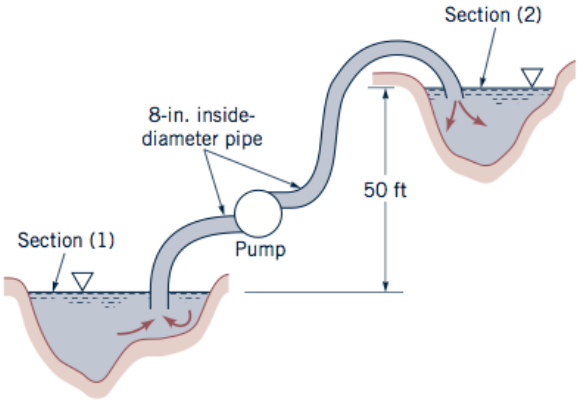
NAME

Quiz 8. Water is to be moved from one large reservoir to another at a higher elevation as indicated in the Figure. The loss of available energy associated with 2.5 ft^3/s being pumped from sections (1) to (2) is $h_L = 61\frac{\bar{V}^2}{2g}$ where $\bar{V}$ is the average velocity of water in 8-in inside-diameter piping involved, Determine the amount of shaft power required.



1) $1\ slug = 1\frac{lb_f\ s^2}{ft}, 1\ hp = 550\frac{lb_f\ ft}{s}$
2) $\rho = 1.94\frac{slugs}{ft^3}, g = 32.2\ \frac{ft}{s^2}$
3) $\frac{p_1}{\gamma} + \frac{V_1^2}{2g} + z_1 + h_p = \frac{p_2}{\gamma} + \frac{V_2^2}{2g} + z_2 + h_t + h_L$
4) Turbine power, $\dot{W}_p = \dot{m}gh_p$

Note: Attendance (+2 points), format (+1 point)

Solution

$h_L = 61\frac{\bar{V}^2}{2g},\ p_1 = p_1, V_1 = V_2 = 0, h_t = 0$

Therefore

$$h_p = (z_2 - z_1) + 61\frac{\bar{V}^2}{2g}$$

(+4 points)

$$\bar{V} = \frac{Q}{A} = \frac{2.5}{\frac{\pi}{4}\left(\frac{8}{12}\right)^2} = 7.162\ ft/s$$

(+2 points)

Power

$$\dot{W}_p = \rho Q\left(g(z_2 - z_1) + 61\frac{\bar{V}^2}{2}\right) = 1.94 \times 2.5[32.2(50) + 30.5 \times 7.162]\left(\frac{1}{550}\right) = 28\ hp$$

(+1points)