

8 • Why Do Hot Air Balloons Float?**CHARLES'S LAW**

Charles' Law states the volume of a gas varies directly with the Kelvin temperature, assuming the pressure is constant. We use the following formulas:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \text{or} \quad V_1 \times T_2 = V_2 \times T_1$$

$$K = ^\circ C + 273$$

Solve the following problems assuming a constant pressure. Assume all numbers are 3 significant figures.

- A sample of nitrogen occupies a volume of 250 mL at 25°C . What volume will it occupy at 95°C ?

$\frac{250 \text{ mL}}{298 \text{ K}} = \frac{x}{368 \text{ K}}$ $x = 309 \text{ mL}$
- Oxygen gas is at a temperature of 40°C when it occupies a volume of 2.30 Liters. To what temperature should it be raised to occupy a volume of 6.50 Liters?

$\frac{2.30 \text{ L}}{313 \text{ K}} = \frac{6.50 \text{ L}}{x}$ $x = 885 \text{ K} = 612^\circ\text{C}$
- Hydrogen gas was cooled from 150°C to 50°C . Its new volume is 75.0 mL. What was its original volume?

$\frac{x}{423} = \frac{75.0 \text{ mL}}{323}$ $x = 98.2 \text{ mL}$
- Chlorine gas occupies a volume of 25.0 mL at 300 K. What volume will it occupy at 600 K?

$\frac{25.0 \text{ mL}}{300 \text{ K}} = \frac{x}{600 \text{ K}}$ $x = 50.0 \text{ mL}$
- A sample of neon gas at 30°C and a volume of 2.50 Liters is cooled to 25°C . What is the new volume?

$\frac{2.50 \text{ L}}{323 \text{ K}} = \frac{x}{298 \text{ K}}$ $x = 2.31 \text{ L}$
- Fluorine gas at 300 K occupies a volume of 500 mL. To what temperature should it be lowered to bring the volume to 300 mL?

$\frac{500 \text{ mL}}{300 \text{ K}} = \frac{300 \text{ mL}}{x}$ $x = 180 \text{ K} = -93^\circ\text{C}$
- Helium occupies a volume of 3.80 Liters at -45°C . What volume will it occupy at 45°C ?

$\frac{3.80 \text{ L}}{228 \text{ K}} = \frac{x}{318 \text{ K}}$ $x = 5.30 \text{ L}$
- A sample of argon gas is cooled and its volume went from 380 mL to 250 mL. If its final temperature was -55°C , what was its original temperature?

$\frac{380 \text{ mL}}{x} = \frac{250 \text{ mL}}{218 \text{ K}}$ $x = 331 \text{ K} = 58.4^\circ\text{C}$

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