HW 3.4

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14-14) $T = 20^\circ C$, $P = 85 kPa$ $\varnothing = 85\% = 0.85$

A) $P_v = \varnothing (P_{sat})$

$= 0.85(2.33)$

$= 1.98$ kPa

$P_{dry} = P - P_v$

$= 85 - 1.98$

$P_{dry} = 83.012$ kPa

B) $w = 0.622\left(\frac{P_v}{P - P_v}\right)$

$w = 0.622(0.02395)$

$= 0.01489$ kg / kg dry air

C) $h = 1.005T + w(2500 + 1.88T)$

$1.005(20) = 20.10$

$2500 + 1.88(20)$

$= 2537.6$

$h = 20.10 + 37.79$

$h = 57.89$ kj / kg dry air

14-16) $V = 8 m^3$, $T = 30°C$, $P = 105$ kPa

$P_{sat} = 4.241$ kPa

$P_{da} = P - P_v$

$= 105 - 4.241$

$= 100.759$ kPa

$= \frac{100.76(8)}{0.287(303)}$

$m_{da} = 9.27$ kg

B) $w = 0.622\left(\frac{P_v}{P - P_v}\right)$

$w = 0.622\left(\frac{4.241}{100.76}\right)$

$w = 0.0262$ kg/kg dry air

C) $h = 1.005T + w(2500 + 1.88T)$

$= 1.005(30)$

$= 30.15$

$2500 + 1.88(30) = 2556.4$

$0.0262(2556.4) = 66.98$

$h = 30.15 + 66.98$

$h = 97.1$ kJ/kg dry air

14-18) $P_1 = 100\ kPa$, $T_1 = 20^\circ C = 293k$

$\phi_1 = 0.90$

$P_2 = 800\ kPa$

$P_v = \phi_1 (P_{sat})$

$= 0.9(2.339)$

$= 2.105\ kPa$

$\omega = 0.622 \left(\frac{P_v}{P_1 - P_{v1}} \right)$

$= 0.622 \left(\frac{2.105}{100 - 2.105} \right)$

$= 0.01338$

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

$T_2 = 293 (8)^{0.286}$

$(8)^{0.286} = 1.81$

$T_2 = 293 (1.81)$

$= 530k = 257^\circ C$

$P_{v2} = \frac{\omega P_2}{0.622 + \omega}$

$P_{v2} = \frac{0.01338(800)}{0.622 + 0.0133}$

$= 16.85\ kPa$

$P_{sat_2} = 4700 kPa$

$\phi_2 = \frac{P_{v2}}{P_{sat_2}} = \frac{16.85}{4700}$

$= 0.0036$

$\phi = 36\%$

14-28) $P = 95\ kPa \quad T_{db} = 25^{\circ}C \quad T_{wb} = 17^{\circ}C$

$$\omega = 0.622\left(\frac{P_{sat}}{P - P_{sat}}\right)$$

$$= 0.622 \cdot \left(\frac{1.93}{95 - 1.93}\right)$$

$$= 0.0129$$

$$h = 1.005T_{wb} + \omega(2500 + 1.88T_{wb})$$

$$h = 1.005(17) + 0.0129(2500 + 1.88(17))$$

$$\boxed{h = 49.8\ kJ/kg\ dry\ air}$$

$$h = 1.005T_{db} + \omega(2500 + 1.88T_{db})$$

$$49.75 = 1.005(25) + \omega(2500 + 1.88(25))$$

$$\omega = \frac{49.75 - 25.125}{2547}$$

$$\boxed{\omega = 0.0097\ kg/kg\ dry\ air}$$

$$P_v = \frac{\omega P}{0.622 + \omega}$$

$$P_v = \frac{0.00967(95)}{0.622 + 0.00967}$$

$$P_v = 1.454\ kPa$$

$$\phi = \frac{P_v}{P_{sat}} = \frac{1.454}{3.17} = 0.458$$

$$\boxed{\phi = 45.8\%}$$

14-32) $T_1 = 35^\circ C$

$T_2 = 25^\circ C$

$P = 98 kPa$

$$\omega_2 = 0.622 \cdot \frac{P_{sat}}{P - P_{sat2}} = 0.622 \left(\frac{3.17}{98 - 3.17} \right)$$

$$\omega_2 = 0.622 (0.0334)$$

$$\omega_2 = 0.0208$$

$$h_1 = h_2 + (\omega_2 - \omega_1) h_f (T_2)$$

$$h_2 = 1.005(25) + \omega_2 (2500 + 1.88(25))$$

$$= 25.125 + 52.98$$

$$= 78.11$$

$h_f (25^\circ C) = 104.8 \ kJ/kg$

$$h_1 = 1.005(35) + \omega_1 (2500 + 1.88(35))$$

$$= 35.175 + \omega_1 (2565.8)$$

$$35.175 + 2565.8 \omega_1 = 78.11 + (0.0208 - \omega_1)(104.8)$$

$$= 80.29 - 104.8 \omega_1$$

$$2670.6 \omega_1 = 45.115$$

$$\boxed{\omega_1 = 0.0169 \ kg/kg \ dry \ air}$$

$$P_v = \frac{\omega_1 P}{0.622 + \omega_1} = \frac{0.0169 (98)}{0.622 + 0.0169}$$

$P_v = 2.59 \ kPa$

$$\phi = \frac{P_v}{P_{sat}} = \frac{2.59}{5.62} = 0.461$$

$$\boxed{\phi = 46.1 \%}$$

14-39) $P = 1\ atm = 101.3\ kPa$

$T_{db} = 24°C$

$T_{wb} = 17°C$

A) $\omega = 0.0105\ kg/kg\ dry\ air$

b) $h = h_{sat}@17°C$

$h = 50\ kJ/kg\ dry\ air$

c) $\phi = 55\%$

D) $T_{dp} = 13°C$

E) $v = 0.86\ m^3/kg\ dry\ air$

14-41) $T_{db} = 28°C$
$T_{wb} = 20°C$

A) $\phi = 60\%$

B) $w = 0.013$ kg / kg dry air

C) $h = h_{sat}$ @ 20°C
$h = 55$ kJ / kg dry air

D) $T_{dp} = 17°C$

E) $P_v = 2.1$ kPa

(4-43) $T_{db} = 90°F$

$T_{dp} = 75°F$

$P_v = P_{sat}\ (75°F)$

$\boxed{P_v = 0.88\ psia}$

$w = 0.622 \cdot \frac{P_v}{P - P_v} = 0.622 \left(\frac{0.88}{14.7 - 0.88}\right)$

$w = 0.622\ (0.0637)$

$\boxed{w = 0.0396\ lbm/lbm\ dry\ air}$

$P_{sat\ 90°F} = 1.42\ psia$

$\phi = \frac{P_v}{P_{sat}} = \frac{0.88}{1.42} = 0.62$

$\boxed{\phi = 62\%}$

$h = 0.24 T_{db} + w(1061 + 0.444 T_{db})$

$h = 0.24(90) + 0.0396(1061 + 0.44(90))$

$h = 21.6 + 43.6$

$\boxed{h = 65.2\ Btu/lbm\ dry\ air}$

$\boxed{T_{wb} = 80°F}$