

$$\dot{m}_w = \frac{Q_{OA}}{v_{OA}} \Delta\omega \rightarrow Q_{OA} = \frac{\dot{m}_w v_{OA}}{\Delta\omega}$$

$$Q_{OA} = \frac{\left(4 \frac{\text{lb}_w}{\text{min}}\right) \left(13.97 \frac{\text{ft}^3}{\text{lb}_{da}}\right)}{\left(0.01321 \frac{\text{lb}_w}{\text{lb}_{da}} - 0.00865 \frac{\text{lb}_w}{\text{lb}_{da}}\right)} = 12,254 \frac{\text{ft}^3}{\text{min}}$$

Answer C

47.32 A refrigeration cycle provides *8 tons* of cooling with a COP of 4.2. What is the required compressor horsepower?

- A. 9hp
- B. 12hp
- C. 31hp
- D. 38hp

Recall from Thermodynamics the formula for **Coefficient of Performance** for a refrigeration cycle.

$$COP_R = \frac{\dot{Q}_{evap}}{\dot{W}_{comp}} = \frac{\dot{Q}_L}{\dot{W}_{in}}$$

Rearrange for the compressor work, \dot{W}_{in} . Substitute, solve, and convert units to *hp*.

$$\dot{W}_{in} = \frac{\dot{Q}_L}{COP} = \frac{8 \text{ tons}}{4.2} \left(12,000 \frac{\text{Btu}}{\text{hr} \cdot \text{ton}}\right) \left(\frac{1 \text{ W}}{3.412 \frac{\text{Btu}}{\text{hr}}}\right) \left(\frac{1 \text{ hp}}{745.7 \text{ W}}\right) = 9 \text{ hp}$$

Answer A

47.33 A 4in thick composite wall has an R-value of $8 \frac{hr \cdot ft^2 \cdot ^\circ F}{Btu}$. The inside and outside convective heat transfer coefficients are $1.5 \frac{Btu}{hr \cdot ft^2 \cdot ^\circ F}$ and $3 \frac{Btu}{hr \cdot ft^2 \cdot ^\circ F}$, respectively. What is the total thermal resistance?

- A. $0.1 \frac{hr \cdot ft^2 \cdot ^\circ F}{Btu}$
- B. $0.9 \frac{hr \cdot ft^2 \cdot ^\circ F}{Btu}$
- C. $1.1 \frac{hr \cdot ft^2 \cdot ^\circ F}{Btu}$
- D. $9.0 \frac{hr \cdot ft^2 \cdot ^\circ F}{Btu}$

The R-value for a **Composite Wall** is the thermal resistance for all materials from which the wall is composed. Film coefficients are an outcome of the orientation, air velocity, and other fluid characteristics, and not a function of the wall construction. Therefore, when calculating the total thermal resistance, the effect of films must be added separately if they are able to be known. In this case, the film coefficients for inside and outside are both given. Write an expression for the total resistance, substitute, and solve.

$$R_t = \frac{1}{h_i} + R + \frac{1}{h_o}$$

$$R_t = \frac{1}{1.5 \frac{Btu}{hr \cdot ft^2 \cdot ^\circ F}} + 8 \frac{hr \cdot ft^2 \cdot ^\circ F}{Btu} + \frac{1}{3 \frac{Btu}{hr \cdot ft^2 \cdot ^\circ F}} = 9 \frac{hr \cdot ft^2 \cdot ^\circ F}{Btu}$$

Answer D

47.34 An object with a surface area of $10 ft^2$ and a surface temperature of $40^\circ F$ gains $1000 \frac{Btu}{hr}$ through a combination of radiation and convection. The ambient temperature as well as the temperature of the surrounding surfaces is $80^\circ F$. The emmissivity is 0.8. What is the convection film coefficient?

- A. $1.7 \frac{Btu}{hr \cdot ft^2 \cdot ^\circ F}$
- B. $3.1 \frac{Btu}{hr \cdot ft^2 \cdot ^\circ F}$
- C. $3.8 \frac{Btu}{hr \cdot ft^2 \cdot ^\circ F}$
- D. $5.6 \frac{Btu}{hr \cdot ft^2 \cdot ^\circ F}$

Radiation and **Convection** are both applicable and together make up the total heat gain.

$$\dot{Q}_t = \dot{Q}_{conv} + \dot{Q}_{rad}$$

$$\dot{Q}_{conv} = hA\Delta T$$