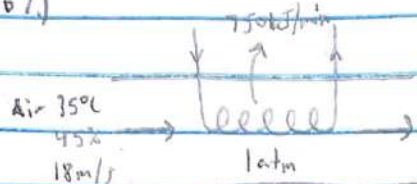


14-67)



* See next page
for psychrometric chart

Given: $D = 30 \text{ cm} = 0.3 \text{ m}$

1 atm

$T_1 = 35^\circ\text{C}$

$\phi = 45\%$

$V = 18 \text{ m/s}$

$\dot{Q}_{\text{out}} = 750 \text{ kJ/min}$

From psychrometric chart:

$h_1 = 76.5 \text{ kJ/kg dry air}$

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

$\omega_2 = \omega_1$

$\dot{m}_{a1} = \rho_1 V A$

$\dot{m}_{a1} = \left(\frac{1}{0.895}\right)(18)(0.0707)$

$\dot{m}_{a1} = 1.42 \text{ kg dry air/s}$

$\dot{m}_{a2} = \dot{m}_{a1}$

$\rho = \frac{1}{v} = v = 0.895 \text{ m}^3/\text{kg dry air}$

$A = \pi r^2 = \pi(0.15)^2 = 0.0707 \text{ m}^2$

$\dot{Q}_{\text{in}} + \dot{W}_{\text{in}} + \sum \dot{m}_i h_i = \dot{Q}_{\text{out}} + \dot{W}_{\text{out}} + \sum \dot{m}_e h_e$

$\dot{m}_1 h_1 = \dot{Q}_{\text{out}} + \dot{m}_2 h_2$

$\left(1.42 \frac{\text{kg dry air}}{\text{s}}\right)(76.5 \frac{\text{kJ}}{\text{kg dry air}}) = (750 \frac{\text{kJ}}{\text{min}})\left(\frac{1 \text{ min}}{60 \text{ s}}\right) + \left(1.42 \frac{\text{kg dry air}}{\text{s}}\right)(h_2)$

$108.63 \text{ kJ/s} = 12.5 \frac{\text{kJ}}{\text{s}} + h_2(1.42 \frac{\text{kg dry air}}{\text{s}})$

