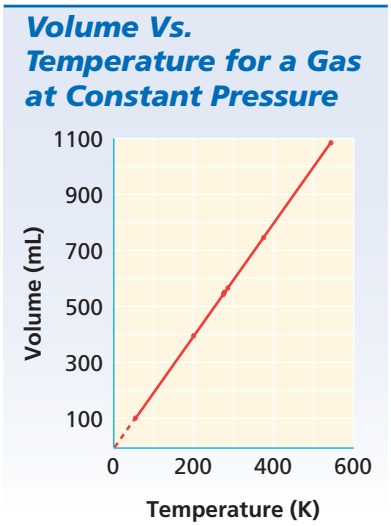

FIGURE 9 This graph shows the plot of the volume versus the Kelvin temperature data of a sample of gas at constant pressure.

Gas volume and Kelvin temperature are directly proportional to each other at constant pressure as shown in **Figure 9.**

The relationship between Kelvin temperature and gas volume is known as Charles's law. **Charles's law** *states that the volume of a fixed mass of gas at constant pressure varies directly with the Kelvin temperature*. Charles's law may be expressed as follows:

$$V = kT \quad \text{or} \quad \frac{V}{T} = k$$

The value of T is the Kelvin temperature, and k is a constant. The ratio V/T for any set of volume-temperature values always equals the same k. The form of Charles's law that can be applied directly to most volume-temperature problems involving gases is as follows:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

V_1 and T_1 represent initial conditions. V_2 and T_2 represent a different set of conditions. When three of the four values T_1, V_1, T_2, and V_2 are known, you can use this equation to calculate the fourth value for a system at constant pressure.

SAMPLE PROBLEM D

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

A sample of neon gas occupies a volume of 752 mL at 25°C. What volume will the gas occupy at 50°C if the pressure remains constant?

SOLUTION

1 ANALYZE

Given: V_1 of Ne = 752 mL; T_1 of Ne = 25°C + 273 = 298 K; T_2 of Ne = 50°C + 273 = 323 K
Unknown: V_2 of Ne in mL

2 PLAN

Because the gas remains at constant pressure, an increase in temperature will cause an increase in volume. To obtain V_2, rearrange the equation for Charles's law.

3 COMPUTE

Substitute values for V_1, T_1, and T_2 to obtain the new volume, V_2.

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{(752 \text{ mL Ne})(323 \text{ K})}{298 \text{ K}} = 815 \text{ mL Ne}$$

4 EVALUATE

As expected, the volume of the gas increases as the temperature increases. Units cancel to yield milliliters, as desired. The answer contains the appropriate number of significant figures.

PRACTICE

Answers in Appendix E

1. A sample of neon gas has a volume of 752 mL at 25.0°C. What will the volume at 100.0°C be if pressure is constant?
2. A sample of nitrogen gas is contained in a piston with a freely moving cylinder. At 0.0°C, the volume of the gas is 375 mL. To what temperature must the gas be heated to occupy a volume of 500.0 mL?

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