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GCSE Chemistry

AQA Topic – Bonding, structure and the properties of matter

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The PiXL Club Ltd, Company number 07321607

Overview

Bonding, Structure and the properties of matter

Bonding

- Chemical bonds
- Ionic bonding
- Ionic compounds
- Covalent bonding
- Metallic bonding

Properties of substances

- States of matter
- State symbols
- Properties of ionic compounds
- Properties of small molecules
- Polymers
- Giant covalent structures
- Properties of metals and alloys

Structure and bonding of carbon

- Diamond, graphite
- Graphene and fullerenes

Nanoparticles (Chemistry ONLY)

- Size of particles
- Uses of nanoparticles

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Bonding part 1

- Chemical bonds
- Ionic bonding
- Ionic compounds

Chemical bonds

There are three types of strong chemical bonds:

- Ionic
- Covalent
- Metallic

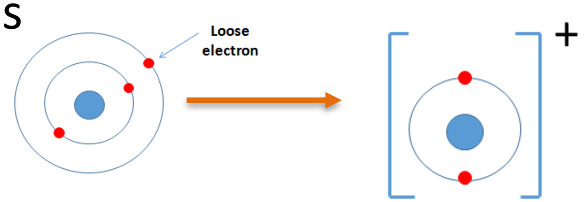
Ionic	Covalent	Metallic
Particles are oppositely charged ions	Particles are atoms which share pairs of electrons	Particles are atoms which share delocalised electrons
Between metals and non-metals	Most non-metallic elements Between non-metals and non-metals	In metallic elements and alloys

You need to be able to explain chemical bonding in terms of **electrostatic forces** and the **transfer of electrons**.

Ionic bonding

Ionic bonds form between **metals and non-metals**. Ionic bonding involves the transfer of electrons in the **outer** shells.

Metals **lose** electrons to become **positively** charged ions and non-metals **gain** electrons to become **negatively** charged ions.



Positive Ions		Negative Ions	
Hydrogen	H^+	Fluoride	F^-
Lithium	Li^+	Chloride	Cl^-
Sodium	Na^+	Bromide	Br^-
Potassium	K^+	Iodide	I^-
Magnesium	Mg^{2+}	Oxide	O^{2-}
Calcium	Ca^{2+}	Hydroxide	OH^-
Aluminium	Al^{3+}	Nitrate	NO_3^-
Silver	Ag^+	Sulphate	SO_4^{2-}
Copper	Cu^{2+}	Phosphate	PO_4^{3-}
Ammonium	NH_4^+	Carbonate	CO_3^{2-}
Iron	Fe^{2+} & Fe^{3+}		