$h_2 = 67.7 \text{ kJ/kg dry air}$

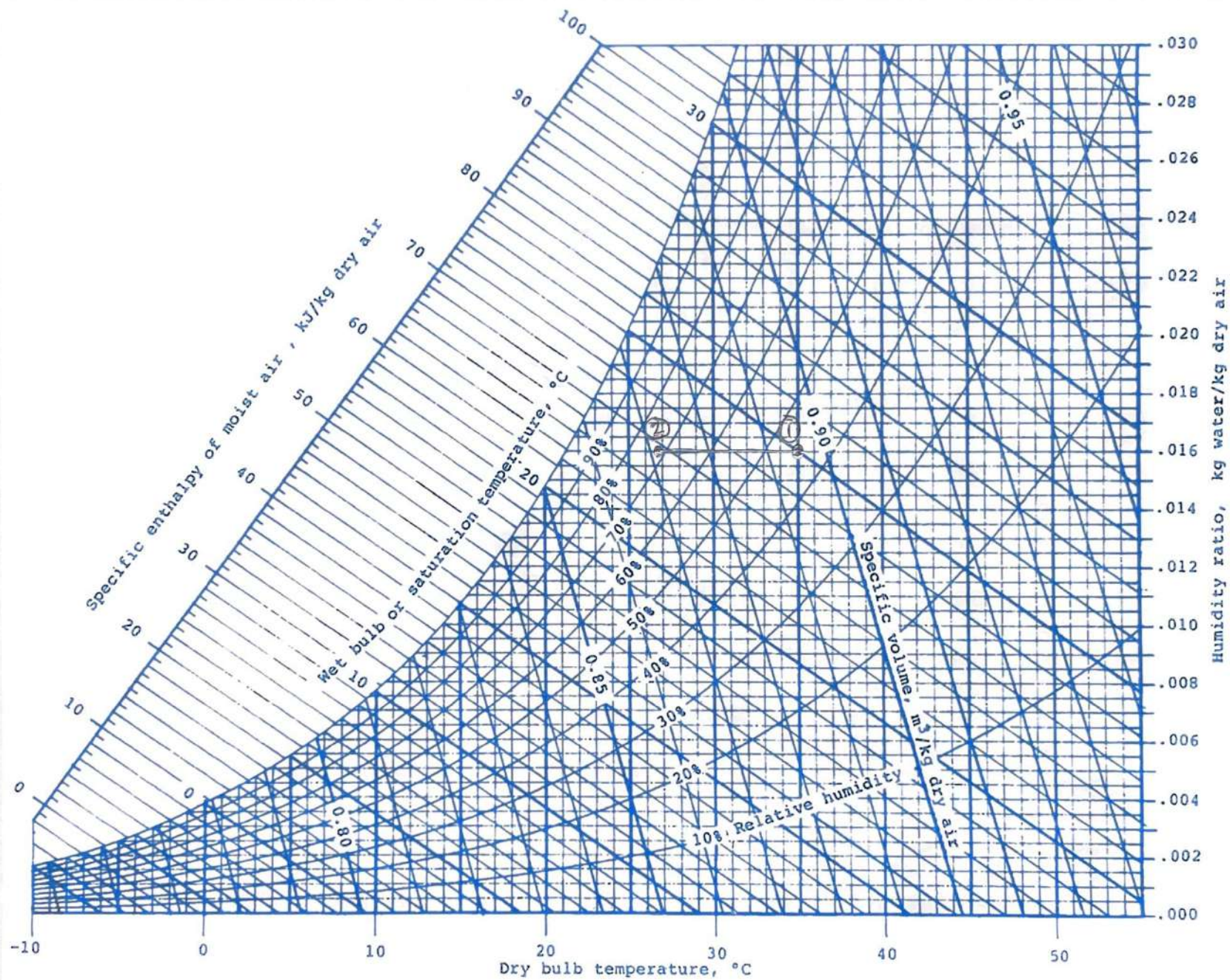
a.) $T_2 = 26.5^\circ\text{C}$

b.) $\phi = 72\%$

c.) $\dot{m}_2 = \rho V A$

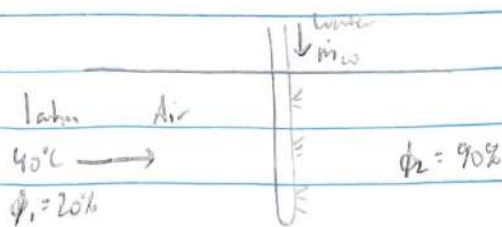
$1.42 = \left(\frac{1}{0.871}\right)V(0.0707)$

$V_2 = 17.49 \text{ m/s}$



14-67.)

14.93)



Given: 1 atm

$$T_{db,1} = 40^\circ\text{C}$$

$$\phi_1 = 20\%$$

$$Q_v = 7 \text{ m}^3/\text{min} = 0.117 \text{ m}^3/\text{s}$$

$$\phi_2 = 90\%$$

From psychrometric chart:

