Week 10

IGCSE Physics

Homework bundle for this week

本周作业合集

exercises.lol

Contents 目录

IGCSE Physics Name: _____ Score: _____

1. In which state are the particles far apart, fast, and moving in random directions?
   - ☐ gas
   - ☐ solid
   - ☐ liquid
   - ☐ they are the same in all states
2. For the same rise in temperature, which expands the most?
   - ☐ a gas
   - ☐ a liquid
   - ☐ a solid
   - ☐ they all expand by the same amount
3. While ice is melting into water, what happens to the temperature?
   - ☐ it stays the same until all the ice has melted
   - ☐ it rises steadily
   - ☐ it falls steadily
   - ☐ it rises then falls
4. Why are metals such good conductors of thermal energy?
   - ☐ they have free electrons that carry energy quickly
   - ☐ they are shiny
   - ☐ they are heavy
   - ☐ they contain trapped air
5. Temperature is a measure of:
   - ☐ the average kinetic energy of the particles
   - ☐ the total number of particles
   - ☐ the mass of the object
   - ☐ the colour of the object
6. Convert 27 °C to kelvin.

   _____ K

7. How much energy is needed to heat 2.0 kg of water by 10 °C? (Use $c = 4200$ J per kg per °C.)

   _____ J

8. Evaporation can happen below the boiling point.

   ☐ True ☐ False

9. Convection can happen in a solid.

   ☐ True ☐ False

10. A gas has a volume of 200 cm^3 at 100 kPa. It is squeezed to 100 cm^3 at constant temperature. What is the new pressure, in kPa?

    _____ kPa

2. Thermal physics

Answers · 答案

IGCSE Physics

1. **gas**

   Gas particles are far apart and move quickly in random directions, filling the container. Solids only vibrate; liquids slide past each other.

2. **a gas**

   Gases expand the most, then liquids, then solids (whose particles are held most tightly).

3. **it stays the same until all the ice has melted**

   During a change of state the energy goes into breaking the forces between particles, so the temperature stays constant until the change is complete.

4. **they have free electrons that carry energy quickly**

   Metals have free (delocalised) electrons that move through the metal and carry energy rapidly from the hot end to the cold end.

5. **the average kinetic energy of the particles**

   Hotter means the particles move faster, so temperature measures their average kinetic energy.

6. **300 K**

   $T = \theta + 273 = 27 + 273 = 300$ K.

7. **84000 J**

   $\Delta E = mc\,\Delta\theta = 2.0 \times 4200 \times 10 = 84\,000$ J.

8. **True**

   Evaporation happens at the surface at any temperature — the fastest surface particles escape. Boiling happens throughout the liquid at the boiling point.

9. **False**

   Convection needs particles to move from place to place, so it only happens in liquids and gases — not solids.

10. **200 kPa**

    pV is constant: $100 \times 200 = p \times 100$, so $p = 200$ kPa. Halving the volume doubles the pressure.

IGCSE PHYSICS • EXERCISE SHEET

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

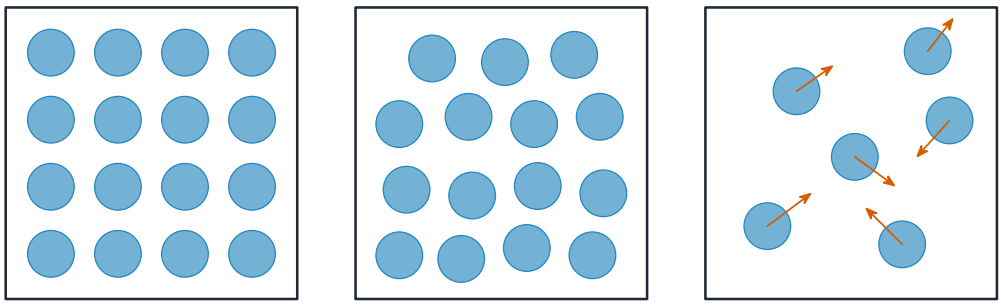
Build the skills to answer exam questions on the **kinetic particle model** 分子动理论 — the three states, **gas pressure** 气体压强, pV = constant, and **Brownian motion** 布朗运动.

You must be able to:

