The content on this sheet is common to Paper 1 & Paper 2

Atomic Structure, Bonding and Types of Substance

* Indicates that these are some examples only: you could be asked about any substance / reaction.

1.32—Substances & their properties

Structure	Bonding	*Relative* melting/boiling point (high or low)	*Relative* solubility in water (high or low)	*Relative* electrical conductivity as solid (high or low)	*Relative* electrical conductivity as solution (high or low)
Giant	ionic	High	High	Low	High
Giant	covalent	High	Low	Low* (except graphite/ graphene)	n/a (don't dissolve)
Simple	molecular (covalent)	Low	Low	Low	n/a (don't dissolve)
Giant	metallic	High	Low	High	n/a (don't dissolve)

1.33—Properties of ionic compounds

Ionic compounds tend to have high melting and boiling points.

This is due to the strong electrostatic forces of attraction between the oppositely charged ions.

These forces require large amounts of energy to overcome them.

Ionic compounds can conduct electricity, but only when they are dissolved or molten, not when they are solid.

They can conduct as solutions / liquids as the ions are free to move and carry a charge.

When they are solid, the ions are not able to do this.

1.34—Properties of simple covalent molecules

Simple covalent molecules tend to have low melting and boiling points.

This is due to the weak intermolecular forces between the molecules.

These forces require small amounts of energy to overcome them.

Simple covalent molecules are unable to conduct electricity.

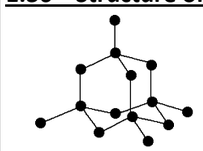
This is because the molecules do not have an overall charge, and there are no free electrons.

1.35—Diamond and graphite

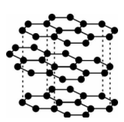
Diamond and graphite are two examples of giant covalent substances.

They are two different forms of the same element, carbon. *These different forms of the same element are known as allotropes.*

1.36—Structure of diamond & graphite



Diamond



Graphite

Describe the structure of diamond. Refer to number & strength of bonds.

- Each C covalently bonds to 4 others; very strong bonds.

Describe the structure of graphite. Refer to the strength and number of **bonds**, the **electrons that don't bond** and **forces between the layers**.

- Each C covalently bonds to 3 others; very strong bonds. Some (unbonded) electrons become delocalised & free to move; weak forces between layers.

1.37—Properties and uses of diamond & graphite

Substance	*Relative* electrical conductivity (high or low)	Relative hardness (hard or soft)
Diamond	Low	Soft
Graphite	High	Hard

Explain why diamond is used in cutting tools. Refer to the table above and any work in section 1.36.

- Very hard, due to the strong covalent bonding of the carbon atoms.

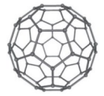
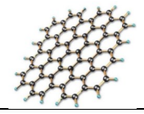
Explain why graphite is used as a lubricant. Refer to the table above and any work in section 1.36.

- Very soft; due to the weak intermolecular forces, the layers can slide easily.

Explain why graphite is used to make electrodes. Refer to the table above and any work in section 1.36.

- Good electrical conductor, due to delocalised electrons that are free to move & carry a charge.

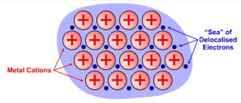
1.38—Properties of other forms of carbon

Structure	Name	Type of substance	*Relative* melting/ boiling point (high or low)	*Relative* electrical conductivity as solid (high or low)
	Fullerene	Simple covalent molecules	Low	Low (cannot pass charge between molecules)
	Graphene	Giant covalent	High	High (as with graphite, free moving electrons)

1.39—Polymers

Simple *(addition)* polymers, such as poly(ethene), are large molecules containing chains of carbon atoms.

1.40—Properties of metals



Explain why metals are malleable, in terms of layers of atoms and forces.

- The layers of positive ions can slide, remain attracted by the negative electrons.

Explain why metals are good conductors of electricity.

- Free moving (delocalised) electrons which can carry a charge.

1.41—Modelling structures

There are many models, including dot-and-cross diagrams, ball-and-stick models and 3d representations. We need multiple models as each individual model has different limitations.

1.42—Metals vs. non-metals

Metals tend to be shiny when cut, have high melting points, high density and are good conductors of electricity. Non-metals tend to be the opposite.