BOYLE'S LAW

OVERVIEW

- Boyle's Law states that there is an inverse relationship between pressure (P) and volume (V) when all other variables are held constant.
- This means that when either P or V goes up, the other goes down.

FORMULA

- The mathematical formula for Boyle's Law is: $P_IV_I = P_2V_2$
- This relationship (Boyle's Law) tells us that if something happens to a gas' pressure or volume, the pressure of a gas before multiplied by its volume before must equal the pressure after multiplied by the volume after.

EXAMPLES

- If you push down on a capped off syringe with a gas inside, the pressure on the gas goes up.
- This is due to the increased numbers of collisions with the sides of the container, while the total volume occupied by the gas decreases.
- If you pull on the syringe, the gas' volume will go up, but its pressure will go down.
- This is due to the decreased number of collisions with the sides of the container.
- See figure 5.1. This graph shows the inverse relationship between pressure and volume for a gas

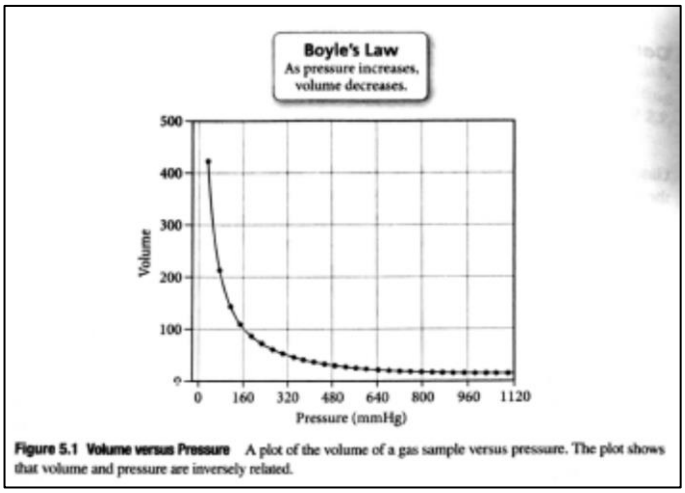
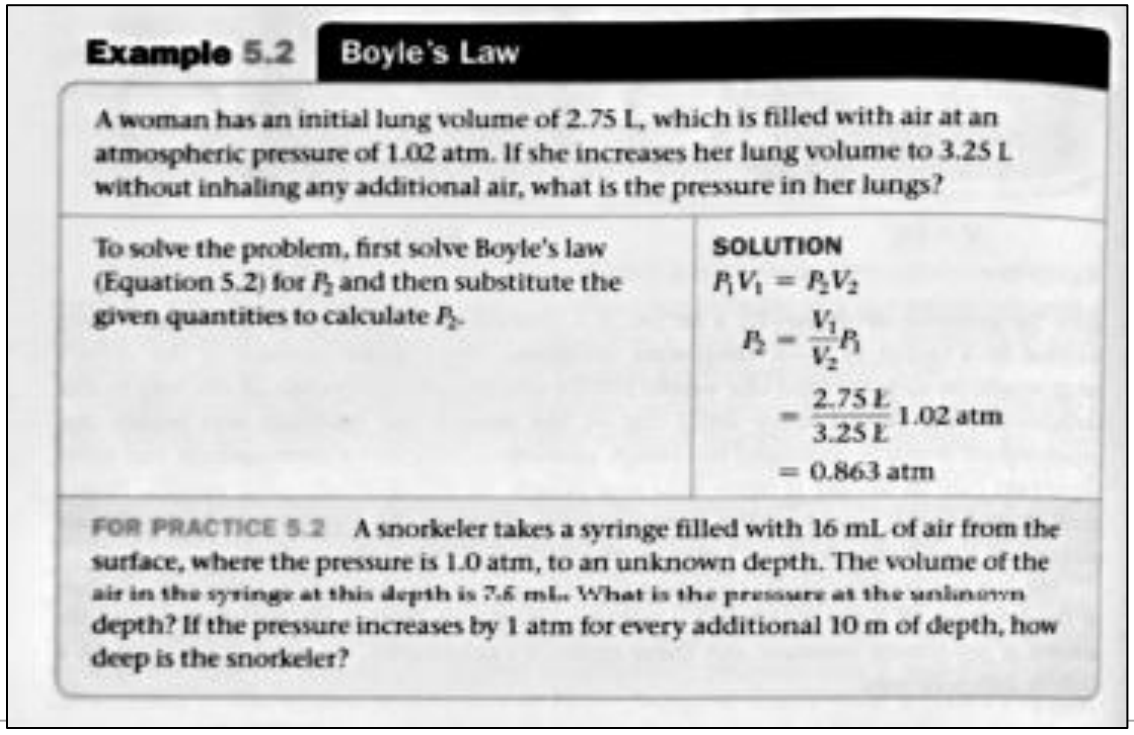


Figure 5.1 Volume versus Pressure A plot of the volume of a gas sample versus pressure. The plot shows that volume and pressure are inversely related.

- See example 5.2 to see how Boyle's Law is used in solving equations.



Example 5.2 **Boyle's Law**

A woman has an initial lung volume of 2.75 L, which is filled with air at an atmospheric pressure of 1.02 atm. If she increases her lung volume to 3.25 L without inhaling any additional air, what is the pressure in her lungs?

To solve the problem, first solve Boyle's law (Equation 5.2) for P_2 and then substitute the given quantities to calculate P_2.

SOLUTION

$$P_1V_1 = P_2V_2$$

$$P_2 = \frac{V_1}{V_2}P_1$$

$$= \frac{2.75\ \text{L}}{3.25\ \text{L}}\,1.02\ \text{atm}$$

$$= 0.863\ \text{atm}$$

FOR PRACTICE 5.2 A snorkeler takes a syringe filled with 16 mL of air from the surface, where the pressure is 1.0 atm, to an unknown depth. The volume of the air in the syringe at this depth is 7.6 mL. What is the pressure at the unknown depth? If the pressure increases by 1 atm for every additional 10 m of depth, how deep is the snorkeler?