Hw 3.9 CH 14 # 14, 16, 18, 28

14.14) Given: $T = 20°C$ $P = 85\ kPa$ $\phi = 55\%$

a) $P_v = \phi P_g = \phi P_{sat@20°C}$

$= (.55)(2.3392\ kPa)$

$P_v = 1.288\ kPa$

b) $w = \frac{.622 P_v}{P - P_v} = \frac{(.622)(1.288\ kPa)}{(85 - 1.288\ kPa)}$

$= .0149\ kg\ H_2O$ / kg dry air.

c) $h = h_a + w h_v$

$= c_p T + w h_g$

$= (1.005\ kJ/kg \cdot °C)(20°C) + (.0149)(2537.4\ kJ/kg)$

$= 57.90\ kJ/kg\ dry\ air$

14.16) Given: $T = 35°C$ $P = 105\ kPa$ $V = 8\ m^3$

a) $m_a = \frac{P_a V}{R_a T} = \frac{[105 - 4.246\ kPa](8)}{(.287\ kJ/kg\,K)(35 + 273.15\ K)} = 9.264\ kg$

b) $P_v = P_g = P_{sat\ @\ 35°C} = 4.246\ kPa$

$w = \frac{.622 P_v}{P - P_v} = \frac{(.622)(4.246\ kPa)}{105 - 4.246\ kPa} = .0262\ kg\ H_2/kg$ dry air.

c) $h = h_a + w h_v$

$= c_p T + w h_{g\ @\ 35°C}$

$= (1.005\ kJ/kg \cdot °C)(35°C) + (.0262)(2565.6\ kJ/kg)$

$= 97.1\ kJ/kg$ dry-air.

14.18) $\phi_{outlet} = ?$ $T = 20°C$ $\phi = 90$ $P_1 = 100 kPa$ $P_2 = 800 kPa$

Inlet:

$$P_{v,1} = \phi_1 P_{g1} = \phi_1 P_{sat\ @20} = (.90)(2.3392 kPa) = 2.105 kPa$$

$$w_2 = w_1$$

$$w_2 = \frac{.622 P_{v,1}}{P - P_{v,1}}$$

$$= \frac{(.622)(2.105 kPa)}{100 - 2.105 kPa} = .0134 \ kg H_2O / kg\ dry\ air$$

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

$$= 293K \left(\frac{800 kPa}{100 kPa}\right)^{.4/1.4} = 531 K$$

$$P_{v,2} = \frac{w_2 P_2}{w_2 + .622} = \frac{(.0134)(800)}{(.0134) + .622}$$

$$P_{v,2} = 16.87 kPa$$

$$\phi_2 = \frac{P_{v,2}}{P_{2sat}} = \frac{16.87}{4542} = .0037 = .37\%$$

P_{2sat} ← from saturated tables

14.28) Given: $T_{dry} = 25°C$ $T_{wet} = 17°C$ $P = 95 kPa$

a)

$$W_1 = \frac{C_p(T_2 - T_1) + W_2 h_{fg2}}{h_{g1} - h_{f2}}$$

$$W_2 = \frac{.622 P_{g2}}{P_2 - P_{g2}} = \frac{(.622)(1.938 kPa)}{95 - 1.938 kPa}$$

$$W_2 = .01295 \text{ kg } H_2O / \text{kg dry air}$$

$$W_1 = \frac{(1.005 kJ/kg°C)(17°C - 25°C) + (.01295)(2460.6 kJ/kg)}{2546.5 - 71.36 kJ/kg}$$

$$W_1 = .00963 \text{ kg } H_2O / \text{kg dry air}$$

b)

$$\phi_1 = \frac{W_1 P_1}{(.622 + W_1) P_{g1}} = \frac{(.00963)(95 kPa)}{(.622 + .00963)(3.1690 kPa)} = .457$$

$$= 45.7\%$$

c) $h_1 = h_{a1} + W_1 h_{v1}$

$$= C_p T_1 + W_1 h_{g1}$$

$$= (1.005 kJ/kg°C)(25°C) + (.00963)(2546.5 kJ/kg)$$

$$h_1 = 49.63 \text{ kJ/kg dry air}$$