

37.60 A single phase 240V motor drives a pump that supplies $100 \frac{lb_m}{min}$ of $80^\circ F$ water and adds 400ft of pressure head. The pump is 70% efficient and the motor is 90% efficient. What is the current drawn by the motor?

- A. 3A
- B. 4A
- C. 5A
- D. 6A

Use the **Properties of Water** table to look up the density of water at $80^\circ F$. Use the density and the mass flow rate to find the volume flow rate. Convert units to *gpm*.

$$\rho = 62.2 \frac{lb_m}{ft^3}$$

$$\dot{m} = \rho Q$$

$$Q = \frac{\dot{m}}{\rho} = \frac{100 \frac{lb_m}{min}}{\left(62.4 \frac{lb_m}{ft^3}\right) \left(\frac{1ft^3}{7.48gal}\right)} = 12gpm$$

Calculate the **Water Horsepower** delivered by the pump.

$$whp = \frac{Qh}{3960}$$

$$whp = \frac{(12)(400)}{3960} = 1.21hp$$

Use the pump and motor efficiencies to calculate the input power to the motor. Convert units to *KW*.

$$P_{[KW]} = \frac{whp}{\eta_m \eta_p} = \frac{(1.21hp) \left(0.7457 \frac{KW}{hp}\right)}{(0.7)(0.9)} = 1.44KW$$

Select the equation in the table **Power for Different Motor Phases** for single-phase motors to determine the current. Assume the power factor is unity. Write and check all units.

$$P_{[KW]} = IV(pf)$$

$$I_{[amps]} = \frac{P_{[KW]} \left(\frac{1000W}{KW}\right)}{V(pf)} = \frac{(1.44KW) \left(\frac{1000W}{KW}\right)}{(240V)(1)} = 6A$$

Answer D