$$t = \frac{Volume}{Q} = \frac{50,000L}{849.6\frac{L}{hr}} = 58.9hr$$

Answer D

47.52 $800gpm$ **of gasoline** $(SG = 0.72)$ **is transported through an** $18in$ **steel pipe. The kinematic viscosity of gasoline is** $6 \times 10^{-6}\frac{ft^2}{s}$**. What is the Reynolds number?**

A. 1,800

B. 180,000

C. 250,000

D. 350,000

Use the volume flow rate and diameter to calculate the velocity of gasoline through the pipe. For larger pipes, there is no need to distinguish nominal from actual size.

$$Q = vA$$

$$v = \frac{Q}{A} = \frac{\left(800\frac{gal}{min}\right)\left(\frac{1ft^3}{7.48gal}\right)\left(\frac{1min}{60s}\right)}{\frac{\pi}{4}\left(1.5ft\right)^2} = 1.01\frac{ft}{s}$$

Use the kinematic viscosity, diameter, and velocity to determine the Reynolds Number. The specific gravity is extra information and should be ignored.

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

$$Re = \frac{\left(1.01\frac{ft}{s}\right)(1.5ft)}{\left(6 \times 10^{-6}\frac{ft^2}{s}\right)} = 252,177$$

Answer C

47.53 A water main is required to transport $8000gpm$ **of water. What is the smallest diameter of pipe that should be used?**

A. $12in$

B. $18in$

C. $24in$

D. $32in$

Start by checking the Steel Pipe Friction Tables. The largest diameter provided is $12in$ and the maximum volume flow rate is $4000gpm$. Eliminate choice A.

Since there is no additional information aside from the flow rate, use a rule of thumb. One handy option is to divide gpm by 20 and take the square root. This is only for getting a ballpark answer.

$$D_{[in]} \approx \sqrt{\frac{Q_{[gpm]}}{20}} = \sqrt{\frac{8000}{20}} = 20in$$

Eliminate choice D as $32in$ is likely excessive. Since $20in$ is only slightly larger than $18in$, answer B is still worth considering.

Another approach is to assume a typical maximum velocity, such as $5\frac{ft}{s}$, and solve for the required area.

$$Q = vA$$

$$A = \frac{Q}{v} = \frac{\left(8000\frac{gal}{min}\right)\left(\frac{1ft^3}{7.48gal}\right)\left(\frac{1min}{60s}\right)}{5\frac{ft}{s}} = 3.56ft^2$$

Solve for the diameter.

$$A = \frac{\pi}{4}D^2$$

$$D = \sqrt{\frac{4A}{\pi}} = \sqrt{\frac{4\left(3.56ft^2\right)}{\pi}} = 2.13ft\left(\frac{12in}{1ft}\right) = 25.6in$$

Since the diameter is only slightly larger than $24in$, and the first rule of thumb gave a 20% smaller answer, choose $24in$.

Answer C

47.54 A pressurized tank contains air at $300psia$. What is the Mach number of air exiting to the atmosphere through a hole in the tank?

A. 0.8

B. 2.6

C. 4.2

D. 5.5

Determine the ratio of the pressure downstream of the opening to the pressure inside the tank.

$$\frac{P}{P_0} = \frac{14.7psia}{300psia} = 0.049$$

Use the One-Dimensional Isentropic Compressible-Flow Functions table to look up the pressure ratio and obtain the corresponding Mach Number, M.