$$\omega_1 = 0.0093 \text{ kg H}_2\text{O}/\text{kg dry air}$$

$$h_1 = 64 \text{ kJ/kg dry air}$$

$$h_2 = h_1$$

a.) $T_{db,2} = 23^\circ\text{C}$

b.) from chart: $\omega_2 = 0.016 \text{ kg H}_2\text{O}/\text{kg Dry air}$

$$\dot{m}_{a,1} = p \dot{Q}_v$$

$$= \left(\frac{1}{0.86}\right)(0.117)$$

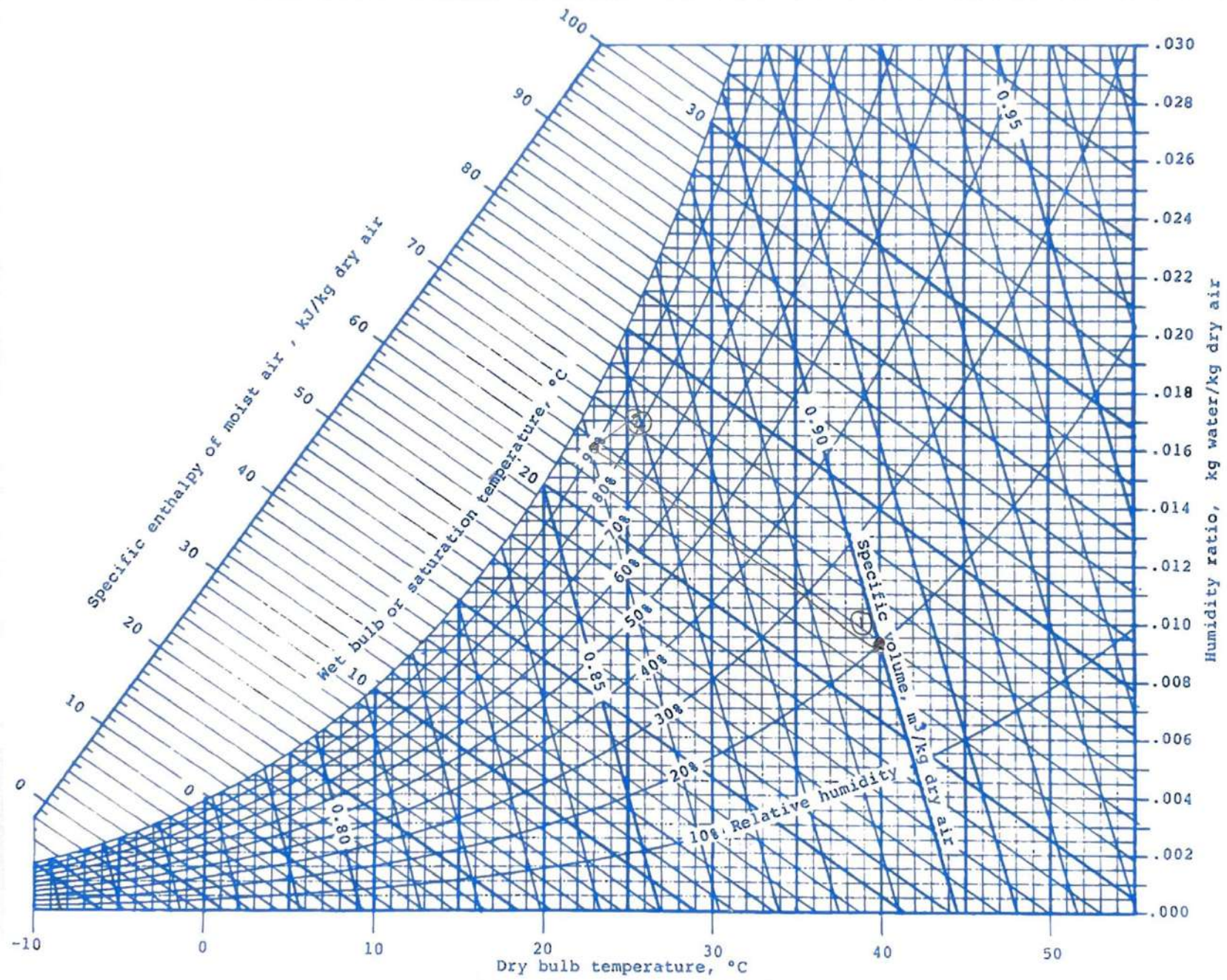
$$p = \frac{1}{\gamma} = \frac{1}{0.86}$$

$$\dot{m}_a = 0.136 \text{ kg/s}$$

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

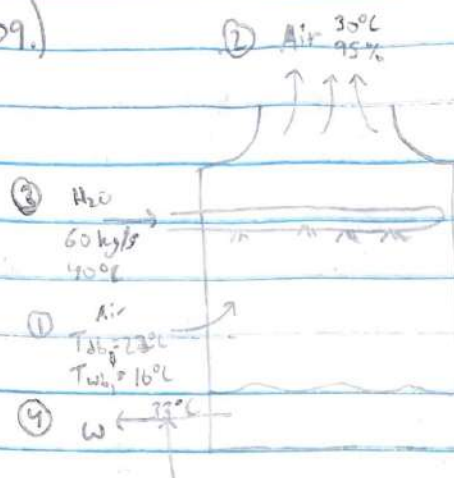
$$\dot{m}_w = (0.136)(0.016 - 0.0093)$$

$$\dot{m}_w = 9.12 \times 10^{-4} \text{ kg/s}$$



14-93.)

