14-60

Given
- .25 Kg moisture / person - shower
- .05 Kg moisture / person - bath
- Family of 4, each takes 1 shower/day
- heat of vaporization of water = 2450 KJ/Kg

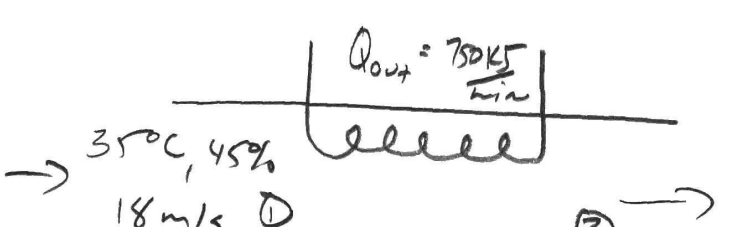
FIND
Latent heat load on A/C due to showers per day

SOL

Total mass per day = .25 Kg · 4 = 1 Kg / day

$\dot{Q} = \dot{m} h_{fg} = 1\ Kg\ (2450\ KJ/Kg) = \boxed{2450\ KJ/day}$

14-67 GIVEN 1 atm, 30 cm diameter pipe



$Q_{out} = \frac{750\ kJ}{min} \left| \frac{1\ min}{60\ sec} \right.$

$Q_{out} = -12.5\ kJ/sec$

FIND a) T_{exit} b) Exit relative humidity (ϕ)

c) exit velocity

$\dot{m}_a = \rho_a V A$

$= \frac{1}{.895} \left(.071 m^2\right) \frac{18 m}{s}$

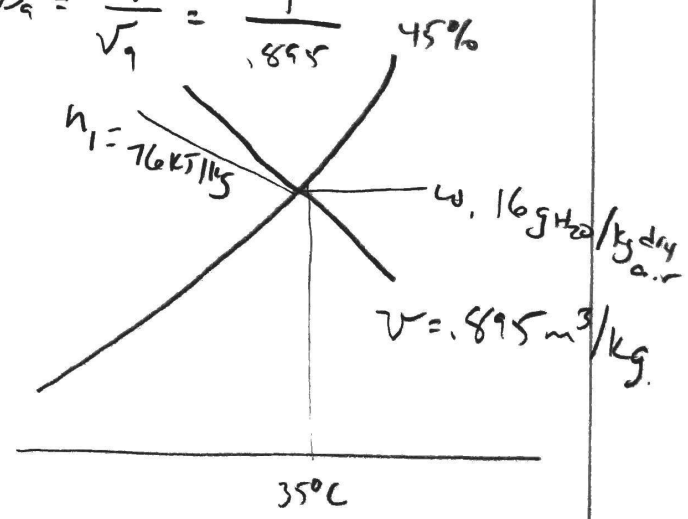
$\dot{m}_a = 1.43\ kg/s$

$V = 18 m/s$

$A = \pi (15)^2 = 706.5\ cm^2 \left| \frac{1 m^2}{100^2 cm^2} \right.$

$A = .071\ m^2$

$\rho_a = \frac{1}{v_1} = \frac{1}{.895}$



$Q_{out} = \dot{m}_{a.r} (h_2 - h_1)$

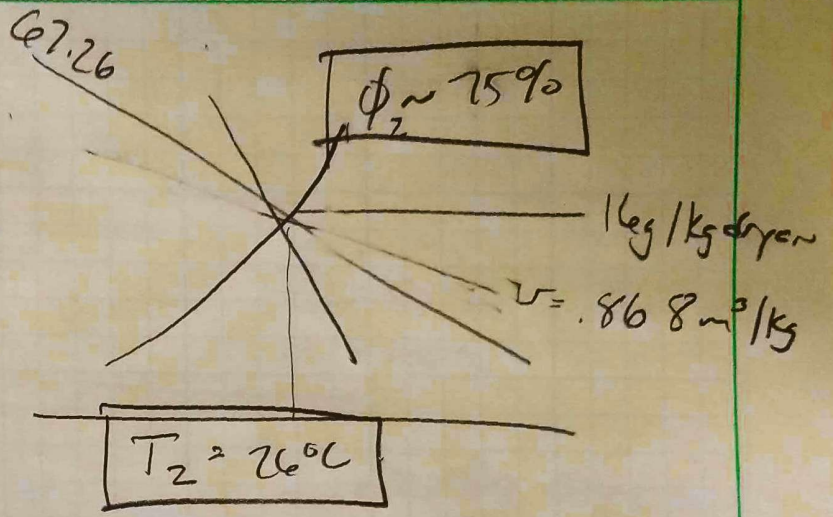
$Q_{out} = \dot{m}_{a.r} h_2 - \dot{m}_a h_1$

