

2.1 Kinetic particle model of matter

Name: _____ Class: _____ Date: _____

Total: 11 marks

KEY WORDS brownian motion 布朗运动 • solid 固体 • liquid 液体 • particle 粒子 • gas 气体

Objective

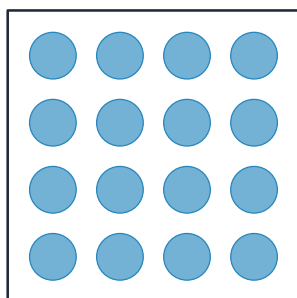
Build the skills to answer exam questions on the **kinetic particle model** 分子动理论 — the three states, **gas pressure** 气体压强, $pV = \text{constant}$, and **Brownian motion** 布朗运动.

You must be able to:

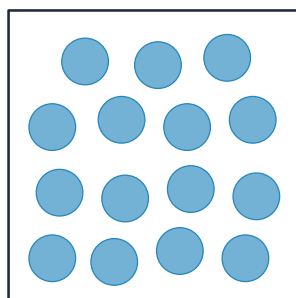
- describe the particle arrangement and motion in solids, liquids, gases
- explain gas pressure and use $p_1V_1 = p_2V_2$ (constant temperature)
- describe Brownian motion as evidence for the particle model

1 Worked examples

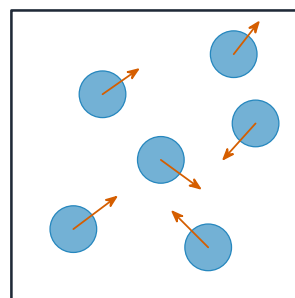
■ States and gas laws



solid
fixed pattern,
vibrate in place

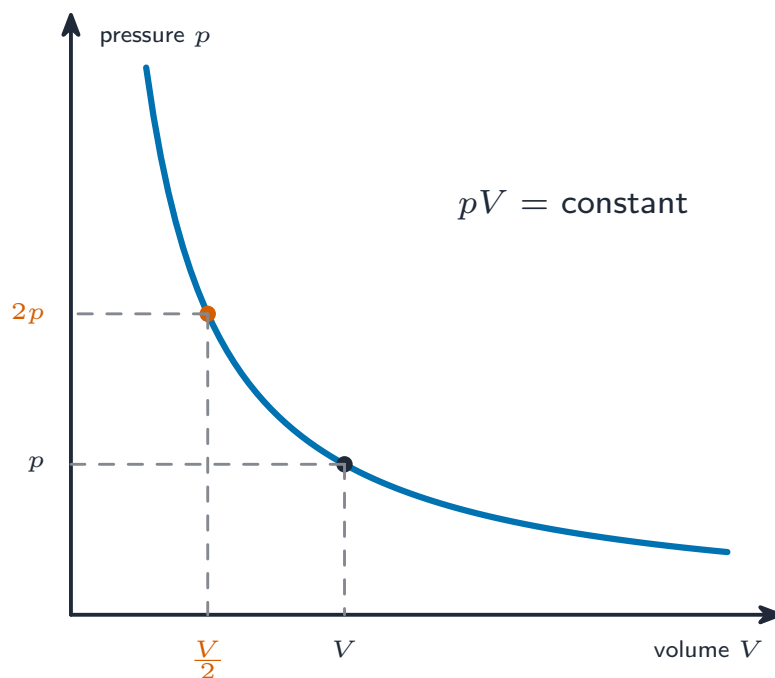


liquid
close, no pattern,
slide past



gas
far apart,
fast and random

Solid: fixed and ordered; liquid: close but disordered; gas: far apart and fast



At constant temperature pV is constant — halve V and p doubles

200 cm³ at 100 kPa squeezed to 50 cm³: $100 \times 200 = p_2 \times 50 \Rightarrow p_2 = 400 \text{ kPa}$.

2 Practice

2.1 Describe the arrangement of particles in a solid.

[1]

2.2 A gas of volume 300 cm³ at 120 kPa is compressed to 100 cm³ at constant temperature. Find the new pressure.

[2]

3 Exam-style questions

3.1 Gas pressure on the container walls is caused by: [1]

- **A** particles vibrating in fixed positions
 - **B** particles colliding with the walls
 - **C** the gas expanding
 - **D** the walls heating up
-

3.2 A fixed mass of gas at constant temperature has $p_1 = 150 \text{ kPa}$ and $V_1 = 400 \text{ cm}^3$.

(a) Find the volume when the pressure is increased to 250 kPa . [3]

(b) Explain, using the particle model, why the pressure rises as the volume falls. [2]

3.3 Explain how Brownian motion provides evidence for the kinetic particle model. [2]

Solutions

2.1 particles are close together in a fixed, regular pattern, vibrating about fixed positions.

2.2 $120 \times 300 = p_2 \times 100 \Rightarrow p_2 = 360 \text{ kPa}$.

3.1 B. Pressure comes from particles colliding with the walls.

3.2 (a) $p_1 V_1 = p_2 V_2$: $150 \times 400 = 250 \times V_2$; $V_2 = \frac{60000}{250}$; $= 240 \text{ cm}^3$.

(b) in a smaller volume the particles hit each unit of wall area more often, so the pressure increases.

3.3 the visible specks (e.g. smoke) move in a random, jerky way; this is because they are struck by fast, invisible air particles — showing matter is made of moving particles.