

Week 1

IGCSE Chemistry

Homework bundle for this week

本周作业合集

exercises.lol

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1. States of matter

Starter Quiz · 课前小测

IGCSE Chemistry

Name: _____ Score: _____

- In a solid, the particles:
 - ☐ are closely packed and only vibrate in place
 - ☐ are far apart and move fast
 - ☐ slide past each other
 - ☐ do not exist
- The change from solid to liquid is called:
 - ☐ melting
 - ☐ freezing
 - ☐ condensing
 - ☐ subliming
- Gas pressure is caused by particles:
 - ☐ colliding with the container walls
 - ☐ melting
 - ☐ staying still
 - ☐ joining together
- Diffusion is the movement of particles from a region of:
 - ☐ high concentration to low concentration
 - ☐ low concentration to high concentration
 - ☐ high pressure to high temperature
 - ☐ solid to liquid
- A gas spreads to fill its container because its particles are:
 - ☐ far apart and moving quickly in all directions
 - ☐ fixed in place
 - ☐ packed tightly
 - ☐ not moving
- A gas at pressure 200 and volume 4 is compressed to volume 2. What is the new pressure?

7. Ice, water and steam are made of the same particles.

☐ True ☐ False

8. During melting, the temperature stays constant until all the solid has melted.

☐ True ☐ False

9. At constant temperature, pressure $\times$ volume stays constant for a fixed mass of gas.

☐ True ☐ False

10. Diffusion is evidence that particles are in constant random motion.

☐ True ☐ False

1. States of matter

Answers · 答案

IGCSE Chemistry

1. are closely packed and only vibrate in place

Solids have closely packed, vibrating particles.

2. melting

Solid $\rightarrow$ liquid is melting.

3. colliding with the container walls

Collisions with the walls create pressure.

4. high concentration to low concentration

Particles spread down the concentration gradient.

5. far apart and moving quickly in all directions

Fast, widely spaced particles fill the available space.

6. 400

$200 \times 4 = p \times 2$, so $p = 800 \div 2 = 400$.

7. True

Only the arrangement and energy differ, not the substance.

8. True

The energy is used to separate particles, not raise temperature.

9. True

This is Boyle's law.

10. True

They mix without any outside force.

1.1 Solids, liquids and gases

Name: _____ Class: _____ Date: _____

Total: 30 marks

KEY WORDS particles 粒子 • pressure 压强 • solid 固体 • liquid 液体 • volume 体积

Objective

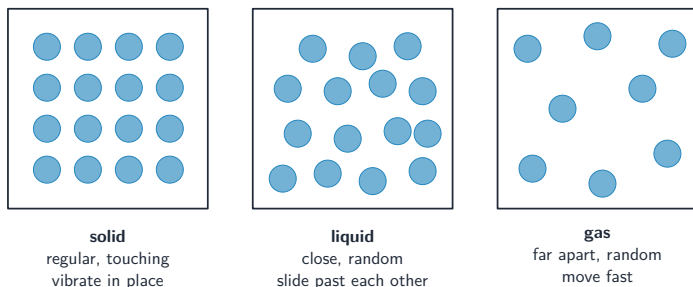
Build the skills to answer exam questions on **solids, liquids and gases** 固液气 — their properties, the particle picture, **changes of state** 状态变化, and gas behaviour.

You must be able to:

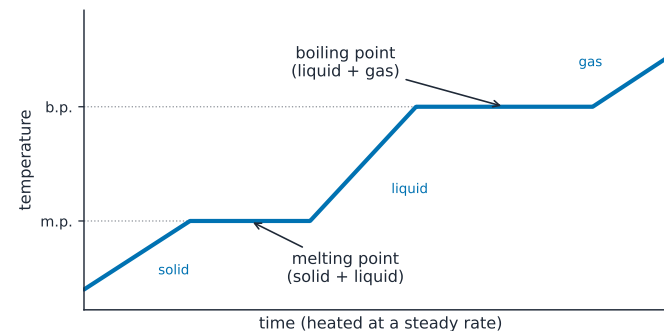
- describe the arrangement, separation and motion of particles in each state
- name the changes of state and explain them with the particle theory
- explain why temperature is constant during melting/boiling, and gas behaviour

