

IGCSE CHEMISTRY STUDY NOTES

UNIT 3 ATOMS, ELEMENTS & COMPOUNDS

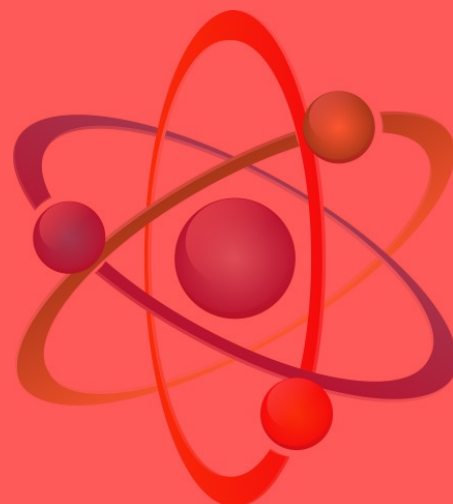




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3.2.4 Macromolecules

CORE

Describe the giant covalent structures of graphite and diamond

- Giant covalent structures are also known as macromolecular structures.
- They consist of an extensive network of strong covalent bonds.
- They have high melting and boiling points.

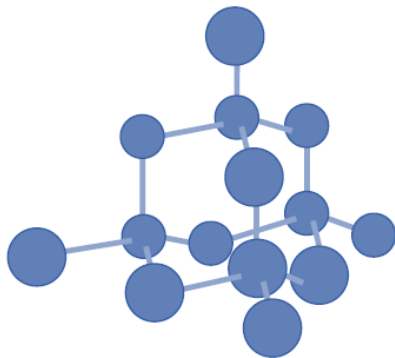
Allotropes are different physical forms of the same element.
Diamond and Graphite are allotropes of Carbon.

Diamond	Graphite
• Colourless, transparent solid with a brilliant shine	• Dark grey shiny solid with a smooth texture
• Tetrahedral macromolecular structure	• Hexagonal layered macromolecular structure
• Each carbon atom is bonded to four other carbon atoms	• Each carbon atom is bonded to three other carbon atoms
• No free electrons, hence does not conduct electricity	• Has one free (delocalised) electron per carbon atom, hence conducts electricity
• Extensive network of strong covalent bonds	• Extensive network of strong covalent bonds exists in each layer of carbon atoms • Weak forces of attraction exist between the layers

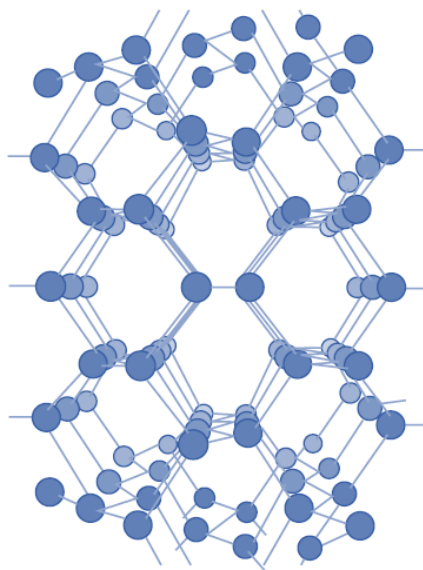
NOTE:

A single layer of Graphite is called Graphene.

