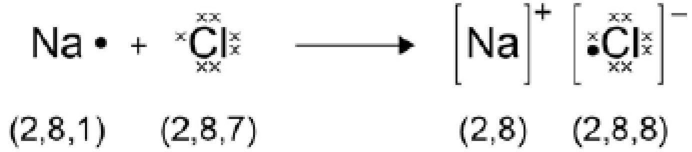
Chemistry 2: Bonding, Structure and the Properties of Matter

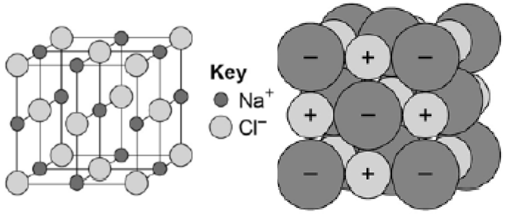
Section 1: Bonding Key Terms

	An atom that is **charged** because of **gain** or **loss** of **electrons**.
	The **bond** between two **oppositely charged ions** (**metal** and **non-metal**). Occurs because of electrostatic attraction.
	The **force** that **holds two oppositely charged ions** together. A **strong** force.
	In ionic bonding, **metals lose electrons** to become **positively-charged** ions.
	In ionic bonding, **non-metals gain electrons** to become **negatively-charged** ions.
	A **large 3D structure** that contains a **lot of bonds**.
	A bond formed when **non-metals share electrons**. A **strong** bond.
	A **small group of atoms** held together with **covalent bonds**. **Not charged**.
	Very large covalent compounds with **many repeating units**.
	The **electrons** in the **outer shell** of metal atoms are **delocalised** and so are **free to move** through the whole structure. The **sharing of delocalised electrons** gives rise to **strong metallic bonds**.
	A mixture of **two or more elements**, **at least one of which is a metal**. E.g. steel

Section 2: Ionic Bonding



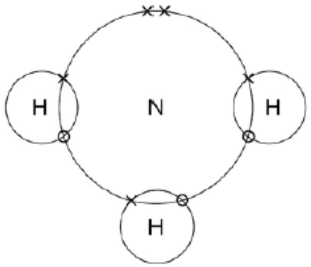
In ionic bonding, metals _____ electrons to become positively-charged ions. Non-metals ________ electrons to become negatively-charged ions.



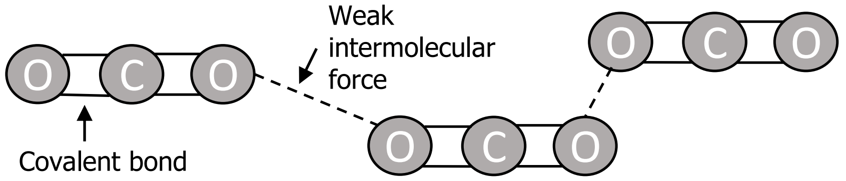
12 Two representations of a **giant ionic lattice**. The lines represent ionic bonds.

Property	Reason
13 High melting point	There is a **s________ electrostatic force** between the **positive and negative ions** in the **giant lattice**. A **large amount of e________** is **needed to overcome this force**.
14 Conduct electricity when liquid/ molten	**Ions are able to move** so there is a **flow of c__________ ions** (current).
15 Do not conduct electricity when solid	**Ions are in fixed positions** so cannot flow**.**

Section 3: Simple Covalent Molecules

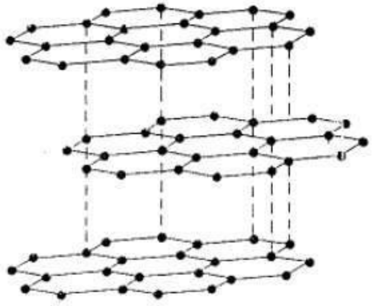


16 Covalent bonding in carbon dioxide



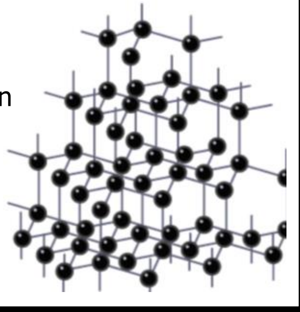
Property	Reason
17 ______ melting and boiling points (usually gases or liquids)	There are only **weak intermolecular forces between the molecules**. **Not much energy** is needed to overcome these forces.
18 Do _____ conduct electricity	Covalent molecules are **not charged**.

Section 4: Giant Covalent Structures Made of Carbon



____
Each **carbon** forms **3 bonds** to other carbon atoms. Arranged in **layers** with **weak intermolecular forces between layers**.

____
Each **carbon** forms **4 bonds** to other carbon atoms.



Section 4a: Properties of Graphite

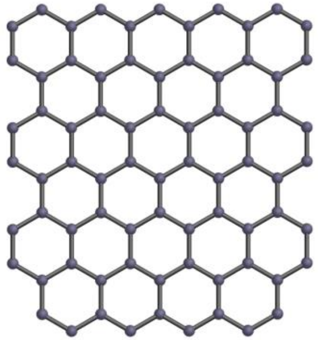
Property	Reason
21 Conducts electricity	Each carbon only **forms 3 bonds** so **one electron is d___________** These electrons are **free to move** and **carry charge** through the structure.
22 Soft and slippery	Only **weak intermolecular forces** exist **between layers**, so layers can easily be rubbed off.