These have all *lost* electrons. They're all metals apart from H^+ and NH_4^+

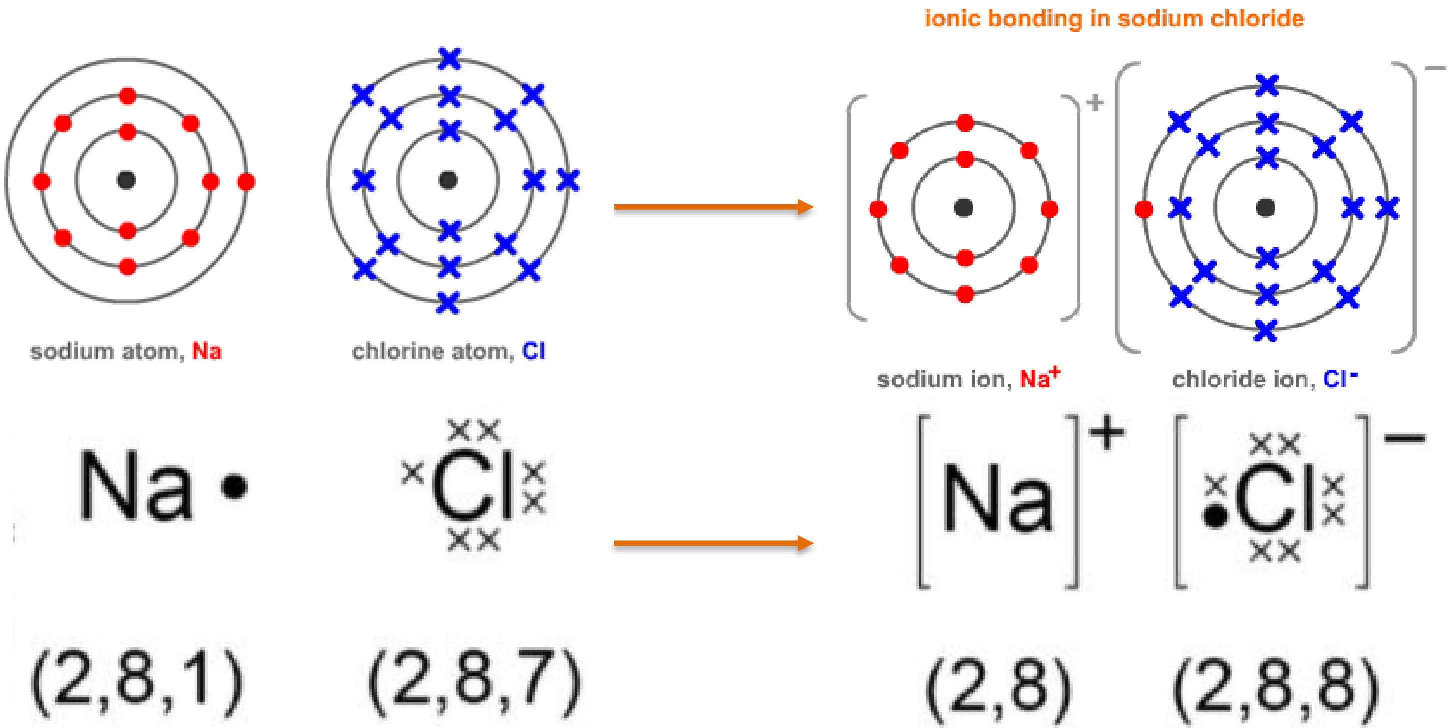
These have all *gained* electrons. They're all non-metals.

The elements in **Group 1** react with the elements in **Group 7.**

Groups 1 elements can each lose **one** electron. This electron can be given to an atom from Group 7, they both achieve the stable electronic structure of a noble gas.

Ionic bonding

The electrostatic attraction between the oppositely charged Na^+ ions and Cl^- ions is called **ionic bonding**. The electron transfer during the formation of an ionic compound can be represented by a **dot and cross diagram**:



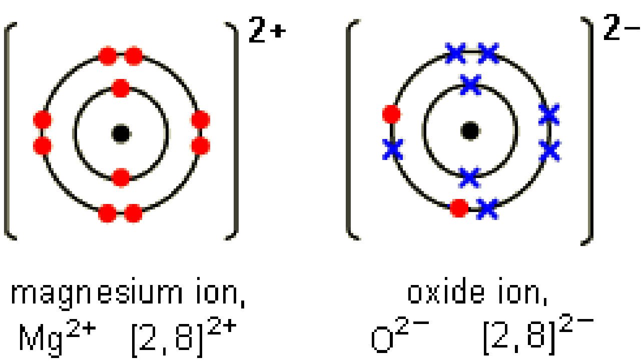
When completing diagrams always include:

- **The correct number of electrons on outer shells**
- **The charge**

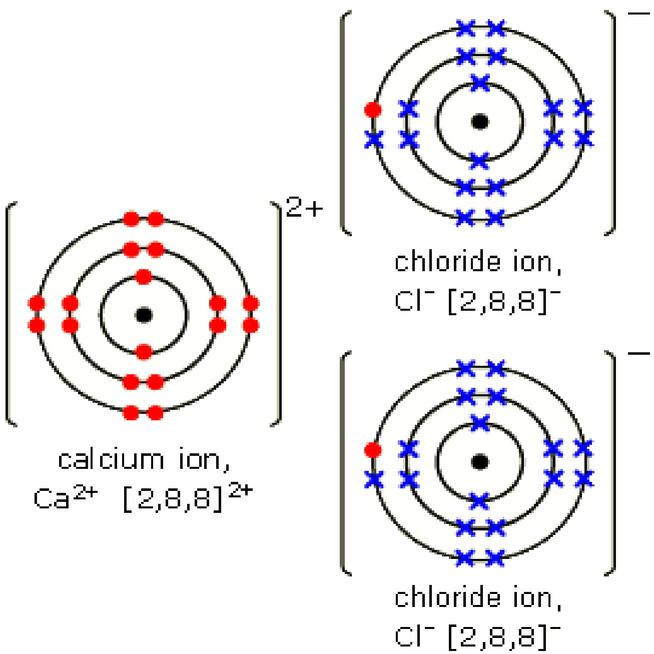
The **charge** on the ions produced by metals in group 1 and 2 and by non-metals in group 6 and 7 relates to the **group number** of the element in the periodic table. For example **group 1** form **1+ ions**, **group 3** form **3+ ions**, **group 6** form **2- ions** and **group 7** form **1- ions**.

