

D. $0.6hp$

Calculate the **Water Horsepower**. Use the differential pressure given in *psi* directly. Ignore the specific gravity which is only needed when the head added by the pump is given in *ft*.

$$whp = \frac{Q\Delta p}{1714} = \frac{(100)(10)}{1714} = 0.58hp$$

Answer D

47.47 Waste water flows to a common drain from 3 upstream sources. The pipes have inside diameters of $1in$, $2in$, and $3in$. The velocity in each upstream pipe is $3\frac{ft}{s}$. If the main drain downstream is sized such that the velocity in is not to exceed $2\frac{ft}{s}$, what is the minimum diameter?

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

Calculate the volume flow rate through the drain by finding the sum of the volume flow rate from each of the 3 sources. Use the relation that volume flow rate is the product of velocity and area for each source. Area is a function of the inside diameter. Label the sources as 1, 2, and 3, and the drain as 4.

$$Q_4 = Q_1 + Q_2 + Q_3$$

$$Q_4 = V_1A_1 + V_2A_2 + V_3A_3$$

Substitute known velocities and diameters. Convert *in* to *ft*.

$$Q_4 = \left(3\frac{ft}{s}\right) \left(\frac{\pi}{4}\right) \left(\frac{1in}{\left(\frac{12in}{ft}\right)}\right)^2 + \left(3\frac{ft}{s}\right) \left(\frac{\pi}{4}\right) \left(\frac{2in}{\left(\frac{12in}{ft}\right)}\right)^2 + \left(3\frac{ft}{s}\right) \left(\frac{\pi}{4}\right) \left(\frac{3in}{\left(\frac{12in}{ft}\right)}\right)^2 = 0.229\frac{ft^3}{s}$$

Solve for the area of the drain.

$$Q_4 = V_4A_4$$

$$A_4 = \frac{Q_4}{V_4} = \frac{0.229\frac{ft^3}{s}}{2\frac{ft}{s}} = 0.1145ft^2$$

Calculate the diameter of the drain. Convert to *in*.

$$A_4 = \frac{\pi}{4} D_4^2$$

$$D_4 = \sqrt{\frac{4}{\pi} A_4} = 0.38 \text{ ft} \left(\frac{12 \text{ in}}{\text{ft}} \right) = 4.6 \text{ in}$$

Answer C

47.48 What is the Reynolds number for 1500 *gpm* of 70°F water flowing in a standard weight steel pipe with a diameter of 10 *in*?

- A. 32,000
- B. 380,000
- C. 480,000
- D. 5,800,000

Use the [Schedule 40 Steel Pipe](#) table or the [Steel Pipe Friction Tables](#) to find the diameter of nominal 10 *in* pipe.

$$D = 10.02 \text{ in}$$

Use the [Steel Pipe Friction Tables](#) to find the velocity for 1500 *gpm* flowing in a 10 *in* pipe. This saves time as compared with calculating $v = \frac{Q}{A}$, which is equally valid.

$$v = 6.1 \frac{\text{ft}}{\text{s}}$$

Look up the kinematic viscosity for 70°F water in the [Properties of Water](#) table.

$$\nu_{@70^\circ F} = 1.059 \times 10^{-5} \frac{\text{ft}^2}{\text{s}}$$

Calculate the [Reynolds Number](#).

$$Re = \frac{vD}{\nu} = \frac{\left(6.1 \frac{\text{ft}}{\text{s}}\right) \left(\frac{10.02 \text{ in}}{12 \frac{\text{in}}{\text{ft}}}\right)}{1.059 \times 10^{-5} \frac{\text{ft}^2}{\text{s}}} = 480,000$$

Answer C

47.49 A gauge reads the static pressure for air flowing in a pipe as 1 *psig*. A pitot tube reads the total pressure as 60 *mm* of mercury. What is the velocity of the air?

- A. 5600 *fpm*
- B. 8400 *fpm*