1 Worked examples

■ Particles and changes of state



Packed and regular in a solid, close and random in a liquid, far apart in a gas



plateau: energy used as latent heat (bonds break) — temperature stays constant

Temperature stays constant while forces of attraction are broken (melting, boiling)

- **changes:** melting, freezing, evaporation, boiling, condensation (and sublimation).
- heating a gas at fixed volume raises the pressure (faster, harder, more frequent collisions).

■ The three states, and the two experiments that prove particles move

	arrangement	movement	forces between particles
solid 固体	regular, closely packed, touching	vibrate about fixed positions	strong
liquid 液体	close together, irregular	move around each other	weaker
gas 气体	far apart, random	move quickly in all directions	very weak or none

That table answers most questions on its own: a gas is easily compressed because of the space between its particles; a solid keeps its shape because its particles cannot change places; a liquid takes the shape of its container but keeps a fixed volume.

The changes of state, with the direction of energy: **melting** 熔化 solid→liquid and **boiling** 沸腾 liquid→gas both take energy IN, to overcome the forces between particles. **Condensing** 冷凝 gas→liquid and **freezing** 凝固 liquid→solid both give energy OUT. **Sublimation** 升华 goes straight from solid to gas.

Diffusion 扩散 is the spreading of a substance from a region of higher concentration to a region of lower concentration, caused by the random movement of the particles. Two rules explain every diffusion question:

- diffusion is **faster at a higher temperature**, because the particles have more

kinetic energy and move faster;

- diffusion is **faster for a lighter particle** — at the same temperature a molecule with a smaller relative molecular mass moves faster.

Worked example (the classic tube experiment). Cotton wool soaked in concentrated ammonia is put in one end of a long tube and cotton wool soaked in concentrated hydrochloric acid in the other. A white ring of ammonium chloride forms nearer the acid end. Explain.

- Both liquids evaporate and their gas particles diffuse along the tube.
- Ammonia, $M_r = 17$, is lighter than hydrogen chloride, $M_r = 36.5$.
- The lighter ammonia molecules move faster, so they travel further before the gases meet.
- The ring therefore forms nearer the hydrogen chloride end.

2 Practice

2.1 Name the change of state from gas to liquid. [1]

2.2 Describe the arrangement and motion of particles in a liquid. [2]

2.3 Explain, in terms of particles, why a gas can be compressed but a liquid cannot. [2]

2.4 Name the change of state from solid directly to gas, and state whether energy is taken in or given out. [2]

2.5 Explain why a smell spreads through a room faster on a hot day. [2]

3 Exam-style questions

3.1 Which property is true for a gas but not a liquid? [1]

- A it flows
- B it has a fixed volume
- C it is easily compressed
- D it has a fixed shape

3.2 A solid is heated until it melts and then boils.

(a) Explain, using the particle theory, why the temperature stays constant while the solid melts. [2]

(b) Explain why a gas can be compressed but a liquid cannot. [2]

3.3 A fixed mass of gas in a sealed rigid container is heated. Explain why its pressure rises. [3]

3.4 A long glass tube has cotton wool soaked in concentrated ammonia solution at one end and cotton wool soaked in concentrated hydrochloric acid at the other. After a few minutes a white ring forms inside the tube.

(a) Name the process by which the gases travel along the tube, and define it. [2]

(b) The white ring forms nearer the hydrochloric acid end. Explain why. [3]

(c) Predict and explain the effect of warming the whole tube. [2]

(d) Describe the arrangement and movement of the particles in the ammonia gas, and contrast them with the particles in the solid white ring. [4]

(e) The white solid is ammonium chloride. State the change of state that occurred when it formed from two gases, and state whether energy was taken in or given out. [2]

Solutions

2.1 condensation.

2.2 particles are close together, in a random arrangement; they move and slide past each other.