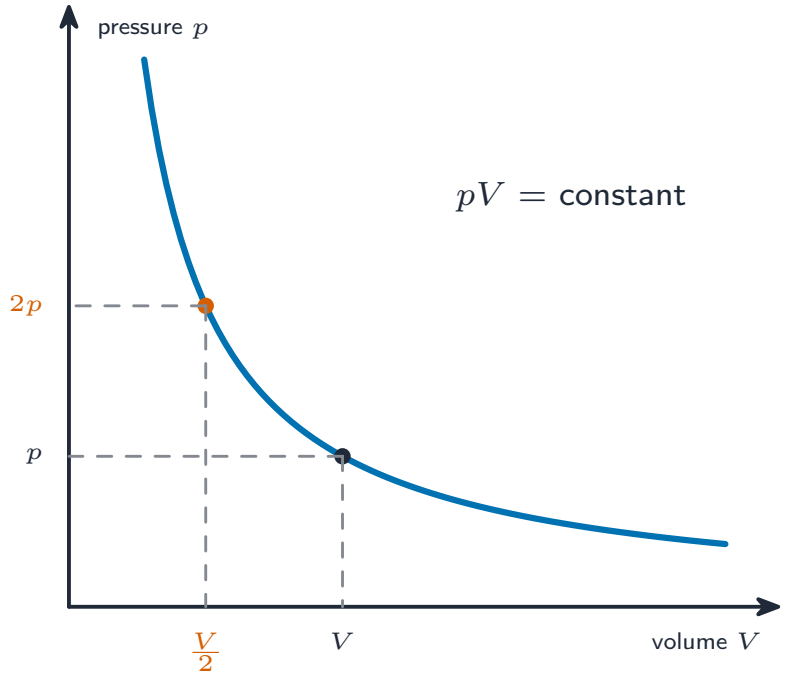
- describe the particle arrangement and motion in solids, liquids, gases
- explain gas pressure and use $p_1V_1 = p_2V_2$ (constant temperature)
- describe Brownian motion as evidence for the particle model

1 Worked examples

■ States and gas laws



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



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

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

2 Practice

2.1 Describe the arrangement of particles in a solid. [1]

2.2 A gas of volume 300 cm^3 at 120 kPa is compressed to 100 cm^3 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 $p_1 = 150$ kPa and $V_1 = 400$ 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 $120 \times 300 = p_2 \times 100 \Rightarrow p_2 = 360$ kPa.

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

3.2 (a) $p_1V_1 = p_2V_2$: $150 \times 400 = 250 \times V_2$; $V_2 = \dfrac{60000}{250}$; $= 240$ 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.

IGCSE PHYSICS • EXERCISE SHEET

2.2 Thermal properties and temperature

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

KEY WORDS specific heat capacity 比热容 • evaporation 蒸发 • thermal expansion 热膨胀 • thermal properties 热学 • melting 熔化

Objective

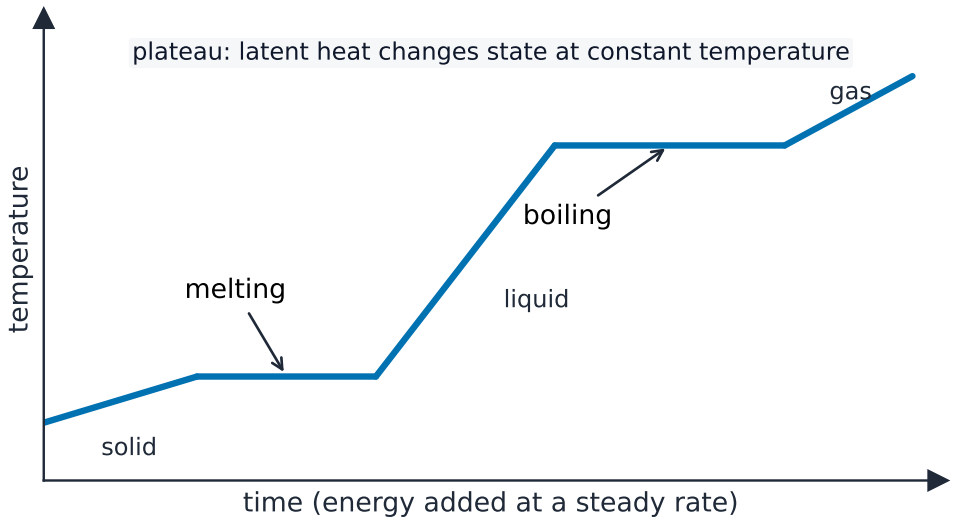
Build the skills to answer exam questions on **thermal properties** 热学性质 — the kelvin scale, **thermal expansion** 热膨胀, **specific heat capacity** 比热容, and melting/boiling/evaporation.

You must be able to:

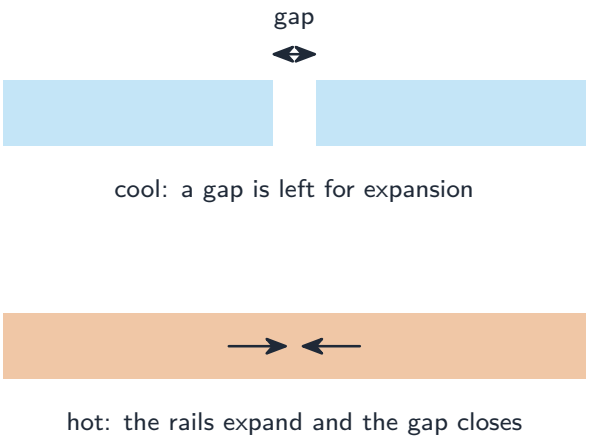
- convert between °C and kelvin ($T = \theta + 273$)
- use $\Delta E = mc\,\Delta\theta$
- describe state changes and explain cooling by evaporation

1 Worked examples

■ Specific heat capacity



During melting and boiling the temperature stays flat while energy is still added



Solids expand on heating — a gap is left so the track does not buckle

Heat 2.0 kg water by 50 °C ($c = 4200$): $\Delta E = mc\Delta\theta = 2.0 \times 4200 \times 50 = 420\,000$ J.