Ionic bonding

Magnesium oxide:
Sometimes the atoms reacting need to gain or lose **two electrons** to gain a stable noble gas structure. Each magnesium loses two electrons and each oxygen gains two electrons. Magnesium ions have the formula Mg^{2+}, while oxide ions have the formula O^{2-} .
This means that one magnesium atom reacts with one oxygen atom, giving the formula **MgO**



Calcium Chloride:
Each calcium atom (2, 8, 8, 2) needs to lose two electrons but each chlorine atom (2, 8, 7) needs to gain only one electron.
This means that two chlorine atoms react with every one calcium atom,



Ionic compounds

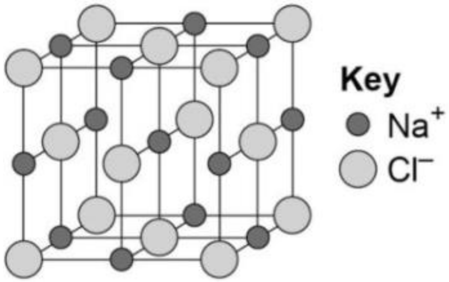
An ionic compound is a **giant structure of ions.**

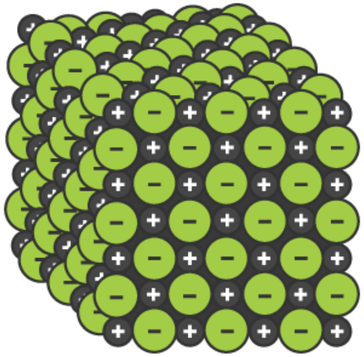
Ionic compounds are held together by **strong electrostatic forces of attraction between oppositely charges ions.** These forces act in all directions in the lattice – this is called **ionic bonding**.

Empirical formula

The models can indicate the chemical formula of a compound by the **simplest ratio** of atoms or ions in models of their giant structure – this is called the **empirical formula**.
e.g. there is a 1:1 ratio of sodium to chlorine in sodium chloride, so the formula is **NaCl**.

The structure of sodium chloride can be represented in the following forms:





- The models never accurately reflect the many millions of atoms/ions bonded together in the giant lattices

QuestionIT!

Bonding part 1

- Chemical bonds
- Ionic bonding
- Ionic compounds

1. What are the three types of strong chemical bond?

2. What particles are found in:
   a) Ionic bonding
   b) Covalent bonding
   c) Metallic bonding?

3. Which type of bonds occurs when metals combine with non-metals?

4. What type of bonding occurs in carbon dioxide? Why?

5. What type of bonding occurs in alloys?

6. What happens to the electrons in ionic bonding?

7. What electronic structure do the ions produced by metals in Groups 1 and 2 and the non-metals in Groups 6 and 7 have?

8. What is the link between the charge number on the ions in groups 1, 2 and 3 and their group number ?

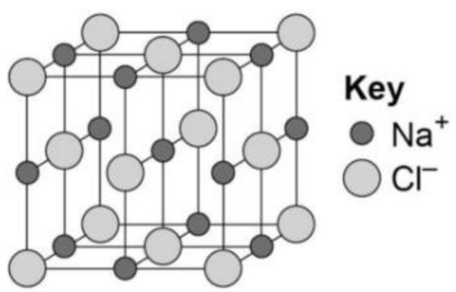
9. What is an ionic compound?