$h_2 = \frac{\dot{m}_a h_1 + Q_{out}}{\dot{m}_a}$

$= \frac{\left(\frac{1.43\ kg}{s}\right)\left(\frac{76\ kJ}{kg}\right) - 12.5\ kJ/s}{1.43\ kg}$ s

$= 67.26\ kJ/kg$

14-67 cont



$W_2 = W_1$

$\Rightarrow W_2 = 16 g/kg_{dryair}$

$\dot{m}_2 = \rho_2 V A$

$V = \dfrac{\dot{m}_2}{\rho_2 A}$

$= \dfrac{1.43 \frac{kg}{s}}{1.15 \frac{kg}{m^3} \cdot .071 m^2}$

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

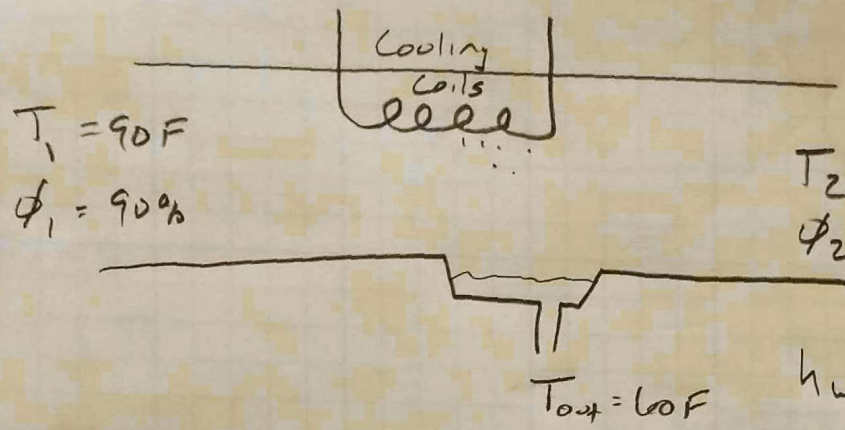
$\rho_2 = \frac{1}{v_2} = \frac{1}{.868}$