2.3 In a gas the particles are far apart with large spaces between them, so they can be pushed closer together; in a liquid the particles are already touching, so there is almost no space to remove.

2.4 Sublimation; energy is taken in.

2.5 The particles have more kinetic energy at a higher temperature and move faster, so they diffuse and spread through the room more quickly.

3.1 C. A gas is easily compressed; a liquid is not.

3.2 (a) the energy goes into breaking the forces of attraction between particles, not into making them move faster; so the temperature does not rise while melting.

(b) a gas has particles far apart with space between them, so it can be squeezed; a liquid's particles are already close together with almost no space.

3.3 heating gives the particles more kinetic energy, so they move faster; they hit the walls harder and more often; in a fixed volume this means the pressure rises.

3.4 (a) Diffusion; the spreading of particles from a region of higher concentration to a region of lower concentration because of their random movement.

(b) Ammonia has a relative molecular mass of 17 and hydrogen chloride 36.5, so ammonia molecules are lighter; at the same temperature the lighter molecules move faster; the ammonia therefore travels further along the tube before the two gases meet, so the ring forms nearer the acid end.

(c) The ring would form sooner, because the particles gain kinetic energy and diffuse faster at the higher temperature.

(d) Ammonia gas: the particles are far apart and randomly arranged, and move quickly in all directions. The solid ring: the particles are close together in a regular arrangement, and only vibrate about fixed positions.

(e) The gases changed to a solid, which is deposition or sublimation in reverse; energy was given out.

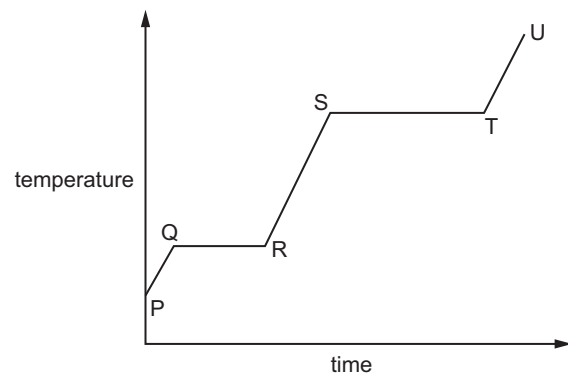
- 1 A sealed balloon contains air.

The temperature of the balloon is increased.

Which row describes how the pressure in the balloon and the kinetic energy of the particles in air change?

	pressure	kinetic energy of particles
A	decreases	decreases
B	increases	decreases
C	decreases	increases
D	increases	increases

- 2 The diagram shows the heating curve for a substance.



Between which two points do the particles of the substance change from being in fixed positions to being mobile?

- A** P and Q **B** Q and R **C** S and T **D** T and U

- 1 What happens to the volume of a fixed mass of gas when pressure and temperature are separately increased?

	volume of gas	
	pressure increased	temperature increased
A	increases	increases
B	no change	decreases
C	decreases	increases
D	no change	increases

1 The three states of matter are solid, liquid and gas.

- (a) Complete Table 1.1 to describe the structures of solids, liquids and gases in terms of particle separation, particle arrangement and particle motion.

Table 1.1

state of matter	particle separation	particle arrangement	particle motion
solid	touching		
liquid			
gas		random	random

[3]

- (b) Substances can physically change.

Name each physical change:

- solid to liquid
- gas to liquid
- solid to aqueous.

[3]

- (c) Gases diffuse.

- (i) Describe, in terms of particles, why gases diffuse.

..... [1]

- (ii) State what determines the relative rate of diffusion of gases at constant temperature.

..... [1]

- (d) Gaseous oxides of nitrogen are atmospheric pollutants. One adverse effect of oxides of nitrogen is the formation of acid rain.

State **two other** adverse effects of oxides of nitrogen.

1.....

2.....

[2]

- (e) In a catalytic converter, oxides of nitrogen are removed by reaction with the toxic gaseous product of the incomplete combustion of hydrocarbon fuels. Two non-toxic gases are formed in this reaction.

