See the HiHW grading rubric posted on Carmen

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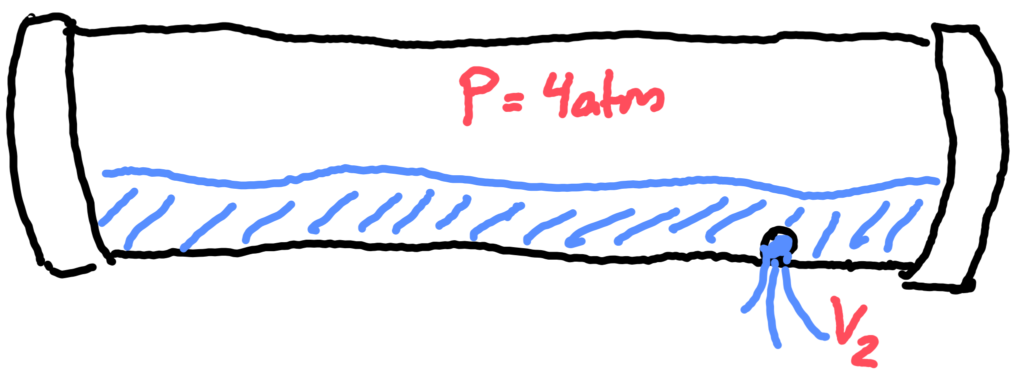
A horizontal section of narrow pipe is filled with water whose flow speed is negligible ($v_1 \approx 0$). The **gauge** pressure inside the pipe is $P_{gauge} = 4.0\,\text{atm}$. There is a pinhole-sized leak in the wall of the pipe, and water exits the hole with speed v_2. What is v_2? For the limit check, investigate what happens to v_2 if the gauge pressure inside the pipe drops to zero ($P_{gauge} \to 0$).

Representation:	0	1	2
Physics Concept(s):	0	1	2
Initial Equation(s):	0	0.5	1
Symbolic Answer:	0		1
Units Check:	0	0.5	1
Limits Check:	0	0.5	1
Neatness:	-2	-1	0
Total:			
Correct Answer:	Y	N	

Representation



Physics Concept(s) (Refer to the list posted on Carmen)

(1) Bernoulli Equation

Initial Equations

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$

↓ Show Your Equation Work On Next Page ↓

Algebra Work (Symbols only. Don't plug in any numbers yet.)

$$P_1 + \cancel{\frac{1}{2}\rho v_1^2} + \cancel{\rho g h_1} = P_2 + \frac{1}{2}\rho v_2^2 + \cancel{\rho g h_2}$$

$$P_1 = P_2 + \frac{1}{2}\rho v_2^2$$

$$\frac{1}{2}\rho v_2^2 = P_1 - P_2$$

$$v_2^2 = \frac{2(P_1 - P_2)}{\rho}$$

$$v_2 = \sqrt{\frac{2(P_1 - P_2)}{\rho}}$$

Symbolic Answer: $v_2 = \sqrt{\frac{2(P_1 - P_2)}{\rho}}$

Units Check

$$m/s = \frac{atm}{kg/m^3} = \frac{N/m^2}{kg/m^3}$$

$$= \frac{\frac{kg\,\cancel{m}}{s^2}}{m^{\cancel{2}}} \div \frac{kg}{m^3} = \frac{\cancel{kg}}{\cancel{m}s^2} \cdot \frac{m^{\cancel{3}}}{\cancel{kg}}$$

$$\frac{m}{s} = \frac{m^{\cancel{2}}}{s^{\cancel{2}}} = \frac{m}{s}$$

Limits Check

a) As $P_{gauge} \to 0$, what limit does v_2 approach?

$$\lim_{P \to 0} v_2 = 0$$

b) Why does the result make physical sense?

If there is no pressure, there is nothing causing water to leave the hole

Numerical Answer: (Obtain this by plugging numbers into your symbolic answer.)

28.47