2 Practice

2.1 Convert 25 °C to kelvin. [1]

2.2 State why a liquid cools as it evaporates. [1]

3 Exam-style questions

3.1 While a pure solid is melting, its temperature: [1]

- **A** rises steadily
- **B** stays constant
- **C** falls
- **D** rises then falls

3.2 A 0.50 kg metal block is given 9000 J of energy and its temperature rises by 40 °C.

(a) Find the specific heat capacity of the metal. [3]

(b) State one reason the actual value might be higher than calculated. [1]

3.3 Explain, using the particle model, why evaporation cools the remaining liquid. [2]

Solutions

2.1 $25 + 273 = 298$ K.

2.2 the fastest particles escape, lowering the average energy of those left.

3.1 B. The temperature stays constant during a change of state.

3.2 (a) $c = \dfrac{\Delta E}{m\,\Delta\theta} = \dfrac{9000}{0.50 \times 40}$; $= 450$ J/(kg °C).
(b) some energy is lost to the surroundings, so more than 9000 J was really needed.

3.3 the most energetic particles leave the surface; so the average kinetic energy — and the temperature — of the remaining particles falls.

IGCSE PHYSICS • EXERCISE SHEET

2.3 Transfer of thermal energy

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

KEY WORDS convection 对流 • radiation 热辐射 • infrared 红外线 • transfer of thermal energy 热能传递 • dull 暗淡

Objective

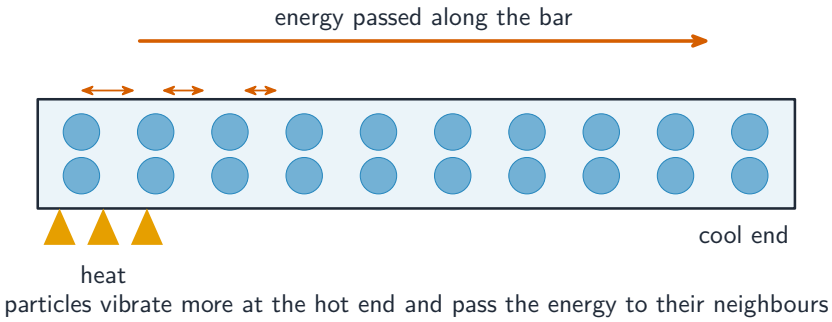
Build the skills to answer exam questions on the **transfer of thermal energy** 热能传递 — **conduction** 热传导, **convection** 对流 and **radiation** 热辐射.

You must be able to:

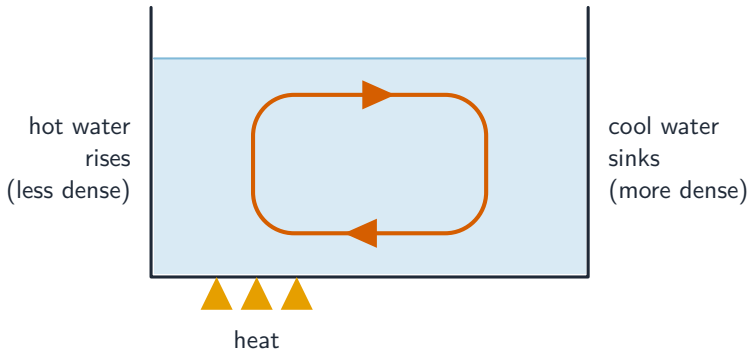
- explain conduction (and why metals are good conductors)
- explain convection currents in fluids
- describe thermal radiation and good/poor emitters

1 Worked examples

■ Three transfer methods



Conduction: vibrating particles (and free electrons in metals) pass energy along



Convection: heated fluid expands, becomes less dense and rises; cooler fluid sinks

- **conduction:** energy passed by vibrating particles; metals conduct best (free electrons).
- **radiation:** infrared waves, no material needed; dull-black surfaces emit/absorb best.

2 Practice

2.1 State why metals are good conductors of thermal energy. [1]

2.2 State which surface is the best emitter of infrared radiation. [1]

3 Exam-style questions

3.1 Convection cannot take place in a solid because: [1]

- **A** solids have no particles
- **B** the particles cannot move from place to place
- **C** solids are too cold
- **D** solids do not conduct

3.2 A beaker of water is heated at the bottom.

(a) Explain how a convection current forms. [3]

(b) State why heating at the top would not set up a convection current. [1]

3.3 Two metal cans are filled with hot water; one is dull black and one is shiny silver. State and explain which cools faster. [2]

Solutions

2.1 they contain free (delocalised) electrons that carry energy quickly.

2.2 a dull, black surface.

3.1 B. In a solid the particles vibrate in fixed positions and cannot move from place to place.

3.2 (a) the water at the bottom is heated, expands and becomes less dense; it rises, and cooler, denser water sinks to replace it; this circulation is a convection current.
(b) hot (less dense) water would already be at the top, so there is nothing to make it rise — no current forms.

3.3 the dull black can cools faster; because a dull, black surface is a better emitter of infrared radiation.