14-14

$T_2 = 20°C \quad P_{sat} = P_g = 2.3392\ kPa$

$\phi = \frac{P_v}{P_g} \Rightarrow P_v = (0.85)(2.3392)$

$P_v = 1.988\ kPa$

$P_a = P - P_v \Rightarrow P_a = 85 - 1.988$

$\boxed{P_a = 83.012\ kPa}$

$\phi = \frac{\omega P}{(0.622+\omega)(P_g)} \Rightarrow 0.85 = \frac{\omega(85)}{(0.622+\omega)(2.3392)}$

$\Rightarrow 1.988 = \frac{\omega(85)}{0.622+\omega} \Rightarrow 1.237 + 1.988\omega = \omega(85)$

$\Rightarrow 1.237 = 83.012\omega$

$\boxed{\omega = 0.0149\ kg\ H_2O / kg\ air}$

$h_g = 2537.4\ kJ/kg \qquad c_p = 1.005\ kJ/kg \cdot K$

$h = h_a + \omega h_g = c_p t + \omega h_g \Rightarrow (1.005)(20) + (0.0149)(2537.4)$

$\Rightarrow 20.1 + 37.84$

$\boxed{h = 57.94\ kJ/kg}$

14-16

$$m_a = \frac{(P - P_v) V_a}{R_a T} \Rightarrow \frac{(105 - 4.2469)(8)}{(0.287)(303.15)}$$

$$\boxed{m_a = 9.265 \text{ kg}}$$

$$\omega = \frac{0.622 (P_v)}{P - P_v} \Rightarrow \frac{0.622 (4.2469)}{(105 - 4.2469)}$$

$$\boxed{\omega = 0.0262 \text{ kg } H_2O / \text{kg dry air}}$$

$$h = h_a + \omega h_v \Rightarrow h = c_p T + \omega h_g$$

$$\Rightarrow h = (1.005)(30) + (0.0262)(2555.6)$$

$$\boxed{h = 97.1 \text{ kJ/kg}}$$

14-181

$$T_2 = T_1\left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}} \Rightarrow (20+273)\left(\frac{800}{100}\right)^{\frac{1.4-1}{1}}$$

$$= 530.7K - 273 = 257.7°C$$

$$P_v = \phi P_{sat} \Rightarrow P_{1v} = \phi_1 P_{1sat} \Rightarrow P_{1v} = 0.9(2.3392)$$

$$P_{1v} = 2.105 kPa$$

$$\omega_2 = \omega_1 = \frac{0.622(P_{1v})}{P_1 - P_{1v}} \Rightarrow \frac{0.622(2.105)}{100 - 2.105} = 0.0134 kg/kg \text{ of dry air}$$

$$\omega_2 = \frac{0.622(P_{2v})}{P_2 - P_{2v}} \Rightarrow 0.0134 = \frac{0.622(P_{2v})}{800 - P_{2v}}$$

$$\Rightarrow 0.6354 P_{2v} = 10.72 \qquad P_{2v} = 16.87 kPa$$

$$\phi_2 = \frac{P_{2v}}{P_{2sat}} \Rightarrow \frac{16.87}{4530} = 0.0037 \Rightarrow \boxed{0.37\%}$$

14-28]

$$\omega_2 = \frac{0.622(P_{g2})}{P_2 - P_{g2}} \Rightarrow \frac{.622(1.938)}{95 - 1.938} = \boxed{0.01295 \text{ kg } H_2O / \text{kg dry air}}$$

$$\omega_1 = \frac{c_p(T_2 - T_1) + \omega_2 h_{fg2}}{h_{g1} - h_{f2}}$$

$$\Rightarrow \frac{1.005(17 - 25) + 0.01295(2460.64)}{2546.5 - 71.36}$$

$$\omega_1 = 0.00963 \text{ kg } H_2O / \text{kg dry air}$$

$$\phi_1 = \frac{\omega_1 P_1}{(0.622 + \omega_1) P_{g1}} \Rightarrow \frac{(0.00963)(45)}{(0.622 + 0.00963)(3.1698)} = 0.457 = \boxed{45.7\%}$$

$$h_1 = h_{a1} + \omega_1 h_{v1} \Rightarrow h_1 = c_p T_1 + \omega_1 h_{g1}$$

$$\Rightarrow 1.005 \times (25 + 273) + 0.0097(2546.5) = \boxed{324.2 \text{ kJ/kg of dry air}}$$

14-32

$$h_1 + (\omega_2 - \omega_1) h_w = h_2$$

$$h_1 + (0.02079 - \omega_1)(104.83) = 78.11$$

trial + error approach

$h_1 = 77.66$ kJ/kg of dry air

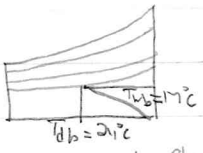
$\omega_1 = 0.01654$ kg H_2O/kg dry air

$\phi_1 = 0.451$

Jordan Whitaker

HW 3.4

(39) a) @ dry bulb temp: 24°C
wet bulb temp: 17°C
specific humidity = 0.0092 $\frac{kg\ H_2O}{kg\ Dry\ air}$ (psychometric chart)