$\rho_2 = 1.15 kg/m^3$

$\dot{m}_2 = \dot{m}_1 = 1.43 kg/s$

$A = .071 m^2$

14-77 GIVEN 1 ATM

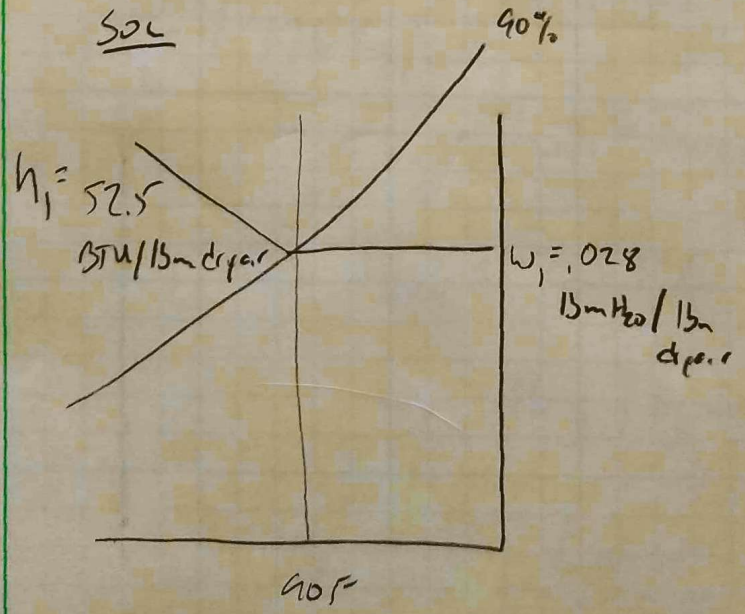


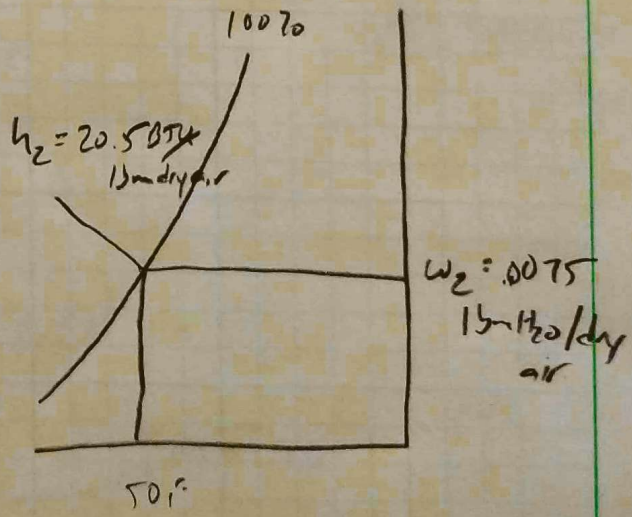
FIND

a) amount of water removed in lbm/lbm dry air

c) Cooling requirement in BTU/lbm dry air

SOL





$\Delta w = w_1 - w_2 = .028 - .0075 =$ **.0205 lbm H_2O/lbm dry air**

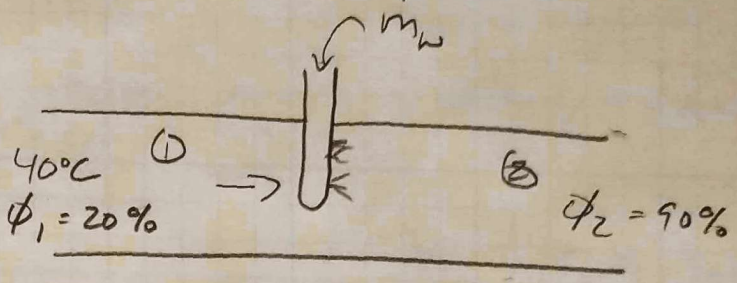
$\frac{Q_{out}}{\dot{m}_a} = h_1 - h_2 - (\Delta w) h_w$

$= 52.5 - 20.5 - .0205(24.08)$

$= 31.42$ BTU/lbm dry air

14-93

Given: 1 ATM



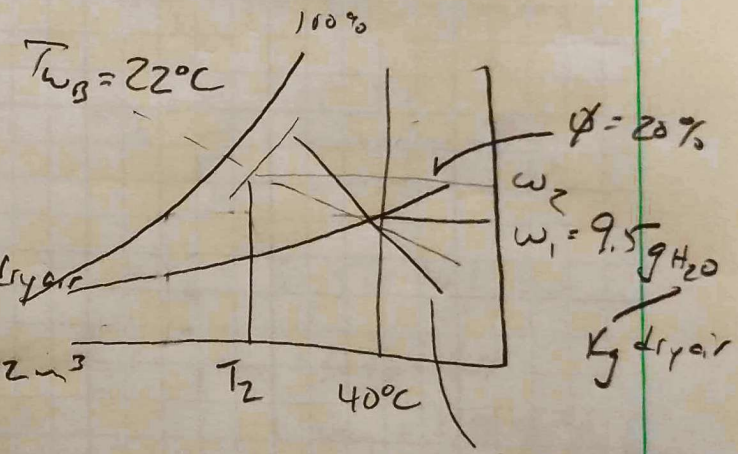
$\forall_a = 7\ m^3/min$

FIND

a) T_2

b) $\dot{m}_w$

SOL



$\dot{m}_1 = \forall_1 \rho_1 = \frac{\forall}{\nu} = \frac{7\ m^3}{min} \Big| \frac{Kg\ dry\ air}{.9002\ m^3}$