DIAMOND

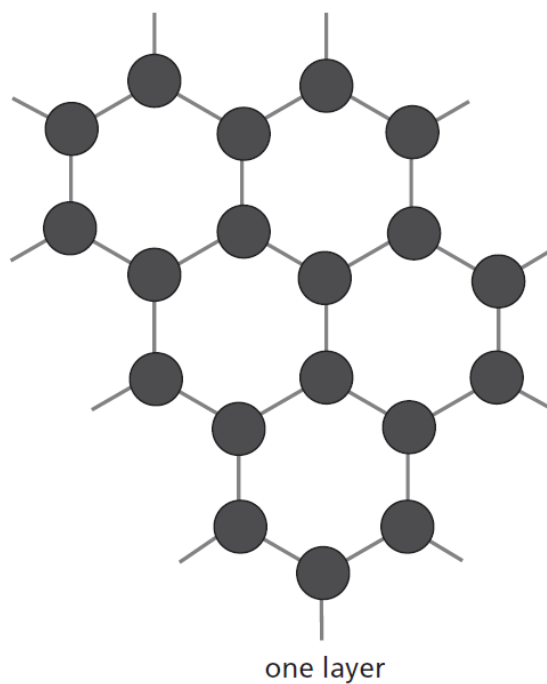


a small part of the structure

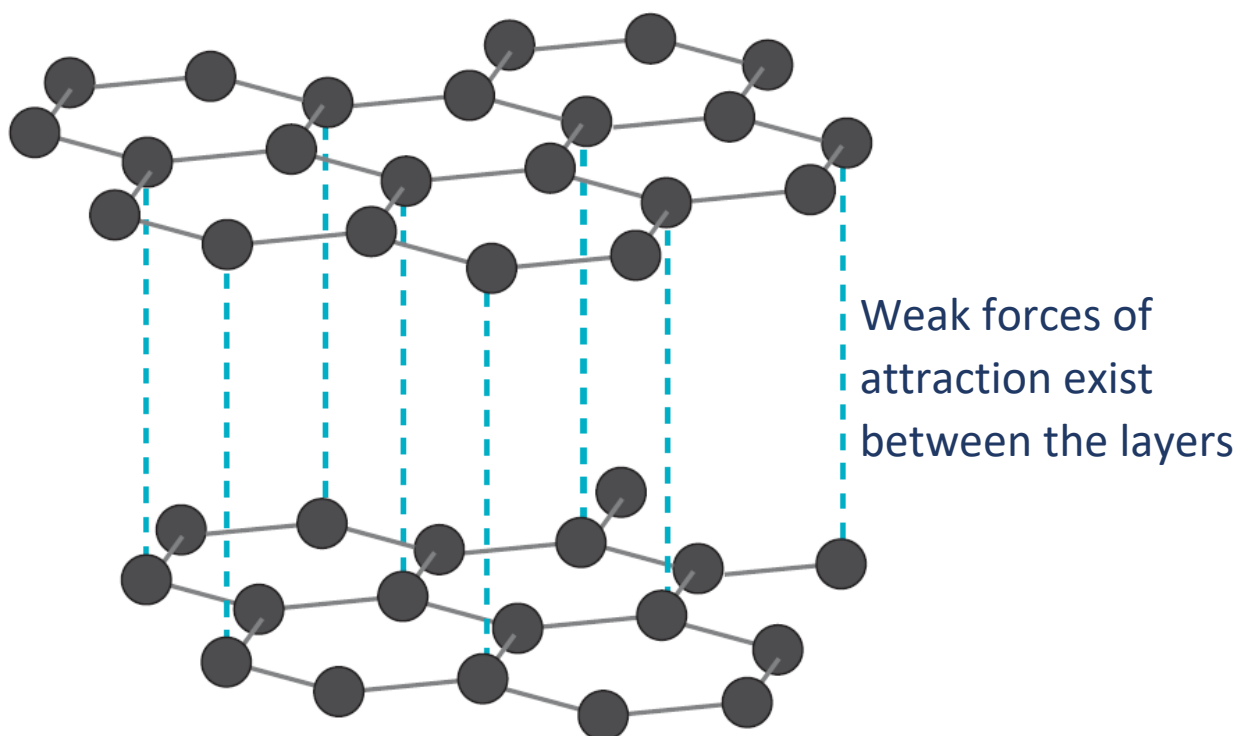


a view of a much larger part of the structure

GRAPHENE



GRAPHITE



Relate their structures to their uses, e.g. graphite as a lubricant and a conductor, and diamond in cutting tools

USES OF GRAPHITE	RELATION TO STRUCTURE
1. Solid lubricant	Smooth and slippery texture
2. Used in pencils	Graphite has a layered structure. Weak forces of attraction exist between the layers. The layers can slide over each other easily.
3. As an electrode material	Conductor of electricity
	Graphite has delocalised electrons that can conduct electricity. It has a high melting point and is relatively inert. It is therefore used to make inert electrodes. Example: Graphite electrodes are used in the extraction of Aluminium from Alumina.

