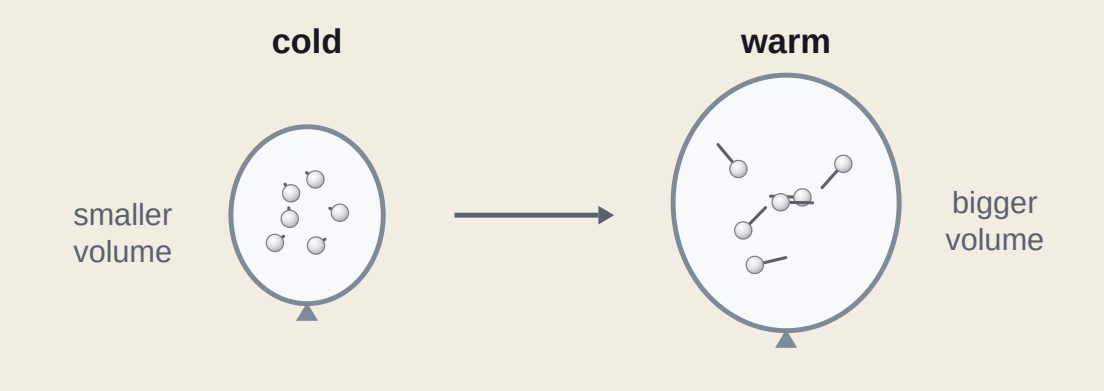
B4 · Charles's law: volume and temperature · Notes

Goals: Describe how the volume of a gas changes when its temperature changes. State Charles's law and the two things that must stay the same. Use Charles's law, with temperatures in kelvin, to find a volume or a temperature.

Name: _____ Date: _____

Slide 1 of 5 · Warming and cooling a gas

Lesson B3 linked pressure and volume. Now you keep the pressure the same and change the temperature.



Key ideas

Take a balloon outside on a cold day and it _____.

No air _____ out.

Warmer particles move _____.

Faster particles push the balloon skin out _____.

Example

A balloon shrinks in the cold, but no air leaked out. Which of the four things we measure changed?

Try it

Why does a balloon get bigger when the air inside it warms up?

Slide 2 of 5 · Volume divided by kelvin temperature stays the same

On the last slide a balloon grew when it warmed. Measurements show exactly how much a gas grows.

temp. (°C)	temp. (K)	volume (L)	V ÷ T (L/K)
−73	200	2.00	0.0100
27	300	3.00	0.0100
127	400	4.00	0.0100

The amount of gas and the pressure stayed the same.

Key ideas

Change each temperature to kelvin: add _____.

Divide each volume by its _____.

Volume divided by kelvin temperature _____.

Example

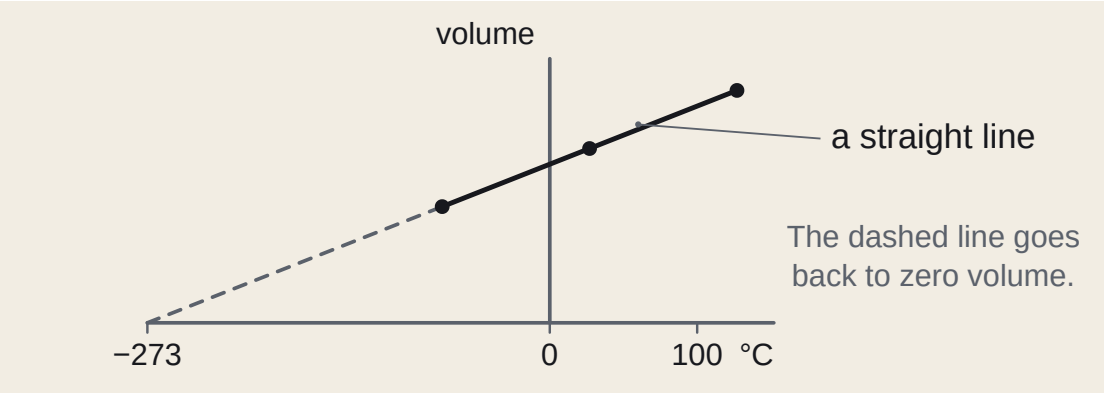
A gas fills 3.00 L at 300 K and 6.00 L at 600 K. Divide each volume by its kelvin temperature. What do you notice?

Try it

A table gives gas volumes with temperatures in degrees Celsius. What must you do before you divide?

Slide 3 of 5 · The graph for Charles's law

The last slide showed the results as a table. A graph shows the pattern, and something more.



Key ideas

The three dots lie on a _____.

As the temperature goes up, the volume goes _____.

Volume and temperature are _____.

The dashed line reaches zero volume at −_____ °C.

Example

Draw the shape of the graph of volume against temperature for a gas. Say what the shape shows.

Try it

The line on the graph is extended back to zero volume. What temperature does it reach?

Slide 4 of 5 · Charles's law as a formula

The last two slides showed the pattern as a table and as a graph. Now you write it as a formula.

$$V_1/T_1 = V_2/T_2$$

T is in kelvin, never in °C.

The pressure must stay the same.
The amount of gas must stay the same.

Key ideas

V_1 and T_1 are the volume and temperature _____ a change.

Both temperatures must be in _____.

Charles's law only works when the _____ and the amount of gas stay the same.

Both volumes must be in the _____.

Example

Write Charles's law as a formula. Say what unit the temperatures must have.

Try it

Name the two things that must stay the same for Charles's law to work.

Slide 5 of 5 · Using Charles's law

The last slide gave Charles's law as a formula. Now you use it to find a volume.

$T_1 = 15 + 273 = 288$ K, $T_2 = 75 + 273 = 348$ K

$V_1 = 3.60$ L, $V_2 = ?$

$V_2 = V_1T_2 / T_1$

$V_2 = (3.60 \text{ L} \times 348 \text{ K}) / 288 \text{ K}$

$V_2 = 4.35$ L

Key ideas

First change both temperatures to _____.

When the gas gets hotter, the volume goes _____.

When the gas gets colder, the volume goes _____.

Example

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 87 °C. What is the new volume?

Try it

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 5.00 L at 47 °C. It is cooled to 7 °C. What is the new volume?