C. $11,800 fpm$

D. $16,300 fpm$

Total Pressure is the sum of static pressure and velocity pressure. Rearrange the formula for velocity pressure.

$$p_t = p_s + p_v$$

$$p_v = p_t - p_s$$

Both the total pressure and the static pressure are measured by gauges and therefore report gauge pressure. It is the *difference* between the two which is relevant in this scenario, which is the same regardless of whether gauge or absolute pressures are used, since atmospheric pressure washes out in the subtraction. In summary, there is no need for converting to absolute pressure.

Use Commonly Used Equivalents to find the conversion from mm of mercury to psi. Calculate the total pressure minus the static pressure. Convert to inches of water.

$$p_v = (60mm\, Hg)\left(\frac{1in}{25.4mm}\right)\left(0.491\frac{psi}{in\, Hg}\right) - 1psi = 0.16psi$$

$$p_v = 0.16psi\left(\frac{2.31ft\, H_2O}{psi}\right)\left(\frac{12in\, H_2O}{ft\, H_2O}\right) = 4.43in\, H_2O$$

Since no temperautre is given, assume air is at standard conditions. Solve the Velocity Pressure equation for velocity in fpm.

$$p_v = \left(\frac{V_{[fpm]}}{4005}\right)^2 = 4.43in\, H_2O$$

$$V = 8430fpm$$

Answer B

47.50 An open loop condenser water system holds $20,000\ gallons$. The system is to be treated with a 45% by volume biocide solution until the average concentration after mixing is $10ppm$. Ignoring evaporation and the addition of make-up water, what volume of the solution is required?

A. $0.2gal$

B. $0.4gal$

C. $2gal$

D. $4gal$

The final concentration of biocide is 10 parts per million (ppm). Calculate the volume of biocide needed to achieve this concentration.

$$20,000gal\left(\frac{10}{10^6}\right) = 0.2gal$$

If the solution being added is only 45% biocide, the volume of the *solution* required is larger than the volume of the active chemical. It is inferred that the remaining 55% of the solution is inactive, probably water. Calculate the volume of the solution needed to provide $0.2gal$ of biocide.

$$\frac{0.2gal}{0.45} = 0.44gal$$

Answer B

47.51 The flow of $20°C$ water through a hose with an inside diameter of $25mm$ is at the lower boundary of the fully turbulent range. How long will it take to fill a $50,000L$ swimming pool?

A. $8\,hours$

B. $27\,hours$

C. $38\,hours$

D. $59\,hours$

Pipe flow is considered Fully Turbulent once the Reynolds Number is greater than 12,000. Since the flow is at the lower boundary of the turbulent range, find the velocity which corresponds to $Re = 12,000$. Use the Properties of Water table to obtain the kinematic viscosity at $20°C$.

$$Re > 12,000$$

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

$$v = \frac{Re \cdot \nu}{D} = \frac{(12,000)\left(0.000001003\frac{m^2}{s}\right)}{(0.025m)} = 0.481\frac{m}{s}$$

Calculate the volume flow rate based on velocity and area. Since the pool volume is in liters, and the answer choices are in hours, convert to $\frac{L}{hr}$.

$$Q = vA = \left(0.481\frac{m}{s}\right)\left(\frac{\pi}{4}\right)(0.025m)^2 = 2.36\times10^{-4}\frac{m^3}{s}\left(\frac{1000L}{1m^3}\right)\left(\frac{3600s}{hr}\right) = 849.6\frac{L}{hr}$$

By definition, volume flow rate is volume per unit time. Rearrange to solve for the time to fill the desired volume.

$$Q = \frac{Volume}{t}$$