B4 · Charles's law: volume and temperature · Worked examples and practice

Name: _____ Date: _____

Worked examples

Read these first. There is one for each kind of question in this lesson.

Example 1 · Find the new volume

Use Charles's law, $V_1/T_1 = V_2/T_2$, and T (K) = t (°C) + 273. The pressure and the amount of gas do not change. A gas fills 2.40 L at 15 °C. It is heated to 75 °C. What is the new volume?

1. $T_1 = 15 + 273 = 288$ K. $T_2 = 75 + 273 = 348$ K.
2. $V_2 = V_1T_2 / T_1 = (2.40 \text{ L} \times 348 \text{ K}) / 288 \text{ K} = 2.90$ L.
3. Check: the gas got hotter, so the volume went up.

Answer: The new volume is 2.90 L.

Example 2 · Find the new temperature

Use Charles's law, $V_1/T_1 = V_2/T_2$, and T (K) = t (°C) + 273. The pressure and the amount of gas do not change. A gas fills 3.00 L at 27 °C. It is cooled until it fills 2.50 L. What is the new temperature?

1. $T_1 = 27 + 273 = 300$ K.
2. $T_2 = T_1V_2 / V_1 = (300 \text{ K} \times 2.50 \text{ L}) / 3.00 \text{ L} = 250$ K.
3. 250 − 273 = −23 °C.
4. Check: the volume went down, so the gas got colder.

Answer: The new temperature is 250 K, which is −23 °C.

Practice

Questions 1 to 4 are easy. Questions 5 to 8 are medium. Questions 9 and 10 are harder.

EASY

1. The kelvin temperature of a gas doubles at the same pressure. Explain what happens to its volume.

EASY

2. Use T (K) = t (°C) + 273. A gas is at 27 °C. What temperature do you put into Charles's law?

EASY

3. Use Charles's law, $V_1/T_1 = V_2/T_2$, and T (K) = t (°C) + 273. The pressure and the amount of gas do not change. A gas fills 2.00 L at 27 °C. It is heated to 177 °C. What is the new volume?

EASY

4. Use Charles's law, $V_1/T_1 = V_2/T_2$, and T (K) = t (°C) + 273. The pressure and the amount of gas do not change. A gas fills 500 mL at 0 °C. It is heated to 91 °C. What is the new volume?

MEDIUM

5. Use Charles's law, $V_1/T_1 = V_2/T_2$, and T (K) = t (°C) + 273. The pressure and the amount of gas do not change. A gas fills 3.60 L at 45 °C. It is cooled to 5 °C. What is the new volume?

MEDIUM

6. Use Charles's law, $V_1/T_1 = V_2/T_2$, and T (K) = t (°C) + 273. The pressure and the amount of gas do not change. A gas fills 1.80 L at 20 °C. It is warmed until it fills 2.10 L. What is the new temperature, in kelvin and in °C?

MEDIUM

7. Use Charles's law, $V_1/T_1 = V_2/T_2$, and T (K) = t (°C) + 273. The pressure and the amount of gas do not change. A gas fills 725 mL at −10 °C. It is heated to 30 °C. What is the new volume?

MEDIUM

8. Use Charles's law, $V_1/T_1 = V_2/T_2$, and T (K) = t (°C) + 273. The pressure and the amount of gas do not change. A gas fills 6.00 L at 77 °C. It is cooled until it fills 4.80 L. What is the new temperature, in kelvin and in °C?

HARDER

9. Use Charles's law, $V_1/T_1 = V_2/T_2$, and T (K) = t (°C) + 273. The pressure and the amount of gas do not change. A balloon holds 4.20 L of air at 22 °C. It is left in a car at 58 °C. Find the new volume. Then explain, using particles, why the balloon grew.

HARDER

10. Use Charles's law, $V_1/T_1 = V_2/T_2$, and T (K) = t (°C) + 273. The pressure and the amount of gas do not change. A gas fills 1.00 L at 10 °C. It is heated to 20 °C. A student says the volume doubles to 2.00 L. Find the correct volume. Then say what the student did wrong.