USES OF DIAMOND	RELATION TO STRUCTURE
1. Glass cutting tools, tips of drill bits, diamond-studded saws, polishers	Very hard, rigid, three-dimensional structure with an extensive network of strong covalent bonds
2. Jewellery	Diamond is a transparent solid with a brilliant shine

3.2.4 Macromolecules

SUPPLEMENT

Describe the macromolecular structure of Silicon (IV) oxide (silicon dioxide)

MUST LEARN!

Silicon (IV) oxide has a tetrahedral macromolecular structure (similar to diamond).

Each Si atom is covalently bonded to four Oxygen atoms.

Each Oxygen atom is covalently bonded to two Silicon atoms.

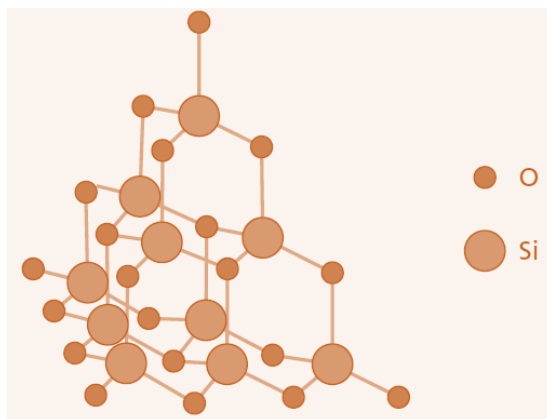
The formula is therefore SiO_2 .

Each Oxygen atom has 2 non-bonded electron pairs (lone pairs) that are localised onto it and are not free to move.

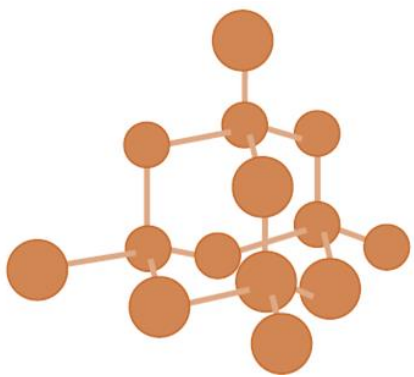
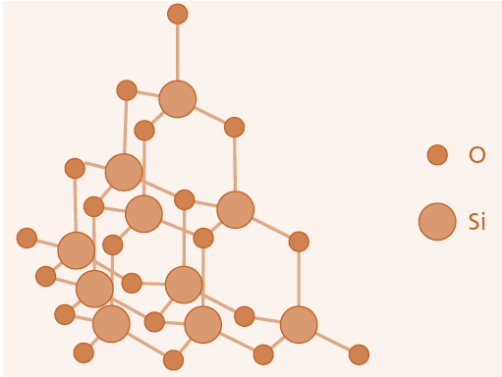
There are no free (delocalised) electrons, hence SiO_2 cannot conduct electricity.

The three-dimensional structure is rigid and hard.

It has a high melting point and high boiling point.



Describe the similarity in properties between diamond and Silicon (IV) oxide, related to their structures

DIAMOND	SILICON (IV) OXIDE
hard, rigid, three-dimensional structures	
tetrahedral crystals	
non-conductors of electricity	
high melting and boiling points	
	



QUESTION

Carbon dioxide and Silicon (IV) oxide are oxides of Group IV elements.

(a) Explain why Silicon (IV) oxide has a very high melting point.

SOLUTION:

SiO_2 has a macromolecular structure that consists of an extensive network of strong covalent bonds.

A large amount of energy is needed to break some of these bonds in order to melt it, hence high melting point.

(b) Explain, in terms of attractive forces between particles, why carbon dioxide has a very low melting point.

SOLUTION:

Carbon dioxide has a simple molecular structure with weak forces of attraction between the molecules.

Less energy is required to break the weak intermolecular forces, hence low melting point.

QUESTION-BANK



ASSESSMENT

