

$$\frac{\pi}{4} D^2 = \frac{Q}{v}$$

$$D = \sqrt{\frac{4Q}{\pi v}} = \sqrt{\frac{4 \left(50 \frac{\text{gal}}{\text{min}} \right) \left(\frac{1 \text{ft}^3}{7.48 \text{gal}} \right) \left(\frac{1 \text{min}}{60 \text{s}} \right)}{\pi \left(12 \frac{\text{ft}}{\text{s}} \right)}} = 0.109 \text{ft} \left(\frac{12 \text{in}}{1 \text{ft}} \right) = 1.30 \text{in}$$

Refer to the **Schedule 40 Steel Pipe** table. The inside diameter of a 1.25in nominal pipe size is physically 1.38in. There is no need to choose a larger size.

Answer B

46.61 1200gpm of water flows through a 50ft length of pipe with a 8in inside diameter and a friction factor of 0.02. What is the pressure drop?

- A. 0.2psi
- B. 0.6psi
- C. 1.4psi
- D. 5.9psi

Determine the velocity of water flowing in the pipe. The **Steel Pipe Friction Tables** provide a reasonable approximation, however the problem does not state 'nominal' or 'standard weight' or 'schedule 40.' Therefore, it is recommended to calculate the values manually.

$$Q = vA$$

$$v = \frac{Q}{A} = \frac{\left(1200 \frac{\text{gal}}{\text{min}} \right) \left(\frac{1 \text{ft}^3}{7.48 \text{gal}} \right) \left(\frac{1 \text{min}}{60 \text{s}} \right)}{\frac{\pi}{4} \left(\frac{8 \text{in}}{12 \frac{\text{in}}{\text{ft}}} \right)^2} = 7.66 \frac{\text{ft}}{\text{s}}$$

Use the **Darcy-Weisbach Equation** to find the head loss in ft. Then use the rule of thumb conversion factor for water to convert the units to psi for the pressure drop.

$$h_f = \frac{fLv^2}{2Dg}$$

$$h_f = \frac{(0.02) (50 \text{ft}) \left(7.66 \frac{\text{ft}}{\text{s}} \right)^2}{2 \left(\frac{8 \text{in}}{12 \frac{\text{in}}{\text{ft}}} \right) \left(32.2 \frac{\text{ft}}{\text{s}^2} \right)} = 1.37 \text{ft}$$

$$\Delta P = \frac{1.37 \text{ft}}{2.31 \frac{\text{ft}}{\text{psi}}} = 0.59 \text{psi}$$

Answer B

46.62 A pump delivers 250gpm and produces 125ft of head. The fluid being distributed has a density of $71 \frac{lb_m}{ft^3}$ and the pump is 80% efficient. What is the brake horsepower required to drive the pump?

- A. 9.0hp
- B. 9.9hp
- C. 11.2hp
- D. 25.9hp

Use the formula for **Brake HP**. The volume flow rate, head, and efficiency are given. Use the density of the fluid along with the standard density of water to determine the **Specific Gravity**, then solve for the *bhp*.

$$bhp = \frac{Q\Delta h \cdot SG}{3960\eta_p}$$

$$SG = \frac{\rho}{\rho_{water}} = \frac{71 \frac{lb_m}{ft^3}}{62.4 \frac{lb_m}{ft^3}} = 1.14$$

$$bhp = \frac{(250gpm)(125ft)(1.14)}{3960(0.8)} = 11.2hp$$

Answer C

46.63 A heat pump operated in cooling mode has a capacity of 2 refrigeration tons and uses a 1500W compressor. What is the coefficient of performance?

- A. 4.7
- B. 5.7
- C. 8.1
- D. 10.4

Since the heat pump is being operated in cooling mode, use the formula for refrigerators and air conditioners under **Coefficient of Performance**. Substitute the cooling capacity for Q_L and the compressor energy for W . Align the units in the numerator and denominator such that the final result is unitless.

$$COP = \frac{Q_L}{W}$$

$$COP = \frac{(2tons)(12,000 \frac{Btu}{hr \cdot ton})}{(1500W)(3.412 \frac{Btu}{hr \cdot W})} = 4.69$$

Answer A