\frac{800}{100} \right)^{\frac{1.4-1}{1.4}}$$

$$T_2 = 530.75^\circ\text{K} = 258.75^\circ\text{C}$$

$$\text{Table A-4} \rightarrow \text{Interpolate} \rightarrow P_{\text{sat}, T_2} = 4599.95 \text{ kPa} = P_{g2}$$

$$w_2 = \frac{0.622 P_{v2}}{P_2 - P_{v2}}$$

$$0.0134 = \frac{0.622 P_{v2}}{800 - P_{v2}}$$

$$10.72 - 0.0134 P_{v2} = 0.622 P_{v2}$$

$$10.72 = 0.622 P_{v2} + 0.0134 P_{v2}$$

$$10.72 = P_{v2} (0.6354)$$

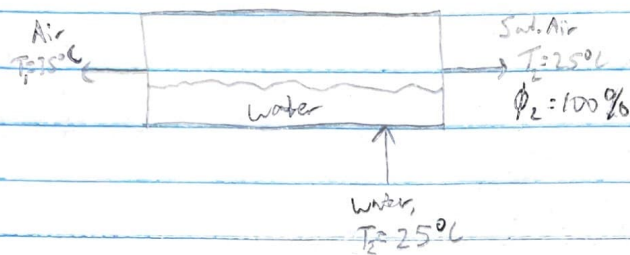
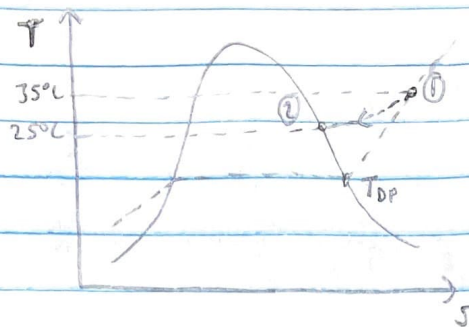
$$P_{v2} = 16.87 \text{ kPa}$$

$$\phi = \frac{P_{v2}}{P_{g2}} = \frac{16.87}{4599.55} = 0.00367 = \boxed{0.37\%}$$

14.32.) Air $T_1 = 35^\circ\text{C}$

$T_2 = 25^\circ\text{C}$ (Sat. mix)

$P = 98 \text{ kPa}$



$$C_p = 1.005 \text{ kJ/kg} \cdot \text{K}$$

$$\textcircled{1} T = 35^\circ\text{C}$$

$$P_{g1} = P_{\text{sat},1} = 5.6291 \text{ kPa}$$

$$h_{f,1} = 146.64 \text{ kJ/kg}$$

$$h_{g,1} = 2564.6 \text{ kJ/kg}$$

$$\textcircled{2} T_2 = 25^\circ\text{C}$$

$$P_{g2} = P_{\text{sat},2} = 3.1698 \text{ kPa}$$

$$h_{f,g,2} = 2441.7 \text{ kJ/kg}$$

$$h_v = 104.83 \text{ kJ/kg}$$

$$P_a = P - P_v$$

$$P_{v,2} = \phi P_{g,2} = (1.00)(3.1698)$$

$$P_{v,2} = 0.31698 \text{ kPa}$$

$$P_{a,2} = P - P_{v,2} = 98 - 0.31698 = 97.68 \text{ kPa}$$

$$w_2 = \frac{0.622 P_{g,2}}{P_2 - P_{g,2}}$$

$$w_2 = \frac{0.622 (3.1698)}{97.68 - 3.1698} = 0.022 \text{ kg H}_2\text{O/kg dry air}$$

$$w_1 = \frac{c_p(T_2 - T_1) + c_{w2} h_{g2}}{h_{g1} - h_{f1}}$$

$$w_1 = \frac{1.005(25 - 75) + 0.022(2441.7)}{2564.6 - 104.83}$$

$$w_1 = 0.0178 \text{ kg H}_2\text{O/kg dry air}$$

$$\phi = \frac{w_1 P_2}{(0.622 + w_1) P_g}$$

$$= \frac{(0.0178)(97.68)}{(0.622 + 0.0178) 5.6291}$$

$$\phi = 0.48 = 48\%$$

17.41) Air $P = 1 \text{ atm}$

$$T_{db} = 28^\circ\text{C}$$

$$T_{wb} = 20^\circ\text{C}$$

a.) $\phi = 49\%$

b.) $w = 0.0115 \text{ kg H}_2\text{O/kg dry air}$

c.) $h = 57.5 \text{ kJ/kg dry air}$

d.) $T_{op} = 16^\circ\text{C}$

e.) $P_v = wP$

$$(0.622 + w)$$

$$P_v = \frac{(0.0115)(101 \text{ kPa})}{(0.622 + 0.0115)}$$

$$P_v = 1.83 \text{ kPa}$$