- (i) Name the toxic gaseous product of the incomplete combustion of hydrocarbon fuels.

..... [1]

- (ii) Name the **two** non-toxic gases formed in the catalytic converter.

1.....

2.....

[2]

[Total: 13]

- 1 A gas is placed in a sealed container with a fixed volume.

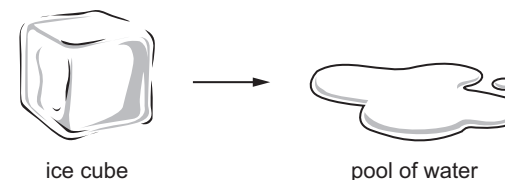
The gas is heated.

Which statements are correct?

- 1 The gas molecules move around faster.
- 2 The gas particles collide with the walls of the container more frequently.
- 3 The pressure in the container decreases.

A 1 and 2 **B** 1 only **C** 2 and 3 **D** 2 only

- 1 An ice cube melts.

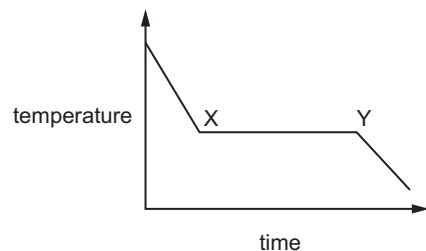


What happens to the molecules of water in the ice cube?

- A** They evaporate.
- B** They dissolve.
- C** They gain energy.
- D** They lose energy.

2 Solid G is heated until it melts. It is then left to cool to room temperature.

The graph shows the cooling curve for G.



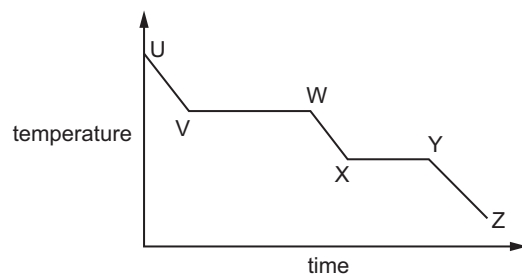
Four statements about the cooling curve between X and Y are listed.

- 1 The speed of the molecules of G decreases.
- 2 The molecules of G become less closely packed.
- 3 Thermal energy is released by the molecules of G to the surroundings.
- 4 G changes from solid to liquid.

Which statements are correct?

- A** 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

2 A cooling curve for a substance is shown.



Which statement is correct?

- A** Between U and V, the substance is condensing.
B Between V and W, heat is being absorbed from the surroundings.
C Between W and X, the particles are close together and randomly arranged.
D Between Y and Z, the substance is changing from a liquid to a solid.

1.2 Diffusion

Name: _____ Class: _____ Date: _____

Total: 8 marks

KEY WORDS diffusion 扩散 • relative molecular mass 相对分子质量 • rate 速率 • particles 粒子
 • mass 质量

Objective

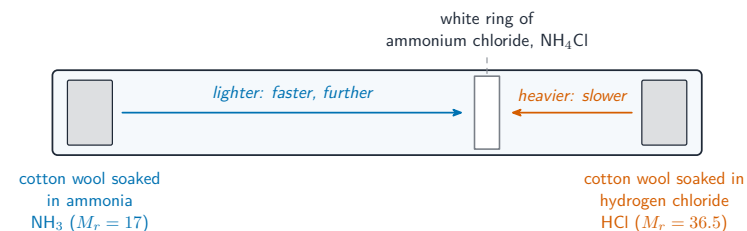
Build the skills to answer exam questions on **diffusion** 扩散 — what it is, why it happens, and how the **rate** depends on **relative molecular mass** 相对分子质量.

