$$\dot{W} = \frac{0.875hp}{(0.75)(0.82)}\left(0.7457\frac{KW}{hp}\right) = 1.06KW$$

Answer B

47.45 A 90% efficient pump normally delivers $50gpm$ of $50°F$ chilled water at a head of $20ft$ of water with a rotational speed of $900rpm$. What is the percent increase in brake horsepower required to increase the volume flow rate by 10%? Assume the pump is oversized and has sufficient capacity in reserve to deliver the additional flow.

A. 10%

B. 21%

C. 33%

D. 46%

Refer to the Pump Affinity Laws. Change in speed and change in volume flow rate are proportional. Therefore, when the volume flow inceases by 10%, the speed also increases by 10%. Establish the ratio of new to old volume flow rate and speed.

$$\frac{Q_2}{Q_1} = \frac{N_2}{N_1} = 1.1$$

The percent increase in brake horsepower is a function of the cube of the change in speed (or volume flow rate).

$$\frac{bhp_2}{bhp_1} = \left(\frac{N_2}{N_1}\right)^3 = (1.1)^3 = 1.33$$

Therefore, a 33% increase in power is required to support a 10% increase in the speed / volume flow rate.

Note there is no need to caclulate the actual brake horsepower to determine the percent change. The specific value of various parameters given are additional information not required to answer the fundamental question put forth, which is purely an application of the pump affinty laws.

Answer C

47.46 $100gpm$ of a liquid with a specific gravity of 0.8 is supplied by a pump operating with a differential pressure of $10psi$. What is the hydraulic horsepower?

A. $0.2hp$

B. $0.3hp$

C. $0.5hp$

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.