

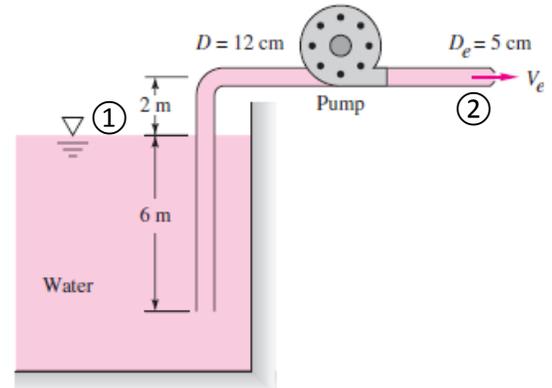
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NAME

Fluids-ID

Quiz 8. When the pump in the figure draws  $220 \text{ m}^3/\text{h}$  of water at  $20^\circ\text{C}$  from the reservoir, the total friction head loss is  $5 \text{ m}$ . The flow discharges through a nozzle to the atmosphere. Estimate the pump power in kW delivered to the water.

- 1) gravity,  $g = 9.81 \text{ m/s}^2$
- 2) density,  $\rho = 998 \text{ kg/m}^3$
- 3)  $\frac{p_1}{\rho g} + \frac{V_1^2}{2g} + z_1 + h_p = \frac{p_2}{\rho g} + \frac{V_2^2}{2g} + z_2 + h_L$
- 4) Pump power,  $P = \rho g Q h_p$



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

### Solution

Assume  $V_1 = 0$  and  $p_1 = p_2 = 0$

$$h_p = \frac{V_2^2}{2g} + (z_2 - z_1) + h_L$$

(+4 points)

Calculating velocity at location 2

$$V_2 = \frac{Q}{A_2} = \frac{\frac{220}{3600}}{\pi(0.025)^2} = 31.12 \text{ m/s}$$

(+1 point)

Thus,

$$h_p = \frac{(31.12)^2}{2(9.81)} + 2 + 5 = 56.4 \text{ m}$$

(+1 point)

The pump power,  $P$ ,

$$P = \rho g Q h_p = (998)(9.81) \left( \frac{220}{3600} \right) (56.4) = 33.7 \text{ kW}$$

(+1 point)