You must be able to:

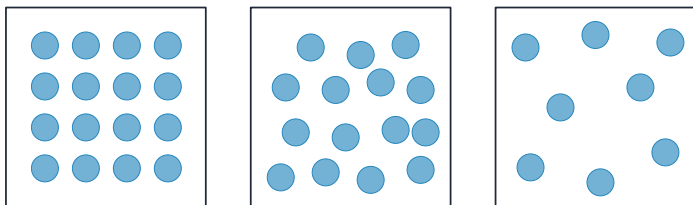
- describe diffusion as spreading from high to low concentration
- explain diffusion using the random motion of particles
- explain why lighter molecules diffuse faster (the NH_3/HCl experiment)

1 Worked examples

■ The NH_3/HCl experiment



Ammonia ($M_r = 17$) is lighter, so it diffuses faster and further; the ring forms nearer HCl



solid
regular, touching
vibrate in place

liquid
close, random
slide past each other

gas
far apart, random
move fast

Diffusion is the random movement of particles

- **diffusion:** particles spread from high to low concentration because they move randomly.
- happens in gases and liquids, **not** solids (particles can't move from place to place).
- lighter molecules (smaller M_r) diffuse **faster**.

2 Practice

2.1 Define diffusion. [1]

2.2 State why diffusion does not occur in solids. [1]

3 Exam-style questions

3.1 Two gases diffuse along a tube. The one that travels faster has the: [1]

- A larger relative molecular mass
- B smaller relative molecular mass
- C higher density
- D larger molecules

3.2 In the experiment, ammonia ($M_r = 17$) and hydrogen chloride ($M_r = 36.5$) diffuse from opposite ends of a tube and form a white ring.

(a) State, with a reason, at which end the white ring forms nearer. [2]

(b) Name the white solid formed. [1]

3.3 Explain, in terms of particles, why you can smell perfume from across a room. [2]

Solutions

2.1 the spreading of particles from a region of high concentration to a region of low concentration.

2.2 the particles in a solid cannot move from place to place (only vibrate).

3.1 B. The gas with the smaller relative molecular mass diffuses faster.

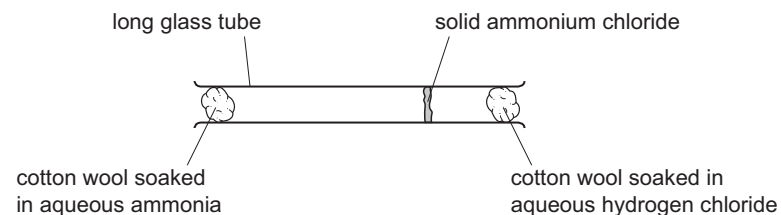
3.2 (a) nearer the hydrogen chloride end; because ammonia is lighter, so it diffuses faster and travels further.

(b) ammonium chloride (NH_4Cl).

3.3 the perfume particles move randomly in all directions; they diffuse and mix with the air until they reach your nose.

2 Ammonia gas is reacted with hydrogen chloride gas using the apparatus shown.

Solid ammonium chloride is produced.



Which statement explains why the solid ammonium chloride is formed nearer to the hydrogen chloride?

- A** Aqueous ammonia is a base and aqueous hydrogen chloride is an acid.
- B** Ammonia molecules diffuse more slowly than hydrogen chloride molecules.
- C** Hydrogen chloride has a greater molecular mass than ammonia.
- D** Only ammonia molecules diffuse in all directions at the same time.

3 A student investigates the diffusion of ammonia gas, NH_3 , and hydrogen chloride gas, HCl .

Two sets of apparatus are set up as shown at room temperature and pressure.



The damp red litmus paper in apparatus 1 changes colour after 30 seconds.

How long does it take for the damp blue litmus paper in apparatus 2 to change colour?

- A** 21 seconds
- B** 30 seconds
- C** 64 seconds
- D** The damp blue litmus paper does **not** change colour.

2 Which gas diffuses most quickly at room temperature and pressure?

- A** CH_4
- B** C_2H_6
- C** CO
- D** SO_2

3 Samples of four gases are released in a room at the same time.

The gases are carbon dioxide, CO_2 , hydrogen chloride, HCl , hydrogen sulfide, H_2S , and nitrogen dioxide, NO_2 .

Which gas diffuses fastest?

- A carbon dioxide
- B hydrogen chloride
- C hydrogen sulfide
- D nitrogen dioxide