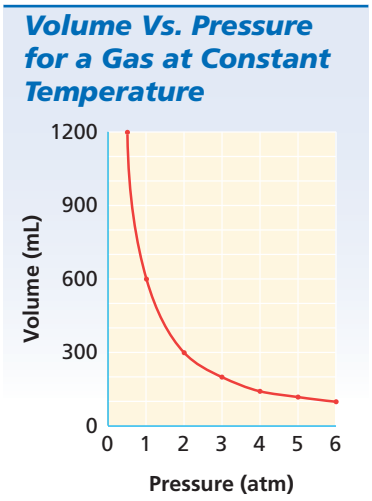


**FIGURE 7** This graph shows that there is an inverse relationship between volume and pressure.

Plotting the values of volume versus pressure for a gas at constant temperature gives a curve like that in **Figure 7.** The general volume-pressure relationship that is illustrated is called Boyle's law. **Boyle's law** *states that the volume of a fixed mass of gas varies inversely with the pressure at constant temperature.*

Mathematically, Boyle's law can be expressed as follows:

$$PV = k$$

In the equation above, $P$ is the pressure, $V$ is the volume, and $k$ is a constant. Since $P$ and $V$ vary inversely, their product remains the same. Because two quantities that are equal to the same thing are equal to each other, the relationship between changes of pressure and volume can be expressed as shown below.

$$P_1V_1 = P_2V_2$$

$P_1$ and $V_1$ represent initial conditions. $P_2$ and $V_2$ represent a different set of conditions. Given three of the four values $P_1$, $V_1$, $P_2$, and $V_2$, you can use this equation to calculate the fourth value for a system at constant temperature.

## SAMPLE PROBLEM C

*For more help, go to the Math Tutor at the end of this chapter.*

**A sample of oxygen gas has a volume of 150.0 mL when its pressure is 0.947 atm. What will the volume of the gas be at a pressure of 0.987 atm if the temperature remains constant?**

### SOLUTION

**1 ANALYZE**

**Given:** $V_1$ of $O_2 = 150.0$ mL; $P_1$ of $O_2 = 0.947$ atm; $P_2$ of $O_2 = 0.987$ atm
**Unknown:** $V_2$ of $O_2$ in mL

**2 PLAN**

Rearrange the equation for Boyle's law ($P_1V_1 = P_2V_2$) to obtain $V_2$.

$$V_2 = \frac{P_1V_1}{P_2}$$

**3 COMPUTE**

Substitute values for $P_1$, $V_1$, and $P_2$ to obtain the new volume, $V_2$.

$$V_2 = \frac{P_1V_1}{P_2} = \frac{(0.947\ \cancel{\text{atm}})(150.0\ \text{mL O}_2)}{0.987\ \cancel{\text{atm}}} = 144\ \text{mL O}_2$$

**4 EVALUATE**

When the pressure is increased slightly at constant temperature, the volume decreases slightly, as expected. Units cancel to give milliliters, a volume unit.

### PRACTICE

*Answers in Appendix E*

1. A balloon filled with helium gas has a volume of 500 mL at a pressure of 1 atm. The balloon is released and reaches an altitude of 6.5 km, where the pressure is 0.5 atm. If the temperature has remained the same, what volume does the gas occupy at this height?

**extension**
Go to **go.hrw.com** for more practice problems that ask you to use Boyle's Law.
**Keyword: HC6GASX**