

Unit 1 & 9: Particulate Nature of Matter & Metals

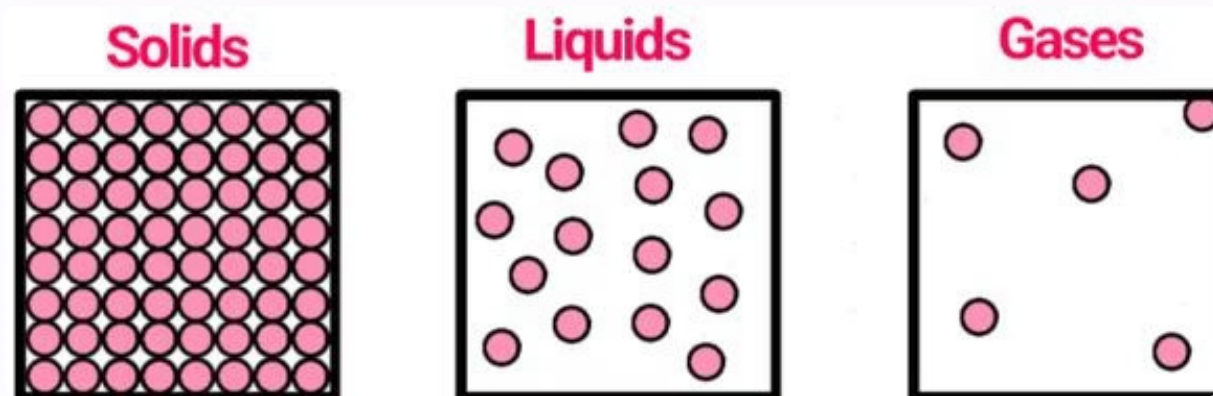
O Level Chemistry — 5070 | Comprehensive revision notes covering the kinetic particle theory, states of matter, state changes, and the properties, reactions, and alloys of metals.

CHEMISTRY 5070

O LEVELS

Kinetic Particle Theory: The Three States of Matter

The kinetic particle theory explains the behaviour of matter in terms of the arrangement, movement, and forces between particles. The three states — solid, liquid, and gas — each have distinct characteristics.



Solids

Forces: Strong forces of attraction between particles.

Arrangement: Orderly, tightly packed.
Particles vibrate in fixed positions.

Properties: Fixed volume, shape, and mass.
High density, incompressible — particles are too close together to be compressed.

Liquids

Forces: Weaker forces of attraction than solids.

Arrangement: Particles slightly further apart with an irregular pattern. Free to move and adapt to the shape of their container.

Properties: Fixed volume but no fixed shape.

Gases

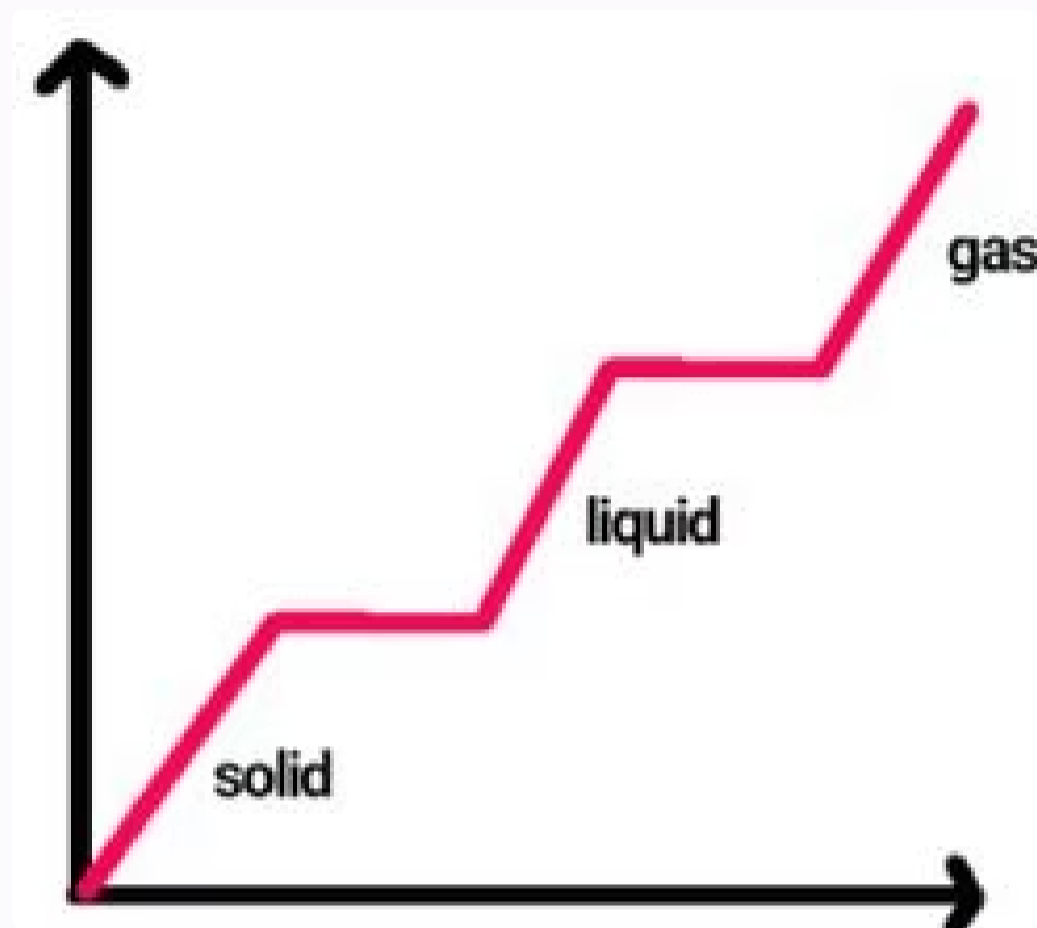
Forces: Barely any forces of attraction.

