Cameron Sitton and Shawn Newman HW 3.4

14.14.) Air $T = 20°C$

$P = 85\ kPa$

$\phi = 85\%$

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

$h_g = 2537.4\ kJ/kg$

a.) $P_a = P - P_v$

$P_v = \phi P_g = (.85)(2.3392) = 1.988\ kPa$

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

b.) $\omega = \frac{0.622 P_v}{P - P_v} = \frac{(0.622)(1.988)}{85 - 1.988} = \boxed{0.015\ kg_{H2O}/kg_{dry\ air}}$

c.) $h = h_a + \omega h_v \cong c_p t + \omega h_g = (1.005)(20) + (0.015)(2537.4)$

$= \boxed{58.161\ kJ/kg_{dry\ air}}$

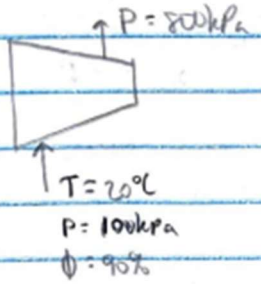
16 $m = \frac{PV}{RT} = \frac{105 \cdot 4}{0.287 \cdot 303} = 4.66\ kg$

$\omega = \frac{0.622 \cdot P_v}{P - P_v} = \frac{0.622 \cdot 4.164}{105 - 4.164} = 0.026\ kg_{water\ vapor}/kg_{dry\ air}$

$h = h_a + \omega \cdot h_g$

$h = 101.1 + 0.026 \cdot 2555.6 = 174.54\ kJ/kg_{dry\ air}$

14.18.) Humid air



$P_{g_1} = P_{sat_1} = 2.3392\ kPa$

$P_a = P - P_v$

$P_v = \phi P_g = (.90)(2.3392) = 2.105\ kPa$

$P_a = 100 - 2.105 = 97.89\ kPa$

$$\omega_1 = \frac{0.622 P_{v1}}{P_1 - P_{v1}} = \frac{0.622(2.105)}{100 - 2.105} = 0.0134 \text{ kg H}_2\text{O/kg dry air}$$

$\omega_1 = \omega_2$

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

$$\frac{T_2}{(20+273)} = \left(\frac{800}{100}\right)^{\frac{1.4-1}{1.4}}$$

$T_2 = 530.75\,^\circ K = 258.75\,^\circ C$

Table A-4 → Interpolate → $P_{sat,2} = 4599.95 \text{ kPa} = P_{g2}$

$$\omega_2 = \frac{0.622 P_{v2}}{P_2 - P_{v2}}$$

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

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

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

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

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

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

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$$\omega_s = \frac{0.622 \cdot P_{vs}}{P - P_{vs}} = \frac{0.622 \cdot 3.17}{95 - 1.938} = 0.013$$

$$\omega_1 = \frac{c_p(t_2 - t_1) + \omega_2 \cdot h_{g2}}{h_{g1} - h_{f1}} = \frac{1.005(10 - 25) + 0.013 \cdot 2440}{2546.5 - 71.36} = 0.0092$$

$$\Phi = \frac{\omega_1 \cdot P}{(0.622 + \omega_1) P_{g1}} = \frac{0.0092 \cdot 95}{(0.622 + 0.013) 3.17} = 0.46$$

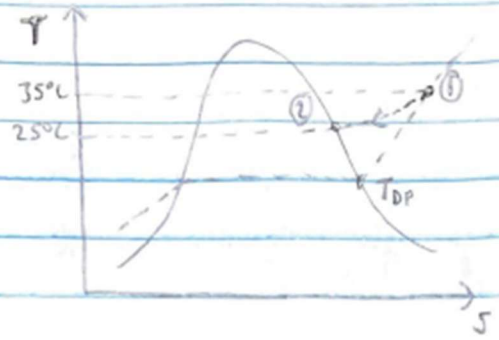
$$h_1 = (c_p \cdot T_1) + (\omega_1 \cdot h_{g1}) = (1.005 \cdot 25) + (0.0092 \cdot 2546.5)$$

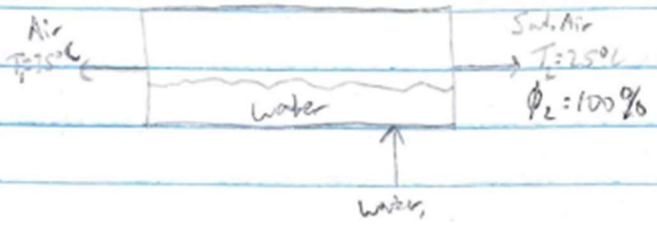
$$h_1 = 49.83 \text{ kJ/kg}$$

14.32.) Air $T_1 = 35°C$

$T_2 = 25°C$ (Sat. min)

$P = 98 kPa$





Water

$C_p = 1.005 \text{ kJ/kg·K}$

① $T = 35°C$

$P_{g_1} = P_{sat,1} = 5.6291 \text{ kPa}$

$h_{f_1} = 146.64 \text{ kJ/kg}$

$h_{g_1} = 2564.6 \text{ kJ/kg}$

② $T_2 = 25°C$

$P_{g_2} = P_{sat,2} = 3.1698 \text{ kPa}$

$h_{fg_2} = 2441.7 \text{ kJ/kg}$

$h_2 = 104.83 \text{ kJ/kg}$

$P_a = P - P_v$

$P_{v_2} = \phi P_g = (.100)(3.1698)$

$P_{v_2} = 0.31698 \text{ kPa}$

$P_{a_2} = P - P_v = 98 - 0.31698 = 97.68 \text{ kPa}$

$$\omega_2 = \frac{0.662\, P_{g_2}}{P_2 - P_{g_2}}$$

$$\omega_2 = \frac{0.662(3.1698)}{97.68 - 3.1698} = \boxed{0.022 \text{ kg H}_2\text{O/kg dry air}}$$

$$\omega_1 = \frac{c_p(T_2 - T_1) + \omega_2 h_{g_2}}{h_{g_1} - h_{f_1}}$$

$$\omega_1 = \frac{1.005(25-35) + 0.022(2441.7)}{2564.6 - 104.83}$$

$$\omega_1 = 0.0178 \text{ kg}_{H_2O}/\text{kg}_{dry\ air}$$

$$\phi = \frac{\omega_1 P_2}{(0.622 + \omega_1) P_{g_1}}$$

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

$$\phi = 0.47 = \boxed{47\%}$$

39 From psychrometric chart

a = 0.00962 kg/kg

b = 48.6 kJ/kg

c = 51.7%

d = 13.5°C

e = 0.85 m³/kg

14.41) Air $P = 1\ atm$

$T_{db} = 28°C$

$T_{wb} = 20°C$

a.) $\phi = 49\%$

b.) $\omega = 0.0115\ kg_{H2O}/kg_{dry\ air}$

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

d.) $T_{DP} = 16°C$

e.) $P_v = \frac{\omega P}{(0.622 + \omega)}$

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

$P_v = 1.83\ kPa$

43 from psychometric chart

$\phi = 61.5\%$

$h = 0.01875$

$\hat{c} = 80.3\ kJ/kg$

$T = 77.72°F$

$c = 2.96\ kPa$