$\dot{m}_1 = 7.776\ Kg/min$

$T_{WB1} = T_{WB2}$

$\Rightarrow T_{DB2} = 23.1°C$

$\omega_2 = 16\ g / Kg\ dry\ air$

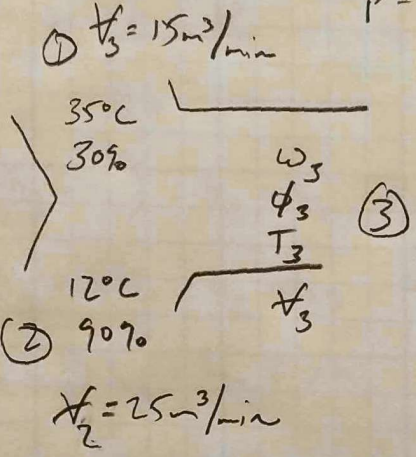
$\dot{m}_w = \omega_2 - \omega_1(\dot{m}_1) = (.0095 - .0016)\ 7.776$

$\boxed{\dot{m}_w = .0543\ Kg/min}$

14-100

Given Data in drwg, Assume mixture is steady + adiabatic

$P = 1$ atm



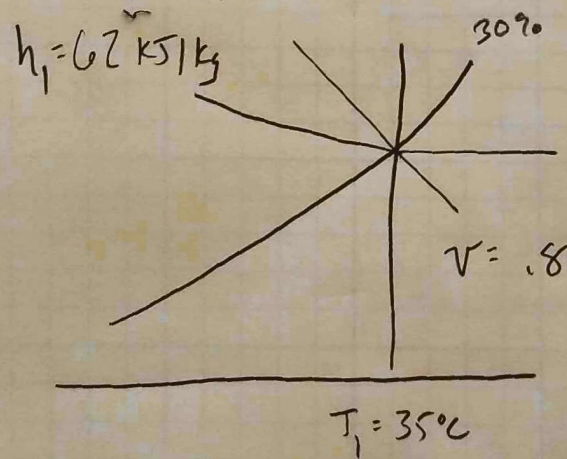
$$\dot{m}_1 = \frac{\forall_1}{v_1} = \frac{15 m^3/min}{.888 m^3/Kg\ dryair}$$

$$\dot{m}_1 = 16.89\ Kg/min$$

$$\dot{m}_2 = \frac{\forall_2}{v_2} = \frac{25 m^3/min}{.818 m^3/Kg}$$

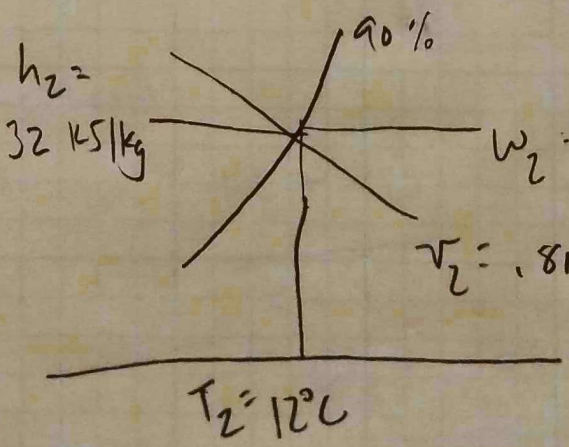
$$\dot{m}_2 = 30.56\ Kg/min$$

From Psychrometric Chart



$$\dot{m}_3 = \dot{m}_2 + \dot{m}_1 = 30.56 + 16.89$$

$$\dot{m}_3 = 47.45\ Kg/min$$



14-100 cont.

