5.2 Ideal gas molecules

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

Objective

Build the skills to answer exam questions on **gas pressure and temperature** : particles and pressure, absolute zero and the kelvin scale, pressure and temperature at constant volume, and pressure and volume at constant temperature.

You must be able to:

- explain gas pressure in terms of particles
- convert between °C and kelvin
- use $p_1/T_1 = p_2/T_2$ and $p_1V_1 = p_2V_2$
- plan an experiment linking the pressure and temperature of a gas

1 Key knowledge and worked examples

Gases

idea	equation or rule
gas pressure	particles hit the walls; each collision pushes on the wall
kelvin scale	T (K) $= \theta$ (°C) $+273$; absolute zero is 0 K $= -273\,°C$
temperature	the average kinetic energy of the particles is proportional to the kelvin temperature
constant volume	$p_1 \div T_1 = p_2 \div T_2$ (temperature in K)
constant temperature	$p_1 \times V_1 = p_2 \times V_2$

Worked example 1: kelvin. Convert 27 °C and −73 °C to kelvin.

1. Known: 27 °C and −73 °C.
2. Rule: add 273.
3. Numbers: $27 + 273$; $-73 + 273$.
4. Result: 300 **K and** 200 **K**.

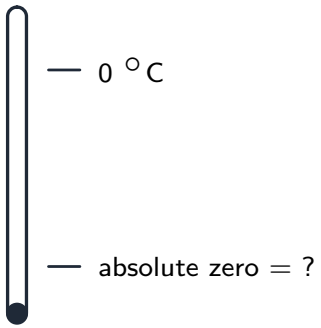
Worked example 2: squashing a gas. 200 cm^3 of gas at 100 kPa is squashed to 50 cm^3 at the same temperature. Find the new pressure.

1. Known: $p_1 = 100$ kPa; $V_1 = 200$; $V_2 = 50$.
2. Rule: $p_1V_1 = p_2V_2$.
3. Numbers: $100 \times 200 = p_2 \times 50$.
4. Result: $p_2 = 400$ **kPa**.

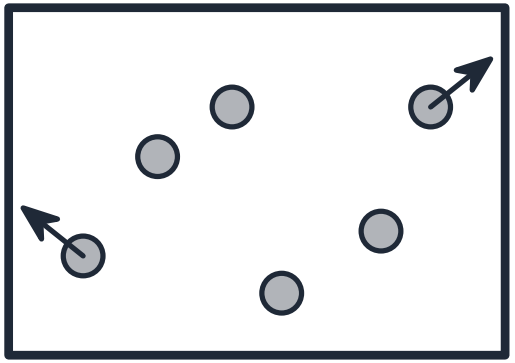
Answer shapes: always change °C to K before using $p \div T$.

2 Practice

2.1 What is absolute zero? Give its value in °C. [2]



2.2 Explain how a gas in a closed container exerts a pressure. [2]



2.3 The gas in a sealed syringe is pushed into a smaller volume at constant temperature. Explain why its pressure rises. [2]

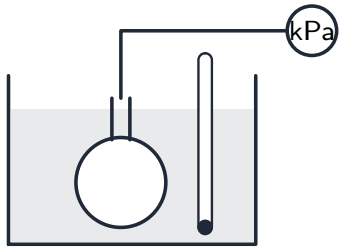


3 Exam-style questions

3.1 A bicycle pump holds 120 cm^3 of air at 100 kPa. The outlet is blocked and the piston is pushed in until the pressure is 250 kPa. The temperature does not change. Calculate the new volume. [3]



3.2 A student heats air in a sealed flask in a water bath. A pressure gauge measures the pressure. At 17 °C the pressure is 100 kPa.



(a) Convert 17 °C and 77 °C to kelvin. [2]

(b) Calculate the pressure at 77 °C. [3]

(c) Explain, using particles, why the pressure rises when the air is heated. [3]

(d) Describe how the student can investigate how the pressure of the air depends on its temperature, and how to show that p is proportional to the kelvin temperature. [6]