Section 4b: Properties of Diamond

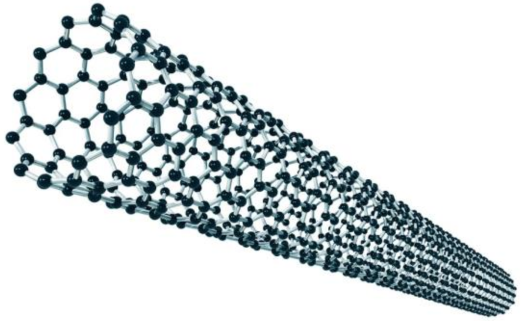
Property	Reason
23 Doesn't conduct electricity	Diamond **doesn't contain delocalised electrons or ions**.
24 Very hard	Each carbon bonds to **4 other carbon atoms** with **strong covalent bonds** to form a **lattice.**
25 High melting point	Each carbon bonds to 4 other carbon atoms with strong covalent bonds to form a lattice. A **large amount of energy** is needed to overcome all these bonds.

Section 5: Small Carbon-Based Structures

26 Fullerene



27 Graphene



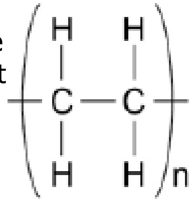
28 Carbon nanotube

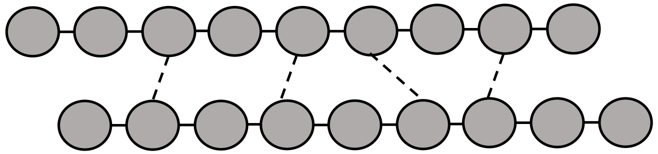
Section 1: Properties of Metals

	Structure	Properties	Uses
29 Fullerene	**Hollow-shaped**. Usually **hexagonal rings of carbon** atoms. E.g. Buckminsterfullerene (C_{60})	Very **strong**. Hollow so can contain other chemicals within it.	**Drug delivery, lubricants**.
30 Graphene	A **single layer of graphite**.	Very **strong**. **Has delocalised electrons** so it is able to **conduct electricity**.	**Electronics, composites.**
31 Carbon nanotube	**Cylindrical tubes** of carbon atoms that are **very long** compared to their diameter.	Very **strong, light** and **flexible**. Has **delocalised electrons** so it is able to **conduct electricity**.	**Nanotechnology, electronics, reinforcing (e.g. tennis rackets).**

Section 6: Polymers

32 A polymer. The lines show covalent bonds. 'n' is a large number.

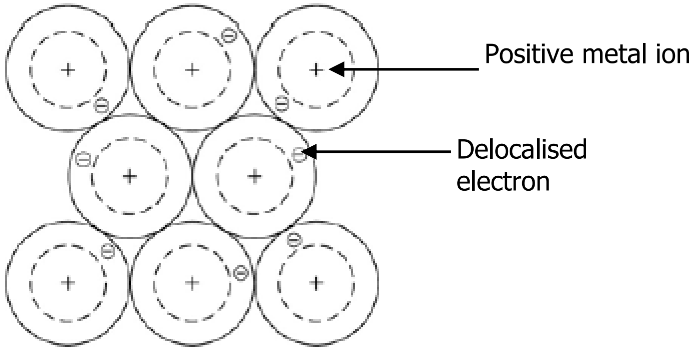




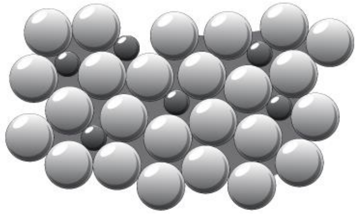
33 Polymer molecules are held together by intermolecular forces (dashed lines)

Property	Reason
34 Solid	Usually solid because the **intermolecular forces between polymer molecules** are **relatively strong**.

Section 7: Metallic Bonding



35 A pure metal. It consists of metal ions in layers with delocalised electrons.



36 An alloy. The layers have been distorted by the presence of other elements

7a Properties of Pure Metals

	Reason
	Strong electrostatic forces between the **positive ions** and **delocalised electrons**. Requires a **large amount of energy** to overcome.
	Metals have **delocalised electrons**. These electrons are **able to move** through the structure and carry charge.
	The **delocalised electrons** are able to **move and transfer thermal energy** through the structure.
	The **layers** are able to **slide over each other** so the metal can be bent and shaped. The attraction between the positive ions and delocalised electrons prevents the metal from shattering.

7b Properties of Alloys

Property	Reason
41 Harder than metals	The **layers are distorted** by the presence of other elements. This **prevents the layers from being able to s________ over each other**.

Section 8: States of Matter