Arrangement: Particles far apart in an irregular pattern, moving randomly — this is **Brownian motion**: movement of particles in fluids due to a large number of collisions with other smaller, fast-moving particles.

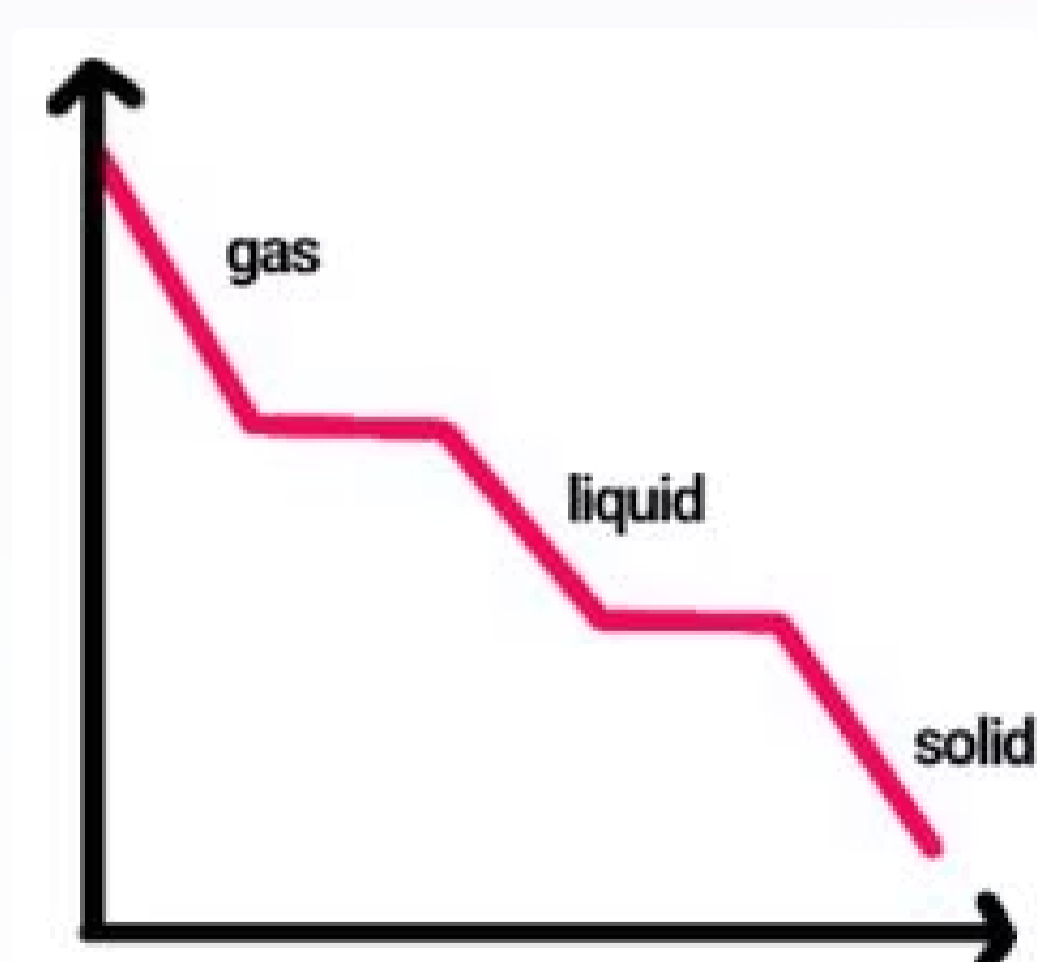
Properties: No fixed shape, fixed mass.
Volume can be changed with pressure; volume increases as temperature increases, because the frequency of collisions with container walls increases as the number of gas particles increases, causing pressure to rise.

State Changes

State changes occur when a substance gains or loses energy, causing particles to rearrange. Each change occurs at a specific or range of temperatures depending on the process.



Heating Curve — temperature rises through solid, liquid, and gas phases with plateaus at phase changes.



