$$Q_{total} = 1530Btu + 11,500Btu + 408Btu = 13,438Btu$$

Divide by time and convert to tons to determine the required refrigeration capacity i.e. rate of heat removal in *tons*:

$$\dot{Q} = \frac{Q}{t} = \frac{13,438Btu}{3hr} = 4480\frac{Btu}{hr}\left(\frac{1ton}{12,000\frac{Btu}{hr}}\right) = .37tons$$

Answer B

42.12 Steam at $40psia$ has a quality of 75%. What is the density?

A. $0.13\frac{lb_m}{ft^3}$

B. $0.17\frac{lb_m}{ft^3}$

C. $0.19\frac{lb_m}{ft^3}$

D. $0.38\frac{lb_m}{ft^3}$

Density is the inverse of specific volume. Use the Properties of Saturated Water and Steam table (by Pressure) to look up the specific volume for saturated liquid water, h_f, and the change in specific volume associated with heating to a saturated vapor at constant pressure, h_{fg}. The formula/property for specific volume based on quality is best memorized rather than looked up, but can be found in the Reference Handbook by searching: Specific Volume of a Two-phase System.

$$v = v_f + \chi v_{fg}$$

$$v = .0171\frac{ft^3}{lb} + (.75)\left(10.49\frac{ft^3}{lb}\right) = 7.88\frac{ft^3}{lb}$$

Calculate the density:

$$\rho = \frac{1}{v} = \frac{1}{7.88\frac{ft^3}{lb}} = .127\frac{lb}{ft^3}$$

Answer A

42.13 What is the viscosity of $150°F$ water?

A. $5 \times 10^{-6} \frac{lb_m}{ft \cdot hr}$

B. $9 \times 10^{-6} \frac{lb_m}{ft \cdot hr}$

C. $3 \times 10^{-4} \frac{lb_m}{ft \cdot hr}$

D. $1 \frac{lb_m}{ft \cdot hr}$

The question is ambiguous in terms of whether the Absolute i.e. Dynamic Viscosity is to be used or the Kinematic Viscosity. Look up the values in the table Properties of Water and note the units:

$$\mu = .905 \times 10^{-5} \frac{lb_f \cdot sec}{ft^2}$$

$$\nu = .476 \times 10^{-5} \frac{ft^2}{sec}$$

Note the answer choices have units of $\frac{lb_m}{ft \cdot hr}$. Choose to work with the dynamic viscosity as it is best suited for conversion to the desired units.

Recall from physics the relationship between force, mass, and acceleration due to gravity:

$$F = mg$$

where g is the constant acceleration due to gravity and the typical units are:

$$[1lb_f] = [1lb_m] \left[32.2 \frac{ft}{sec^2} \right]$$

Make a substitution for lb_f in the units of μ, evaluate, and simplify:

$$\mu = .905 \times 10^{-5} \frac{sec}{ft^2} \left(32.2 \frac{lb_m \cdot ft}{sec^2} \right) = .000291 \frac{lb_m}{ft \cdot sec}$$

Convert seconds to hours for alignment with answer choice units:

$$\mu = .000291 \frac{lb_m}{ft \cdot sec} \left(\frac{60sec}{1min} \right) \left(\frac{60min}{1hr} \right) = 1.05 \frac{lb_m}{ft \cdot hr}$$

Answer D