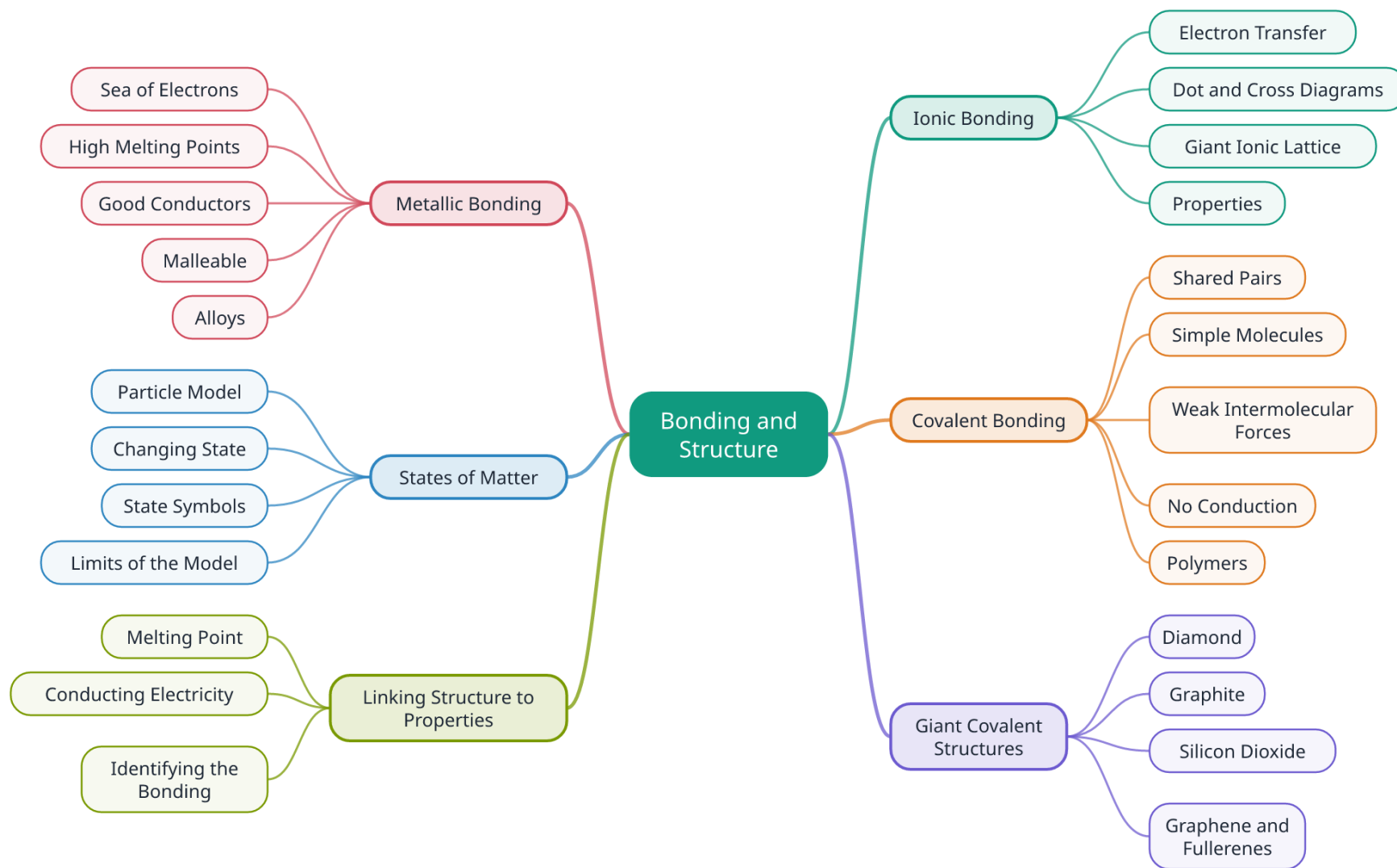


Bonding and Structure Mind Map (GCSE)

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Bonding and Structure mind map explained

Ionic Bonding

Happens between a metal and a non-metal.

Electron Transfer

Metal atoms lose electrons to form positive ions; non-metal atoms gain them to form negative ions. Both end up with the electronic structure of a noble gas.

