

One of the most important things in fluid mechanics is to find the temperature of a substance because it affects the properties. The first thing to do in solving a Bernoulli's Equation is to pick a reference point. Typically, you pick the point with the most information given. However, when there is a when the fluid is flowing out of the system, the procedure is a little different. One thing I found interesting is when liquid leaves the system and goes into the atmosphere, it then has the same pressure as the atmosphere. It does not change, it remains constant.

Diagram: A vertical pipe with a diameter of 300 mm at the bottom (point A) and 600 mm at the top (point B). The height difference is 4.5 m. Water at 10°C flows upwards at a rate of 0.37 m³/s. The pressure at point A is 66.2 kPa, and the pressure at point B is unknown.

Given data:

- Water @ 10°C
- rate 0.37 m³/s
- pressure A = 66.2 kPa
- pressure B = ?
- Diameter A = 300 mm
- Diameter B = 600 mm
- Length A-B = 4.5 m

Bernoulli's Equation:

$$\frac{P_A}{\gamma} + \frac{V_A^2}{2g} + Z_A = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + Z_B$$

Continuity Equation:

$$V = \frac{Q}{A}$$

Pressure at point B:

$$P_B = P_A + \frac{\gamma}{2g} (V_A^2 - V_B^2) + \gamma (Z_A - Z_B)$$

Area calculations:

$$A_A = \frac{\pi}{4} 0.3^2 = 0.0707 \text{ m}^2$$

$$A_B = \frac{\pi}{4} 0.6^2 = 0.2827 \text{ m}^2$$

Final pressure calculation:

$$P_B = 66.2 \text{ kPa} + \frac{9.81 \cdot 0.37}{2 \cdot 9.81 \text{ m/s}^2} \cdot \left(\frac{1}{0.0707^4} - \frac{1}{0.2827^4} \right) + 9.81 \text{ kN/m}^3 \cdot (0 - 4.5) \text{ m}$$

Result:

$$P_B = 34.893 \text{ kPa}$$