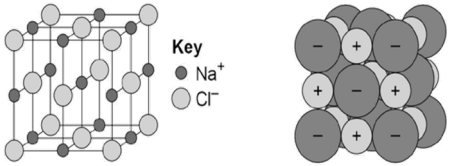
Science Steps to Success *Week 3* *Chemistry*

Structure and Bonding

Chemists use theories of structure and bonding to explain the **physical and chemical properties** of materials. Analysis of structures shows that **atoms can be arranged in a variety of ways**, some of which are **molecular** while others are **giant structures**. Theories of bonding explain how atoms are held together in these structures.

GIANT IONIC LATTICES

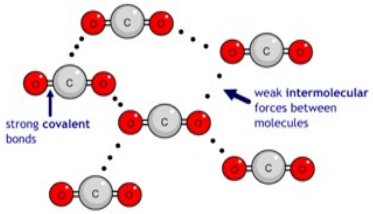


When a metal atom reacts with a non-metal atom, **electrons** in the **outer shell** of the metal atom are **transferred** to the non-metal atom. **Metal atoms lose electrons** to become **positively charged ions**. **Non-metal atoms gain electrons to become negatively charged ions.** The **ions** have the **electronic structure** of a **noble gas (Group 0)**.

An ionic compound is a **giant structure of ions**. Ionic compounds are held together by **strong electrostatic forces of attraction** between **oppositely charged ions**.

These compounds have **high melting points** and **high boiling points** because of the **large amounts of energy** needed to **break** the many **strong bonds**. When **melted or dissolved in water**, ionic compounds **conduct electricity** because the **ions are free to move** and so **charge can flow.**

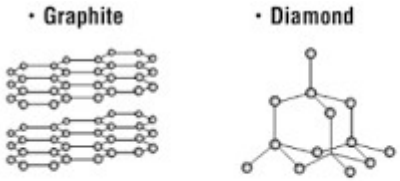
SIMPLE COVALENT MOLECULES



When atoms **share pairs** of electrons, they form **covalent bonds**. These bonds between atoms are **strong**. Substances that consist of **small molecules** are usually **gases or liquids** that have **low melting and boiling points**. These substances have only **weak forces between the molecules** (**intermolecular forces**). It is **these forces that are overcome**, **not the covalent bonds**, when the substance **melts or boils.** The intermolecular **forces increase with the size of the molecules**, so **larger molecules have higher melting and boiling points**. These substances **do not conduct electricity** because the **molecules do not have an overall electric charge**.

GIANT COVALENT STRUCTURES

In covalent bonding, atoms of non-metals share pairs of electrons. Substances that consist of giant covalent structures are **solids** with very high melting points. **All of the atoms** in these structures are **linked to other atoms** by **strong covalent bonds**. These **bonds** must be **overcome** to **melt or boil** these substances. **Diamond** and **graphite** (forms of **carbon**) and silicon **dioxide** (silica) are examples of giant covalent structures.



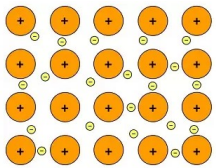
DIAMOND

Each carbon atom forms **four covalent bonds** with **other carbon atoms** , so diamond is very **hard**, has a **very high melting point** and **does not conduct electricity**

GRAPHITE

Each carbon atom forms **three covalent bonds** with **three other carbon atoms**, forming **layers of hexagonal rings** which have **no covalent bonds between the layers**. In graphite, one electron from each carbon atom is **delocalised** and can move throughout the whole structure, meaning it conducts electricity.

METALS



Metals have **giant structures of atoms in a sea of delocalised electrons** which are **free to move** through the whole structure. This means they have **strong metallic bonds,** which means that most metals have **high melting and boiling points**. In pure metals, **atoms are arranged in layers**, which allows metals to be **bent and shaped**. Metals are **good conductors of electricity** because the **delocalised electrons** in the metal **carry electrical charge** . Metals are good conductors of thermal energy because energy is transferred by the delocalised electrons.

Youtube

Giant Ionic

Simple Covalent

Diamond

Graphite

Metals

Other Links

Bitesize