Ch 13 Fluids

Season 1 Episode 2 - HYDRODYNAMICS

In this episode of LARC Physics 3B, we're going to . . .

- Evaluate fluid motion by applying **Bernoulli's Equation** and the **Continuity Equation**, along with **Pascal's Principle** sprinkled on top.
- Applying these concepts/equations, we can answer questions like:
  - How fast water is flowing from the water tank to a house faucet? How much pressure does a syringe need to enter the blood stream? How does a vacuum cleaner create suction?

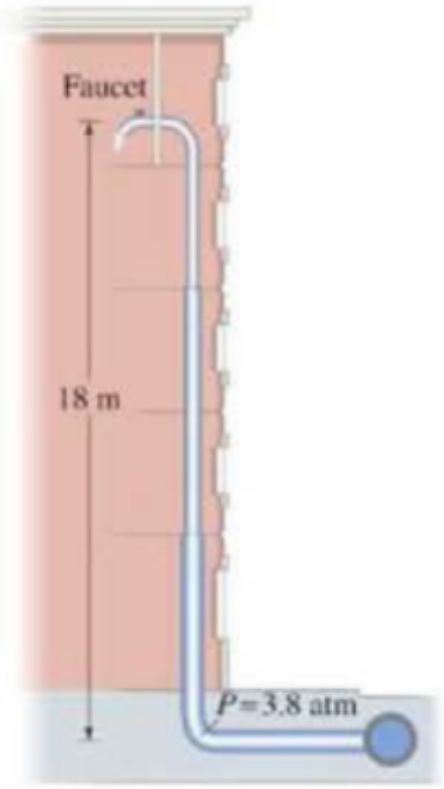
Guided Practice

Water at a gauge pressure of 3.8 atm at street level flows into an office building at a speed of 0.68 m/s through a 5 cm diameter pipe. The pipe tapers down to 2.8 cm in diameter by the top floor, which is located 18 m above the street level.

(a) Calculate the flow velocity of the water exiting the faucet on the top floor

(b) Calculate the gauge pressure in the pipe on the top floor

Answer: (a) $v = 2.2\,\text{m/s}$ (b) $P = 2\,\text{atm}$

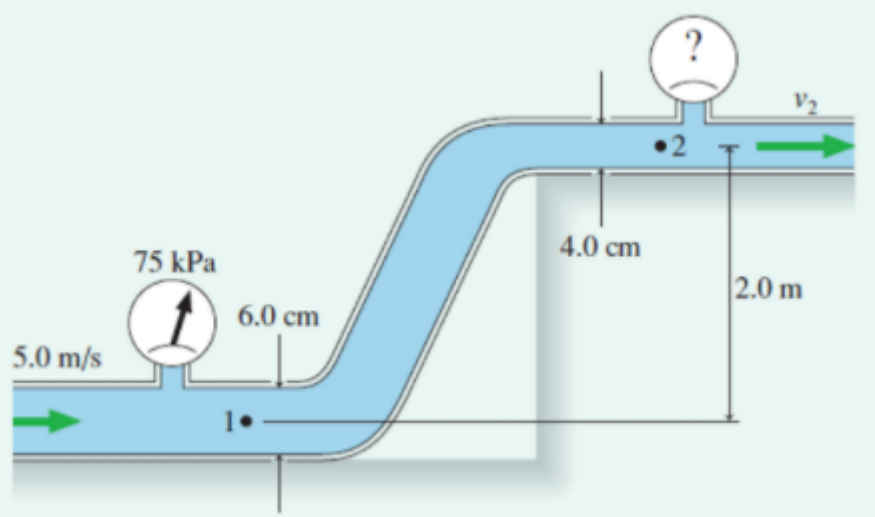


Breakout-Room Activity

Water flows through the pipes as shown in the figure below. The water's speed through the lower pipe is 5 m/s and a pressure gauge reads 75 kPa. What is the reading of the pressure gauge on the upper pipe, which is 2 m above?

NOTE: The pressure gauge device gives the gauge pressure, not the absolute pressure

Answer: $P = 4.6\,\text{kPa}$ (Gauge Pressure)



Breakout-Room Activity

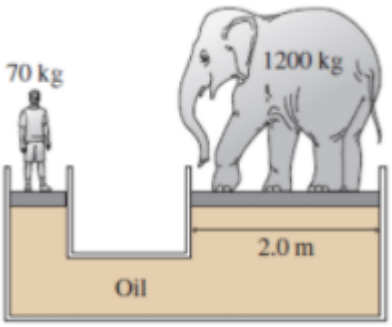


FIGURE P15.40

(a) A 70 kg student balances a 1200 kg elephant on a hydraulic lift as shown in the figure. What is the diameter of the piston the student is standing on?

(b) A second student joins the first, causing the elephant's platform to rise by 35 cm in order to return the system back to equilibrium. What is the mass of the second student?

Useful info: $\rho_{oil} = 900\,\text{kg/m}^3$

Hint: the additional height gained on the elephant's side can be thought of as an additional "weight" or "pressure" due to the oil.

Answer: (a) $d = 0.5\,\text{m}$ (b) $m = 53\,\text{kg}$

Challenge Activity

A 2.0 mL syringe has an inner diameter of 6.0 mm, a needle inner diameter of 0.25 mm, and a plunger pad diameter (where you place your finger) of 1.2 cm. A nurse uses the syringe to inject medicine into a patient whose blood pressure is 140/100.

(a) What is the minimum force the nurse needs to apply to the syringe?

(b) The nurse empties the syringe in 2.0 s. What is the flow speed of the medicine through the needle?

Useful info: 100 mmHg $= 1.33 \times 10^4$ Pa, 1 m^3 = 1000 L

Answer: (a) 1.5 N (b) $v = 20$ m/s