14-109.)



$$\dot{m}_3 = 60 \text{ kg/s}$$

$$T_3 = 40^\circ\text{C}$$

$$T_4 = 33^\circ\text{C}$$

$$T_1, T_2 = 30^\circ\text{C}$$

$$\phi_2 = 95\%$$

$$T_{db,air} = 22^\circ\text{C}$$

$$T_{wb,air} = 16^\circ\text{C}$$

$$c_{p,w@40^\circ\text{C}} = 4.18 \text{ kJ/kg}\cdot\text{K}$$

From Table A-9:

$$\text{at } 22^\circ\text{C} \quad h_a = 92.28 \text{ kJ/kg}$$

$$\text{at } 16^\circ\text{C} \quad h_a = 67.17 \text{ kJ/kg}$$

$$h_4 = 138.28 \text{ kJ/kg}$$

From psychrometric chart:

$$h_1 = 45 \text{ kJ/kg dry air}$$

$$w_1 = 0.009 \text{ kg}_w/\text{kg dry air}$$

$$h_2 = 96.3 \text{ kJ/kg dry air}$$

$$w_2 = 0.026 \text{ kg}_w/\text{kg dry air}$$

$$v_1 = 0.848 \text{ m}^3/\text{kg dry air}$$

$$v_2 = 0.895 \text{ m}^3/\text{kg dry air}$$

$$\text{Dry air: } \dot{m}_{a1} = \dot{m}_{a2} = \dot{m}_a$$

$$\text{Water: } \dot{m}_3 + \dot{m}_{a1} w_1 = \dot{m}_4 + \dot{m}_{a2} w_2$$

$$\dot{m}_a = \frac{\dot{m}_3 (h_3 - h_4)}{(h_2 - h_1) - (w_2 - w_1) h_4}$$

$$\dot{m}_a = \frac{\dot{m}_3 c_p (T_3 - T_4)}{(h_2 - h_1) - (w_2 - w_1) h_4}$$

$$\dot{m}_a = \frac{\dot{m}_3 c_p (T_3 - T_4)}{(h_2 - h_1) - (w_2 - w_1) h_4}$$

$$\begin{aligned} \dot{m}_a &= 60 \text{ kg/s} \cdot 4.18 \text{ kJ/kg} \cdot \text{K} (40 - 33) \text{ K} \\ &\quad (96.3 - 45) \frac{\text{kJ}}{\text{kg dry air}} = (0.026 - 0.009) \frac{\text{kg w}}{\text{kg dry air}} \cdot 138.28 \frac{\text{kJ}}{\text{kg}} \\ \dot{m}_a &= 1755.6 \text{ s} \\ &\quad 48.949 \text{ kg dry air} \\ \dot{m}_a &= 35.87 \text{ kg dry air/s} \end{aligned}$$

a.) $\dot{V}_1 = v_1 \dot{m}_a$
 $\dot{V}_1 = (0.848 \text{ m}^3/\text{kg dry air}) (35.87 \text{ kg dry air/s})$
 $\dot{V}_1 = 30.42 \text{ m}^3/\text{s}$

b.) $\dot{m}_{\text{makeup}} = \dot{m}_a (w_2 - w_1)$
 $\dot{m}_{\text{makeup}} = 35.87 \text{ kg dry air/s} (0.026 - 0.009) \frac{\text{kg w}}{\text{kg dry air}}$
 $\dot{m}_{\text{makeup}} = 0.61 \text{ kg w/s}$

