

15 The ideal gas equation – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
ideal gas	理想气体	_____
equation of state	状态方程	_____
molar gas constant	摩尔气体常量	_____

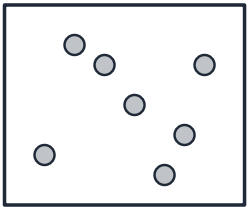
Recall

An **ideal gas** 理想气体 follows a simple law linking its pressure, volume and temperature — one equation covers the air in a tyre, a balloon, or a syringe.

New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

■ 1 The equation of state



gas: p , V , T , n moles

$$pV = nRT$$

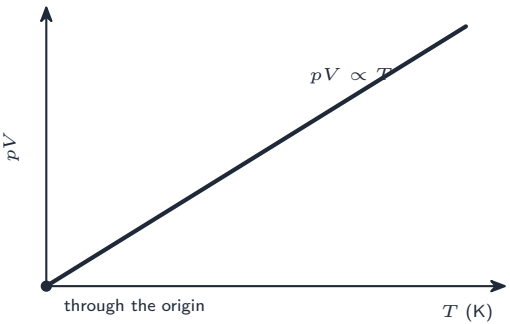
The **equation of state** 状态方程 of an ideal gas is

$$pV = nRT,$$

where n is the number of moles and $R = 8.31 \text{ J mol}^{-1}\text{K}^{-1}$ is the **molar gas constant** 摩尔气体常量. Temperature T must be in kelvin.

Worked example. Find the pressure of 2.0 mol of gas in a 0.050 m^3 container at 300 K:
$$p = \frac{nRT}{V} = \frac{2.0 \times 8.31 \times 300}{0.050} \approx 1.0 \times 10^5 \text{ Pa}.$$

■ 2 The straight-line link



For a fixed amount of gas, $pV \propto T$ — a straight line through the origin when T is in kelvin.

Worked example. A sealed gas is heated from 300 K to 600 K. Since $pV \propto T$ and T doubles, the product pV also doubles.

Watch out: T must be in kelvin in $pV = nRT$. Putting in degrees Celsius gives the wrong answer — and total nonsense near 0°C .

Practice

Try these in order.

15.1 Write the *equation of state* of an ideal gas. [1]

15.2 In that equation, what does n stand for? [1]

15.3 In which unit must the temperature T be given? [1]

15.4 A gas has $n = 1.5$ mol, $T = 400$ K and $V = 0.020$ m³. Find the pressure ($R = 8.31$). [2]

15.5 For a fixed gas, pV is proportional to what? [1]

15.6 A sealed gas is heated from 300 K to 600 K at constant pressure. What happens to its volume? Explain. [2]

15.7 Challenge. A student writes "the gas is at 27 °C, so I put $T = 27$ into $pV = nRT$." Explain the mistake and give the value that should be used. [2]
