

Answer on Question #71645-Physics-Other

Water is flowing through a horizontal pipe of varying cross section. At any two places, the diameters of the tube are 4 cm and 2cm. If the pressure between these two places be equal to 4.5cm, then determine the rate of flow of water in the tube

Solution

$$\frac{\rho v_1^2}{2} = \frac{\rho v_2^2}{2} + \rho gh$$

$$v_1^2 = v_2^2 + 2gh$$

$$\frac{\pi d_1^2}{4} v_1 = \frac{\pi d_2^2}{4} v_2$$

$$v_2 = v_1 \left(\frac{d_1}{d_2} \right)^2$$

$$v_1^2 = v_1^2 \left(\frac{d_1}{d_2} \right)^4 + 2gh$$

$$v_1^2 = \frac{2gh}{1 - \left(\frac{d_1}{d_2} \right)^4}$$

The rate of flow of water in the tube is

$$\frac{dV}{dt} = \frac{\pi d_1^2}{4} v_1 = \frac{\pi d_1^2}{4} \sqrt{\frac{2gh}{1 - \left(\frac{d_1}{d_2} \right)^4}}$$

$$\frac{dV}{dt} = \frac{\pi(0.02)^2}{4} \sqrt{\frac{2(9.8)(0.045)}{1 - \left(\frac{2}{4} \right)^4}} = 0.0003 \frac{m^3}{s}$$

Answer: $0.0003 \frac{m^3}{s}$.

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