Cooling Curve — temperature falls through gas, liquid, and solid phases with plateaus at phase changes.

Melting

Solid → Liquid. Occurs at a fixed **melting point**. Energy breaks forces of attraction, allowing particles to move more freely.

Freezing

Liquid → Solid. Opposite of melting. Occurs at the **same fixed temperature** as the melting point.

Boiling

Liquid → Gas. Occurs at a fixed **boiling point**. Bubbles form at the bottom and escape through the surface — occurs **throughout** the liquid.

Condensation

Gas → Liquid. Opposite of boiling. Particles lose energy upon cooling, settling into closer positions. Can occur at a **range of temperatures**.

Evaporation

Liquid → Gas. Occurs **only at the surface**. High kinetic energy particles escape; overall energy of remaining liquid is reduced. Occurs below boiling point across a range of temperatures. Rate increases with greater surface area and higher temperature.

Sublimation

Solid → Gas directly. Occurs in only a few solids (e.g. **iodine**). Occurs at a fixed temperature. The reverse process is known as **deposition**.

Metals: Properties, Reactions & Alloys

Properties of Metals

Metals have **high melting and boiling points** due to strong metallic bonds that require large amounts of energy to overcome.

They are **good conductors of heat and electricity** owing to a 'sea' of delocalised electrons that are free to move throughout the structure.

Metals are **malleable and ductile** — layers of positive ions can slide over each other without breaking the metallic bonds, allowing metals to be shaped without fracturing.

Reactions of Metals

- Reaction with **cold water**: produces the metal hydroxide + hydrogen gas
- Reaction with **steam**: produces the metal oxide + hydrogen gas
- Reaction with **air/oxygen**: produces the metal oxide
- Metals **above hydrogen** in the reactivity series can react with acids

Alloys

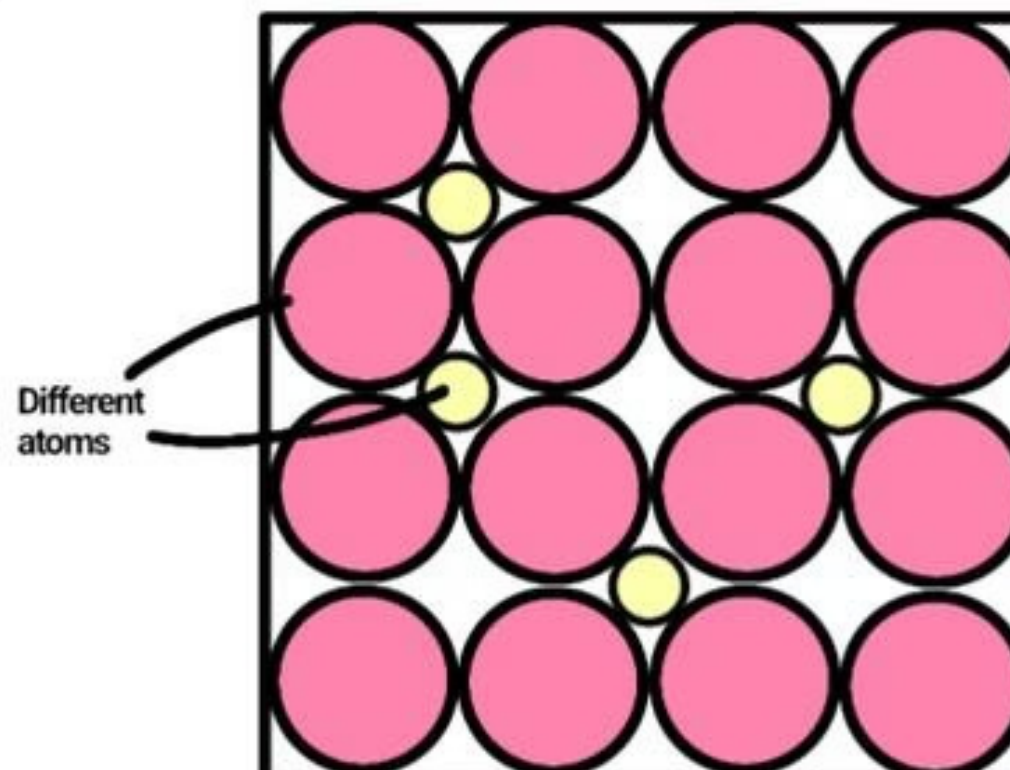
An **alloy** is a mixture of a metal with other elements. The introduction of atoms of different sizes disrupts the regular lattice, preventing layers from sliding as easily — this typically makes alloys **harder and stronger** than pure metals.

Brass

A mixture of **copper and zinc**.
Used for its corrosion resistance and acoustic properties.

Stainless Steel

A mixture of **iron, chromium, nickel, and carbon**. Highly resistant to rust and corrosion.



Alloy structure: large pink metal atoms with smaller yellow atoms of different elements interspersed in the lattice, disrupting the regular arrangement.