$$v_B \approx 1.8fps$$

$$L_{elbow} \approx 5ft$$

$$L_B = 60ft + 35ft + (6)(5ft) = 125ft$$

$$\frac{Q_B}{Q_A} = \sqrt{\frac{L_A}{L_B}} = \sqrt{\frac{100ft}{125ft}} = 0.8944$$

$$\frac{Q_B}{Q_A} = \frac{19gpm}{21gpm} = 0.9048$$

These ratios are within about 1%, therefore no further iteration is required.
Answer B

46.10 What is the maximum COP of a Carnot refrigerator operating between $40°F$ and $95°F$?

A. 0.7

B. 1.7

C. 9.1

D. 10.1

The maximum Coefficient of Performance, or COP, for any heat engine, including all heat pumps and refrigerators, is the Carnot cycle. Select the formula for Carnot COP for a refrigerator. The numerator should be the temperature of the *cold* reservoir. Remember to use absolute temperature units i.e. degrees Rankine.

$$T_L = 40°F + 460 = 500°R$$

$$T_H = 95°F + 460 = 555°R$$

$$COP_c = \frac{T_L}{T_H - T_L} = \frac{500°R}{555°R - 500°R} = 9.1$$

Answer C

46.11 **$10,000 cfm$ of air enters a cooling coil at $78°F$ and 60% relative humidity and exits at $58°F$ db / $54°F$ wb. At what rate is condensate removed?**

A. $0.5\frac{gal}{hr}$

B. $6\frac{gal}{hr}$

C. $23\frac{gal}{hr}$

D. $190\frac{gal}{hr}$

Consider the air entering the coil as State 1 and the air leaving the coil as State 2. Both states are fully defined. Use the Psychrometric Chart to look up the humidity ratio for both states. Also obtain the specific volume for the entering air condition.

$$T_{1,db} = 78°F$$

$$\phi_1 = 60\%$$

$$\omega_1 = 0.01235\frac{lb_w}{lb_{da}}$$

$$v_1 = 13.88\frac{ft^3}{lb_{da}}$$

$$T_{2,db} = 58°F$$

$$T_{2,wb} = 54°F$$

$$\omega_2 = 0.00798\frac{lb_w}{lb_{da}}$$

Use the formula under Moist-Air Cooling and Dehumidification to quantify the mass flow rate of water vapor being condensed from the air stream as it flows through the cooling coil.

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

Express the mass flow rate of air entering the coil as the product of the density and volume flow rate. Substitute for density using $\rho_1 = \frac{1}{v_1}$.

$$\dot{m}_a = \rho Q = \frac{Q}{v_1} = \frac{10,000\frac{ft^3}{min}}{13.88\frac{ft^3}{lb_{da}}} = 720.46\frac{lb_{da}}{min}$$

Substitute and solve for the mass flow rate of condensate removed. Convert *minutes* to *hours* and lb_w to gal.

$$\dot{m}_w = \left(720.46\frac{lb_{da}}{min}\right)\left(\frac{60min}{1hr}\right)\left(0.01235\frac{lb_w}{lb_{da}} - 0.00798\frac{lb_w}{lb_{da}}\right)\left(\frac{1gal}{8.34lb_w}\right) = 22.65\frac{gal}{hr}$$

Answer C