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NAME

Fluids-ID

Quiz 9. Water is to be moved from one large reservoir to another a higher elevation as indicated in the Figure. The flow rate, *Q =2.5 ft³/s* and the head loss, $h_L = 61\frac{\bar{V}^2}{2g}$ where $\bar{V}$ is the average velocity. Determine the pump power required.

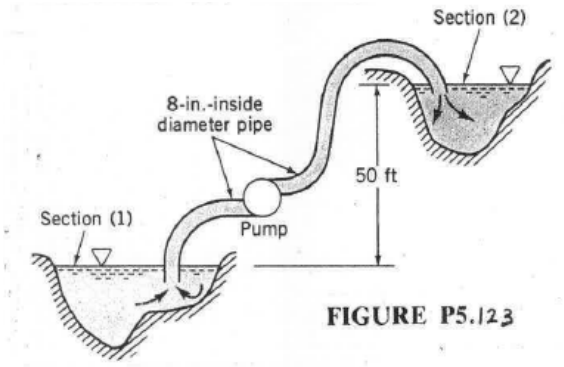

FIGURE P5.123

Hint.

1) density,$\rho = 1.94\ slugs/ft^3$
2) $\frac{p_1}{\gamma} + \frac{V_1^2}{2g} + z_1 + h_p = \frac{p_2}{\gamma} + \frac{V_2^2}{2g} + z_2 + h_t + h_L$
3) Pump power, $\dot{W}_p = Q\rho g h_p$

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

Solution

Assumptions; $p_1 = p_1, V_1 = V_2 = 0, h_t = 0$

Therefore the energy equation reduces to

$z_1 + h_p = z_2 + h_L$ (+4 points)

Or

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

Pump power

$$\dot{W}_p = Q\rho g h_p = Q\rho g\left[(z_2 - z_1) + 61\frac{\bar{V}^2}{2g}\right] = Q\rho\left[g(z_2 - z_1) + 61\frac{\bar{V}^2}{2}\right]$$

Where

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

Therefore

$$\dot{W}_p = 1.94 * 2.5\left[32.2 * 50 + 61\frac{(7.162)^2}{2}\right] = 15400\ \frac{ft*lb}{s}$$ (+1 point)