46.38 A fluid with a kinematic viscosity of $3centistokes$ and a specific gravity of 0.88 flows through a nominal $3in$ pipe at $4fps$. What is the Reynolds number?

A. $32,000$

B. $104,000$

C. $380,000$

D. $3,700,000$

Reynolds Number is a function of velocity, diameter, and kinematic viscosity. Specific gravity has no bearing on Reynolds number.

$$Re = \frac{vD}{\nu}$$

The kinematic viscosity has been given in cSt which is best converted to $\frac{ft^2}{s}$ since the problem is otherwise specified in US Customary units. Use the table Measurement Relationships to find the relevant conversion factors from cSt to $\frac{m^2}{s}$ and from $meters$ to ft. Substitute directly into the Reynolds number formula and solve. Use the table Schedule 40 Steel Pipe to look up the internal diameter of a nominal $3in$ pipe.

$$Re = \frac{\left(4\frac{ft}{s}\right)\left(\frac{3.068}{12}ft\right)}{(3cSt)\left(\frac{1\times10^{-6}\frac{m^2}{s}}{1cSt}\right)\left(\frac{3.281ft}{1m}\right)^2} = 31,666$$

Answer A

46.39 What is the quality of $1300psia$ steam produced by a boiler that adds $600\frac{Btu}{lb}$ to $250°F$ saturated liquid feedwater?

A. 0.22

B. 0.39

C. 0.61

D. 0.78

Consider the feedwater as State 1 and the saturated mixture leaving the boiler as State 2. Use the Properties of Saturated Water and Steam table by temperature to obtain the enthalpy at State 1.

$$T_1 = 250°F\,(saturated)$$

$$h_1 = h_f = 218.6\frac{Btu}{lb}$$

Calculate the enthalpy at State 2 by accounting for the heat added by the boiler.

$$\Delta h = h_2 - h_1 = 600\frac{Btu}{lb}$$

$$h_2 = h_1 + 600\frac{Btu}{lb} = 218.6\frac{Btu}{lb} + 600\frac{Btu}{lb} = 818.6\frac{Btu}{lb}$$

Use the steam table by pressure to obtain the enthalpy values h_f and h_{fg} at $1300psia$. Then calculate the quality at State 2.

$$P_2 = 1300psia$$

$$h_f = 585.6\frac{Btu}{lb}$$

$$h_{fg} = 593.9\frac{Btu}{lb}$$

$$\chi_2 = \frac{h_2 - h_f}{h_{fg}} = \frac{818.6\frac{Btu}{lb} - 585.6\frac{Btu}{lb}}{593.9\frac{Btu}{lb}} = 0.39$$

Answer B