$$\frac{\dot{m}_1}{\dot{m}_2} = \frac{h_2 - h_3}{h_3 - h_1}$$

$$\frac{m_1}{m_2} = x = \frac{16.89}{30.56} = .553$$

$$x(h_3 - h_1) = h_2 - h_3$$

$$xh_3 - xh_1 = h_2 - h_3$$

$$xh_3 + h_3 = h_2 + xh_1$$

$$h_3(x+1) = h_2 + xh_1$$

$$h_3 = \frac{h_2 + xh_1}{x+1} = \frac{h_2 + \frac{m_1}{m_2} h_1}{\frac{m_1}{m_2} + 1}$$

$$h_3 = \frac{32 + (.553)(62)}{.553 + 1}$$

$$h_3 = 42.68 \text{ KJ/kg}$$

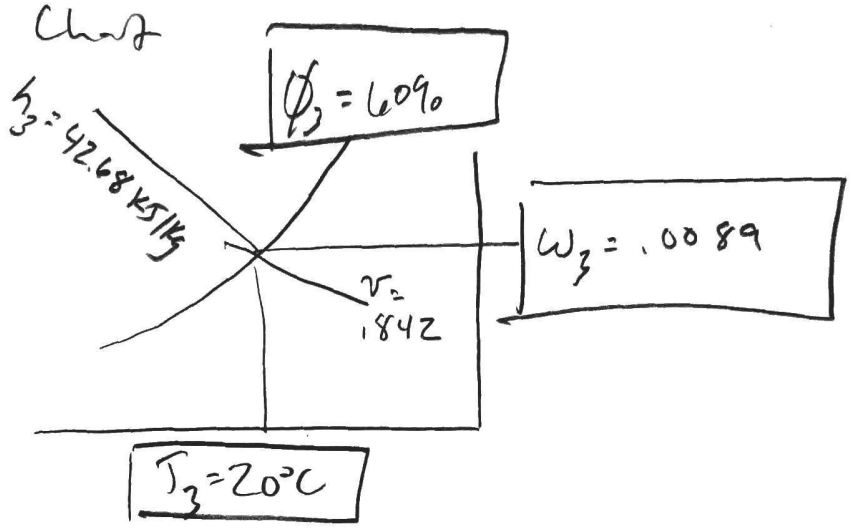
-AND-

$$w_3 = \frac{w_2 + xw_1}{x+1} = \frac{.008 + .553(.0106)}{.553 + 1}$$

$$w_3 = .0089 \text{ kg}_{H_2O}/\text{kg}_{\text{dry air}}$$

14-100 cont

From Chart

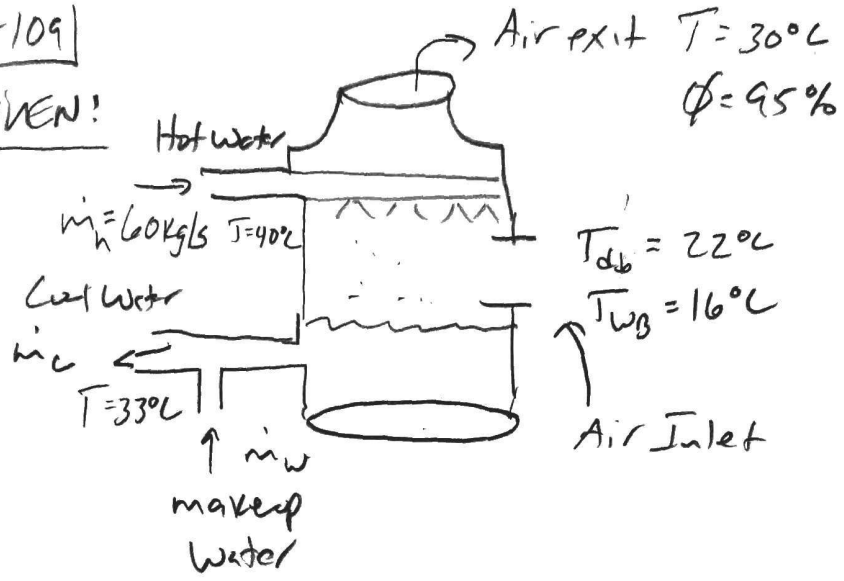


$$\dot{V}_3 = \dot{m}_3 v_3 = \frac{47.45 \text{ Kg}}{\text{min}} \cdot \frac{.842 \text{ m}^3}{\text{Kg dry air}}$$

$$\boxed{\dot{V}_3 = 39.95 \text{ m}^3/\text{min}}$$

14-109

GIVEN!



FIND a) $\forall_{air\,inlet}$ b) $\dot{m}_w$