Dot and Cross Diagrams

Show the electrons moving, for example sodium chloride: Na^+ and Cl^- . Groups 1 and 2 form $1+$ and $2+$ ions; groups 6 and 7 form $2-$ and $1-$ ions.

Giant Ionic Lattice

Oppositely charged ions held together by strong electrostatic forces acting in all directions.

Properties

- High melting and boiling points: lots of energy breaks the strong bonds
- Conduct electricity when melted or dissolved, because the ions can move
- Do not conduct when solid

Covalent Bonding

Happens between non-metal atoms, which share pairs of electrons.

Shared Pairs

Each covalent bond is a shared pair of electrons. Covalent bonds are strong.

Simple Molecules

Small molecules such as H_2 , Cl_2 , O_2 , N_2 , HCl , H_2O , NH_3 and CH_4 . Learn to draw their dot and cross diagrams.

Weak Intermolecular Forces

Simple molecules have low melting and boiling points because only the weak forces between molecules break, not the covalent bonds. Larger molecules have stronger forces.

No Conduction

Simple molecular substances do not conduct electricity, because the molecules have no overall charge.

Polymers

Very long chains of atoms joined by covalent bonds. Their intermolecular forces are stronger, so they are usually solid at room temperature.

Giant Covalent Structures

Huge networks of atoms joined by covalent bonds, so they have very high melting points.

Diamond

Each carbon atom forms four covalent bonds. Very hard, a very high melting point and does not conduct electricity.

Graphite

Each carbon atom forms three bonds, in layers of hexagons. The layers slide, so graphite is soft and slippery. One electron per atom is delocalised, so it conducts electricity.

Silicon Dioxide

Silica, the main compound in sand. Another giant covalent structure with a high melting point.

Graphene and Fullerenes

Graphene is a single layer of graphite: strong and a good conductor. Fullerenes are hollow carbon molecules, such as buckminsterfullerene (C_{60}) and nanotubes.

Metallic Bonding

Metals form giant structures of positive ions in a sea of delocalised electrons.

Sea of Electrons

The strong attraction between the positive ions and the delocalised electrons holds the metal together.

High Melting Points

Most metals have high melting and boiling points because the metallic bonds are strong.

Good Conductors

The delocalised electrons carry electrical charge and thermal energy through the metal.

Malleable

Layers of atoms can slide over each other, so metals can be bent and shaped.

Alloys

Mixtures of metals. Different sized atoms distort the layers so they cannot slide easily, which makes alloys harder than pure metals.

States of Matter

Solid, liquid and gas, explained with the particle model.

Particle Model

Solids: particles vibrate in fixed positions. Liquids: particles move around each other. Gases: particles move quickly and randomly, far apart.

Changing State

Melting and boiling need energy to overcome the forces between particles. The stronger the forces, the higher the melting and boiling points.

State Symbols

(s) solid, (l) liquid, (g) gas, (aq) dissolved in water.

Limits of the Model

Higher tier, AQA. It treats particles as solid spheres with no forces between them, which they are not.

Linking Structure to Properties

Most marks in this topic come from explaining a property using the structure.

Melting Point

Ask which forces or bonds must break. Strong bonds in giant structures mean high melting points; weak intermolecular forces mean low ones.

Conducting Electricity

Ask whether there are charged particles free to move: ions in molten or dissolved ionic compounds, or delocalised electrons in metals and graphite.

Identifying the Bonding

- Metal and non-metal: ionic
- Non-metals only: covalent
- Metal only: metallic

How to revise with this mind map

1. Start by identifying the bonding. Metal and non-metal is ionic, non-metals only is covalent, and a metal on its own is metallic.
2. Practise dot and cross diagrams for ionic compounds and the common simple molecules until you can draw them from memory.

3. Explain properties with structure. For every melting point or conductivity question, say which particles there are, which forces hold them, and whether anything charged can move.
4. Watch the commonest slip: boiling a simple molecule breaks the weak forces between molecules, not the covalent bonds inside them.
5. Make it yours. Build your own bonding map in Mindmapi from your class notes, and ask the AI about any branch you are unsure of. The answer is saved into that branch's notes for next time.