

$$T_{3,db} = 84^\circ F$$

$$T_{3,wb} = 70^\circ F$$

$$h_3 = 33.96 \frac{Btu}{lb}$$

$$T_4 = 76^\circ F$$

$$\phi_4 = 50\%$$

$$h_4 = 28.74 \frac{Btu}{lb}$$

Use the total heating rule of thumb to calculate the total heat added to the exhaust stream, and thus removed from the supply stream. Convert to refrigeration *tons*.

$$\dot{Q}_t = 4.5cfm\Delta h = 4.5(5000)(33.96 - 28.74) = 117,450 \frac{Btu}{hr}$$

$$\dot{Q}_t = \frac{117,450 \frac{Btu}{hr}}{12,000 \frac{Btu}{hr \cdot ton}} = 9.8 tons$$

Answer C

46.68 A 75% effective enthalpy wheel supplies 2000cfm of tempered air by recovering energy from a return air stream at 74°F and 50% relative humidity. The entering outside air is 96°F db / 76°F wb. What is the dry bulb temperature of the tempered air?

- A. 76°F
- B. 79°F
- C. 82°F
- D. 85°F

An enthalpy wheel is an example of an **Energy-Recovery Ventilator (ERV)**. Therefore, both sensible and latent energy are transferred through the device. However, the question is concerned only with the *dry bulb temperature* of the tempered air, therefore it is not necessary to consider the enthalpy values in this case. (To be clear, it wouldn't be incorrect or inappropriate to explore the enthalpies as both sensible and latent heat are being conveyed when using an enthalpy wheel; it simply is not necessary in this case.) The effectiveness of the enthalpy wheel applies to both the sensible and latent heat being transferred in an equal manner. In other words, 75% of the possible sensible heat is being transferred, and 75% of the possible latent heat is being transferred.

Sketch the enthalpy wheel and label with all given information. Equate the effectiveness to the ratio of the actual delta T achieved between the outside air and the tempered air as compared to the maximum delta T possible, which would be the difference between the outside air and the return air. It is recommended to arrive at this relation through reasoning since the HRV/ERV formulas in the Reference Handbook are unnecessarily convoluted.

$$\varepsilon = \frac{T_{OA} - T_{TA}}{T_{OA} - T_{RA}}$$

$$0.75 = \frac{96^\circ F - T_{TA}}{96^\circ F - 74^\circ F}$$

$$T_{TA} = 79.5^\circ F$$

Answer B

46.69 10,000cfm of air at 90°F db / 54°F wb enters an evaporative cooler using a 50°F water spray to produce 60°F leaving air. What is the saturation efficiency?

- A. 62%
- B. 67%
- C. 75%
- D. 83%

Sketch the evaporative cooler and label the entering and leaving air conditions. Consider the entering condition as State 1 and the leaving condition as State 2. Use the formula for **Saturation Efficiency**. The numerator is the actual ΔT observed, and the denominator is the maximum possible ΔT achievable if the leaving air was reduced to the wet bulb temperature of the entering air. This would imply 100% saturation efficiency. The volume flow rate of the air and the spray temperature are excess information.

$$\varepsilon_e = \frac{T_1 - T_2}{T_1 - T_{1,wb}} = \frac{90^\circ F - 60^\circ F}{90^\circ F - 54^\circ F} = 0.833 = 83.3\%$$

Answer D