

**47.28** Air at  $75^\circ F$  db /  $64^\circ F$  wb enters a cooling coil with an ADP of  $45^\circ F$  and a bypass factor of 15%. What is the wet bulb temperature of the leaving air?

- A.  $45^\circ F$
- B.  $48^\circ F$
- C.  $50^\circ F$
- D.  $61^\circ F$

Use the **Psychrometric Chart** to plot the process line from the room condition to the ADP. Determine the coil efficiency using the bypass factor.

$$\eta_{coil} = 1 - BF = 1 - 0.15 = 0.85$$

Set the coil efficiency equal to the ratio of the actual reduction in wet bulb temperature from 1  $\rightarrow$  2 to the maximum possible reduction which would be achieved only when State 2 is the ADP, corresponding to 100% coil efficiency. Substitute and solve for  $T_{2,wb}$ .

$$\eta_{coil} = \frac{T_{1,wb} - T_{2,wb}}{T_{1,wb} - ADP}$$

$$0.85 = \frac{64^\circ F - T_{2,wb}}{64^\circ F - 45^\circ F}$$

$$T_{2,wb} = 47.9^\circ F$$

**Answer B**

**47.29** A 230V, single-phase, 5-hp motor operates at full load with a power factor of 0.8. The motor efficiency is 75%. What is the current drawn?

- A. 10A
- B. 13A
- C. 15A
- D. 27A

The current drawn by an AC motor is a function of the number of phases, power, voltage, motor efficiency, and power factor. Search for **Motor Phases** and find the table **Power for Different Motor Phases**. Select the first equation in the “Single-Phase” column. Substitute and solve using the values given.

$$I_{amps} = \frac{P_{hp} \left( 746 \frac{W}{hp} \right)}{V \eta (pf)}$$

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

**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 vaporization,  $h_{fg}$ . 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**