

Exercise walk-through

Kinetic particle model of matter ■ 2.1

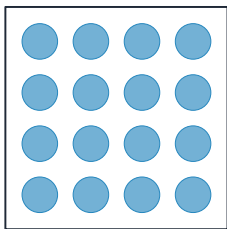
eXercise

You must be able to

- describe the particle arrangement and motion in solids, liquids, gases
- explain gas pressure and use $p_1 V_1 = p_2 V_2$ (constant temperature)
- describe Brownian motion as evidence for the particle model

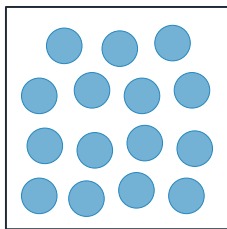
Method — States and gas laws

200 cm^3 at 100 kPa squeezed to 50 cm^3 : $100 \times 200 = p_2 \times 50 \Rightarrow p_2 = 400 \text{ kPa}$.



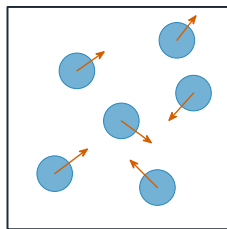
solid

fixed pattern,
vibrate in place



liquid

close, no pattern,
slide past

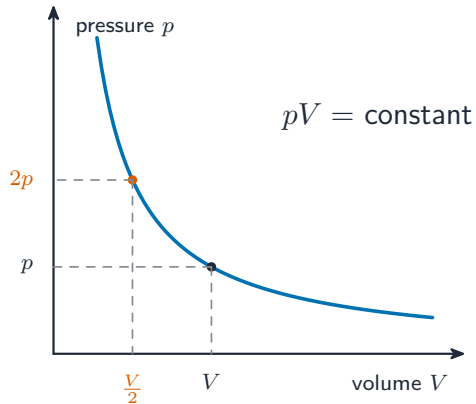


gas

far apart,
fast and random

Particles in three states: ordered solid, close-jumbled liquid, far-apart fast gas

Method — States and gas laws



A pressure–volume curve: halve the volume, double the pressure

Practice 2.1 ■ 1 mark

Describe the arrangement of particles in a solid.

Solution 2.1

Method: States and gas laws

Worked steps

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

B1.

Practice 2.2 ■ 2 marks

A gas of volume 300 cm^3 at 120 kPa is compressed to 100 cm^3 at constant temperature. Find the new pressure.

Solution 2.2

Method: States and gas laws

Worked steps

$$120 \times 300 = p_2 \times 100 \Rightarrow p_2 = 360 \text{ kPa} \quad \text{M1} \quad \text{A1}.$$

Exam-style 3.1 ■ 1 mark

Gas pressure on the container walls is caused by:

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

Solution 3.1

A particles vibrating in fixed positions

B particles colliding with the walls



C the gas expanding

D the walls heating up

Worked steps

B. Pressure comes from particles colliding with the walls.

Exam-style 3.2 ■ 3 marks

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

Solution 3.2

Method: States and gas laws

Worked steps

(a) $p_1 V_1 = p_2 V_2$: $150 \times 400 = 250 \times V_2$ (M1); $V_2 = \frac{60000}{250}$ (M1); $= 240 \text{ cm}^3$ (A1).

(b) in a smaller volume the particles hit each unit of wall area more often (M1), so the pressure increases (A1).

Exam-style 3.3 ■ 2 marks

Explain how Brownian motion provides evidence for the kinetic particle model.

Solution 3.3

Worked steps

the visible specks (e.g. smoke) move in a random, jerky way **M1**; this is because they are struck by fast, invisible air particles — showing matter is made of moving particles **A1**.