$$U_{window} = .43 \frac{Btu}{hr \cdot ft^2 \cdot {}^\circ F}$$

Determine the total overall coefficient of heat transfer for the wall *inclusive* of the window by taking a weighted average of the U factors by area.

$$A_{window} = (3ft)(6ft) = 18ft^2$$

$$A_{wall} = (10ft)(10ft) - 18ft^2 = 82ft^2$$

$$U_{total} = \frac{\left(.07\frac{Btu}{hr \cdot ft^2 \cdot {}^\circ F}\right)(82ft^2) + \left(.43\frac{Btu}{hr \cdot ft^2 \cdot {}^\circ F}\right)(18ft^2)}{82ft^2 + 18ft^2} = .135 \frac{Btu}{hr \cdot ft^2 \cdot {}^\circ F}$$

Find the heat flux by diving the overall heat transfer formula by area:

$$\dot{Q} = UA\Delta T$$

$$\dot{q} = \frac{\dot{Q}}{A} = U\Delta T$$

$$\dot{q} = \left(.135 \frac{Btu}{hr \cdot ft^2 \cdot {}^\circ F}\right)(20^\circ F) = 2.7 \frac{Btu}{hr \cdot ft^2}$$

Answer C

44.19 An R-1234yf chiller operates between $50psia$ on the low pressure side and $150psia$ on the high pressure side with no subcooling and no superheat. What is the quality of refrigerant entering the evaporator?

A. 0

B. 0.12

C. 0.22

D. 0.32

Look up Pressure Versus Enthalpy Curves for Refrigerant 1234yf in the Reference Handbook and draw the refrigeration cycle on the diagram, either using on-screen drawing tools or scratch paper. Carefully locate State 3, the condition leaving the condenser prior to expansion, on the left side of the saturation curve. Assume the expansion is isenthalpic, therefore the enthalpy of State 4, after the expansion and before entering the evaporator, is known to be equal to the enthalpy at State 3.

For State 3:

$$P_3 = 150psia$$

$$\chi_3 = 0$$

$$h_3 = 45 \frac{Btu}{lb}$$

For State 4:

$$P_4 = 50psia$$

$$h_4 = h_3 = 45 \frac{Btu}{lb}$$

On the next page after the Pressure Enthalpy curves, refer to the table for Refrigerant 1234yf listing Properties of Saturated Liquid and Saturated Vapor. Since the pressure at State 4 is between two rows, it is necessary to interpolate to find h_f and h_g for R-1234yf at $P_4 = 50psia$. Make a table to organize the data collected and help set up for the interpolation:

$Pressure[psia]$	$h_f(liquid)\ [\frac{Btu}{lb}]$	$h_g(vapor)\ [\frac{Btu}{lb}]$
48.45	21.98	91.77
50	$h_f \approx 22.5$	$h_g \approx 92$
53.12	23.54	92.54

Calculate the quality at State 4:

$$\chi_4 = \frac{h_4 - h_f}{h_g - h_f} = \frac{45\frac{Btu}{lb} - 22.5\frac{Btu}{lb}}{92\frac{Btu}{lb} - 22.5\frac{Btu}{lb}} = .32$$

Answer D

44.20 An outside air handler tempers outside air of $90°F$ dry bulb and $80°F$ wet bulb using return air at $74°F$ and 50% relative humidity using an air-to-air heat exchanger. The heat exchanger effectiveness is 72%. What is the enthalpy of the air leaving the heat exchanger?

A. $31\frac{Btu}{lb}$

B. $33\frac{Btu}{lb}$

C. $41\frac{Btu}{lb}$

D. $43\frac{Btu}{lb}$

An air to air heat exchanger in a tempering application will drive only sensible cooling of the outside air stream being treated. A 100% efficient heat exchanger would cool the outside air all the way to the temperature of the return air, $74°F$ in this case. Apply the given efficiency to determine the dry bulb temperature actually achieved as the result of tempering. Let State 1 be the outside air,