$$I_{amps} = \frac{(5hp)\left(746\frac{W}{hp}\right)}{(230V)\,(0.75)\left(0.8\frac{W}{VA}\right)} = 27A$$

Answer D

47.30 The bedroom of a pre-war apartment contains a steam radiator which provides up to $40,000\frac{Btu}{hr}$ at full load. Building steam is supplied at $4psig$ saturated. The radiator discharge is a saturated liquid. Neglecting losses, what mass flow rate of steam is required to satisfy the heating demand?

A. $34.6\frac{lb}{hr}$

B. $35.5\frac{lb}{hr}$

C. $39.8\frac{lb}{hr}$

D. $41.6\frac{lb}{hr}$

Since the steam enters the radiator as a saturated vapor and leaves as a saturated liquid, the amount of heat provided as the steam condenses is by definition the latent heat of vaporaization, h_{fg}. Use the table Properties of Saturated Water and Steam (Pressure) to obtain h_{fg} at the operating pressure given. Rough interpolation is sufficient.

$$P = 4psig \approx 19psia$$

$$h_{fg} \approx 962\frac{Btu}{lb}$$

Set the heating demand equal to the product of the mass flow rate of steam and the latent heat of vaporization which released as the steam condenses. Rearrange for mass flow rate, substitute, and solve.

$$\dot{Q} = \dot{m}h_{fg}$$

$$\dot{m} = \frac{\dot{Q}}{h_{fg}} = \frac{40,000\frac{Btu}{hr}}{962\frac{Btu}{lb}} = 41.6\frac{lb}{hr}$$

A quick and easy rule of thumb worth considering for steam applications is $\Delta h \approx 1000\frac{Btu}{lb}$, however if the answers are close together as they are here, it's worth the time to look up the particular h_{fg} value from the steam table.

Answer D

47.31 A heated indoor swimming pool is maintained at $78°F$. Evaporation of pool water introduces moisture into the surrounding space at a rate of $4\frac{lb}{min}$. The room is maintained at $80°F$ and 60% relative humidity by exhausting a constant volume of room air and replacing it with outside air at $85°F$ db / $65°F$ wb. What volume flow rate of outside air is required to achieve the intended dehumidification?

A. $9800cfm$

B. $11,600cfm$

C. $12,300cfm$

D. $18,100cfm$

Sketch the pool room and label the outside air and room air. The primary driver for the required volume flow rate of outside air is the difference in humidity ratio between the inside and outside conditions, both of which are fully defined states. Use the Psychrometric Chart to obtain both humidity ratios. Also obtain the specific volume for the outside air condition.

$$T_r = 80°F$$

$$\phi_r = 60\%$$

$$\omega_r = 0.01321\frac{lb_w}{lb_{da}}$$

$$T_{OA,db} = 85°F$$

$$T_{OA,wb} = 65°F$$

$$\omega_{OA} = 0.00865\frac{lb_w}{lb_{da}}$$

$$v_{OA} = 13.97\frac{ft^3}{lb_{da}}$$

Using the equation under Moist-Air Cooling and Dehumidification, then substitute for the mass flow rate of air, $\dot{m}_a$, and rearrange for the volume flow rate of outside air, Q_{OA}. The mass flow rate of water, $\dot{m}_w$, is the evaporation rate of pool water into the room air, which is given. Substitute and solve.

$$\dot{m}_w = \dot{m}_a\Delta\omega$$

$$\dot{m}_a = \rho_{OA}Q_{OA} = \frac{Q_{OA}}{v_{OA}}$$