

**SAMPLE PROBLEM F**

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

A helium-filled balloon has a volume of 50.0 L at 25°C and 1.08 atm. What volume will it have at 0.855 atm and 10.0°C?

**SOLUTION**

- 1 ANALYZE** Given:  $V_1$  of He = 50.0 L;  $T_1$  of He = 25°C + 273 = 298 K;  $T_2$  of He = 10°C + 273 = 283 K  
 $P_1$  of He = 1.08 atm;  $P_2$  of He = 0.855 atm  
Unknown:  $V_2$  of He in L
- 2 PLAN** Because the gas changes in both temperature and pressure, the combined gas law is needed. Rearrange the combined gas law to solve for the final volume,  $V_2$ .
- $$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \longrightarrow V_2 = \frac{P_1 V_1 T_2}{P_2 T_1}$$
- 3 COMPUTE** Substitute the known values into the equation to obtain a value for  $V_2$ .
- $$V_2 = \frac{(1.08 \text{ atm})(50.0 \text{ L He})(283 \text{ K})}{(0.855 \text{ atm})(298 \text{ K})} = 60.0 \text{ L He}$$
- 4 EVALUATE** Here the pressure decreases much more than the temperature decreases. As expected, the net result of the two changes gives an increase in the volume, from 50.0 L to 60.0 L. Units cancel appropriately. The answer is correctly expressed to three significant figures. It is also reasonably close to an estimated value of 50, calculated as  $(50 \times 300)/300$ .

**PRACTICE**

Answers in Appendix E

1. The volume of a gas is 27.5 mL at 22.0°C and 0.974 atm. What will the volume be at 15.0°C and 0.993 atm?
2. A 700.0 mL gas sample at STP is compressed to a volume of 200.0 mL, and the temperature is increased to 30.0°C. What is the new pressure of the gas in Pa?

**extension**

Go to [go.hrw.com](http://go.hrw.com) for more practice problems that ask you to use the combined gas law.



Keyword: HC6GASX

**SECTION REVIEW**

1. Relate the effect of temperature and pressure on a gas to the model of a gas given by the kinetic-molecular theory.
2. A sample of helium gas has a volume of 200.0 mL at 0.960 atm. What pressure, in atmospheres, is needed to reduce the volume at constant temperature to 50.0 mL?
3. A sample of nitrogen gas occupies 1.55 L at 27.0°C and 1.00 atm. What will the volume be at -100.0°C and the same pressure?
4. A gas occupies 2.0 m<sup>3</sup> at 100.0 K and exerts a pressure of 100.0 kPa. What volume will the gas occupy if the temperature is increased to 400.0 K and the pressure is increased to 200.0 kPa?

**Critical Thinking**

5. **ANALYZING RESULTS** A student has the following data:  $V_1 = 822 \text{ mL}$ ,  $T_1 = 75^\circ\text{C}$ , and  $T_2 = -25^\circ\text{C}$ . He calculates  $V_2$  and gets -274 mL. Is this value correct? Explain why or why not.
6. **APPLYING MODELS** Explain Charles's law in terms of the kinetic-molecular theory.