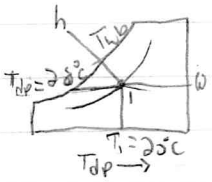
b) @ T_{wb} = 17°C
T_{db} = 24°C
Enthalpy = 47.6 kJ/kg dry air

c) @ T_{wb} = 17°C
T_{db} = 24°C
Rel. humidity = 49.6%

d) @ T_{wb} = 17°C
T_{db} = 24°C
Rel. hum. = 49.6%
Dew point temp. = 12.8°C

e) @ T_{wb} = 17°C
T_{db} = 24°C
Specific Vol. of air = 0.855 m^3/kg dry air

(41)



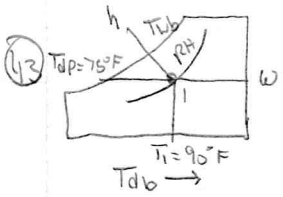
a) ϕ = 48%
b) ω = 0.0113 kg H_2O/kg dry air
c) h = 57 kJ/kg dry air
d) T_{dp} = 16°C
e) $P_v = \phi P_{sat}$ @ 28°C

$y_2 = P_{sat}$ @ 28°C $= \frac{(x_2 - x_1)(y_3 - y_1)}{(x_3 - x_1)} + y_1$ (y_1, y_3 } Sat. water temp table

$= \frac{(28-25)(4.2469 - 3.1698)}{(30-25)} + 3.1698$

= 1.88 kPa

(43)



a) $\phi = 61\%$

b) $\omega = 130 \text{ grains } H_2O / 1 \text{ lbm}$ | $\frac{0.0001428571 \text{ lbm } H_2O / 1 \text{ lbm dry air}}{1 \text{ grains } H_2O / 1 \text{ lbm dry air}}$

$\omega = 0.018571 \text{ lbm } H_2O / 1 \text{ lbm dry air}$

c) $h = 42.7 \text{ Btu/lbm dry air}$

d) $T_{wb} = 79°F$

e) @ 90°F, $P_g = 0.699424 \text{ psia}$ } saturation pressure table

$$\phi = \frac{m_v}{m_g} \Rightarrow \frac{P_v V / R_v T}{P_g V / R_v T}$$

$$\phi = \frac{P_v}{P_g}$$

$$P_v = \phi P_g$$

$$= 0.61 (0.699424)$$

$$= 0.426641 \text{ psia}$$

(60)

$\dot{m}_{vapor} = 4 (\dot{m}_a)$

$= 4 (0.25)$

$\dot{m}_{vapor} = 1 \text{ kg/day}$

$\dot{Q} = \dot{m}_{vapor} h_{fg}$

$= 1 (2450)$

$\dot{Q} = 2450 \text{ kJ/day}$

(67)

psychometric chart @ 1 atm

$\omega_1 = 0.016 \text{ kg } H_2O / \text{kg dry air}$

$h_1 = 76.25 \text{ kJ/kg dry air}$

$V_1 = 0.895 \text{ m}^3/\text{kg dry air}$

$\dot{m}_a = \frac{1}{V_{a1}} \forall_1 A_1 \Rightarrow \frac{1}{V_{a1}} \times \frac{\pi}{4} D_1^2$

$= \frac{1}{0.895} \cdot \frac{\pi}{4} (0.3)^2$

$\dot{m}_a = 0.0792 \text{ kg/s}$

$\dot{m}_a (h_1 + \frac{V_1^2}{2} + g z_1) + \dot{W}_{in} = \dot{m}_a (h_2 + \frac{V_2^2}{2} + g z_2) + \dot{Q}_{out}$

$\dot{m}_a h_1 = \dot{m}_a h_2 + \dot{Q}_{out}$

$h_2 = \frac{\dot{m}_a h_1 - \dot{Q}_{out}}{\dot{m}_a}$

$= \frac{0.0792 (76.25) - 750 (\frac{1}{60})}{0.0792}$

$h_2 = 60.416 \text{ kJ/kg dry air}$

$\omega_1 = \omega_2$ (psychometric chart w/ $h_2 + \omega_2$)

$T_{db2} = 26.3°C$

$\phi_2 = 74\%$

$V_{a2} = 0.857 \text{ m}^3/\text{kg}$

a) Exit temp = 26.3°C

b) $\phi_2 = 74\%$

c) $\dot{m}_a = \frac{V_2 A_2}{v_{a2}}$

$V_2 = \frac{v_{a2} \dot{m}_a}{A_2}$

$= \frac{0.87(124.28)}{\frac{\pi}{4}(0.3)^2}$

$V_2 = 17.5 \text{ m/s}$

(17) @ inlet section-1

$T_{db1} = 90°F$, $\phi_1 = 0.9$ } $W_1 = 0.028$ lbm H_2O/lbm dry air

$h_1 = 52.4$ Btu/lbm dry air

Exit section-2

$T_{db2} = 50°F$

$\phi_2 = 100\%$

$T_{db2} = 50°F$ => @ Sat. temp. table, $h_F = 18.08$ Btu/lbm

@ Section-2

$T_{db2} = 50°F$

$\phi_2 = 100\%$

$\omega_2 = 0.0078$ lbm H_2O/lbm dry air

$h_2 = 20.5$ Btu/lbm dry air

$\dot{m}_a \omega_1 = \dot{m}_a \omega_2 + \dot{m}_w$

$\frac{\dot{m}_w}{\dot{m}_a} = \omega_1 - \omega_2$

$\Delta\omega = \omega_1 - \omega_2$

$= 0.026 - 0.0078$

$\Delta\omega = 0.0202$ lbm H_2O/lbm dry air