10. How are ionic compounds held together?

11. Why is the ball and stick model not an accurate representation of the structure of an ionic compound?

12. Draw a diagram to show how potassium and chlorine atoms join together to form ions.

13. Explain how you can use the following model to work out the empirical formula of sodium chloride.



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AnswerIT!

Bonding part 1

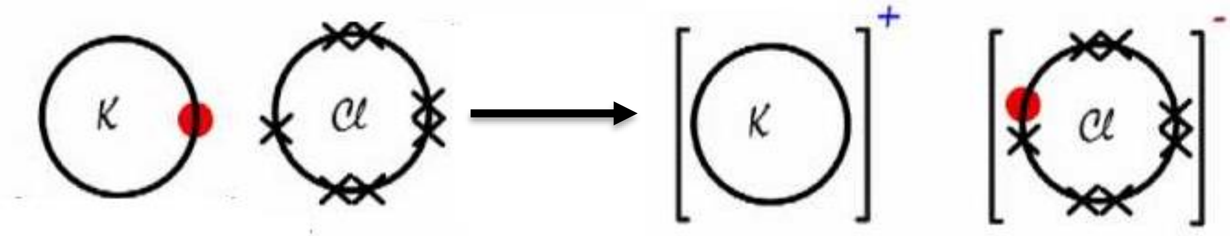
- Chemical bonds
- Ionic bonding
- Ionic compounds

1. What are the three types of strong chemical bond?
   Ionic, covalent, metallic.
2. What particles are found in:
   a) Ionic bonding **oppositely charged ions.**
   b) Covalent bonding **atoms which share electrons.**
   c) Metallic bonding? **Atoms which share delocalised electrons.**

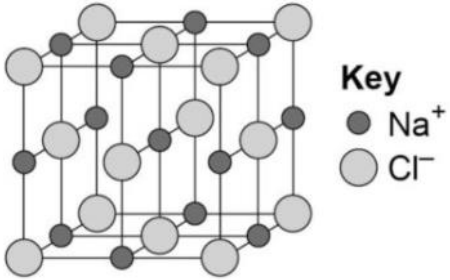
3. Which type of bonds occurs when metals combine with non-metals?
   Ionic.
4. What type of bonding occurs in carbon dioxide? Why?
   Covalent; two non-metals.
5. What type of bonding occurs in alloys?
   Metallic.

6. What happens to the electrons in ionic bonding?
   Transferred.
7. What electronic structure do the ions produced by metals in Groups 1 and 2 and the non-metals in Groups 6 and 7 have?
   Electronic structure of a noble gas.
8. What is the link between the charge number on the ions in groups 1, 2 and 3 and their group number ?
   Charge number is same as Group number.
9. What is an ionic compound?
   Giant structure of ions.
10. How are ionic compounds held together?
    Strong electrostatic forces of attraction; between oppositely charged ions.

11. Why is the ball and stick model not an accurate representation of the structure of an ionic compound?
    Does not accurately depict the millions of ions in the lattice. The ions should touch each other/ there are no gaps between the ions.
12. Draw a diagram to show how potassium and chlorine atoms join together to form ions.



13. Explain how you can use the following model of sodium chloride to work out the empirical formula.



Count the number of each type of atom in the giant structure and work out simplest whole number ratio.

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Bonding
PART 2

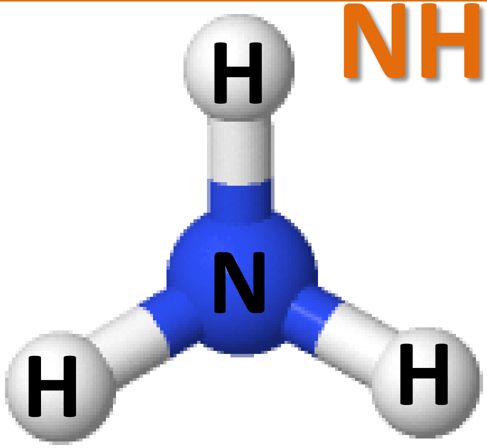
- Covalent bonding
- Metallic bonding

Covalent bonding - PART 1

When atoms **share pairs of electrons**, they form **covalent bonds**.

These are **STRONG** bonds.

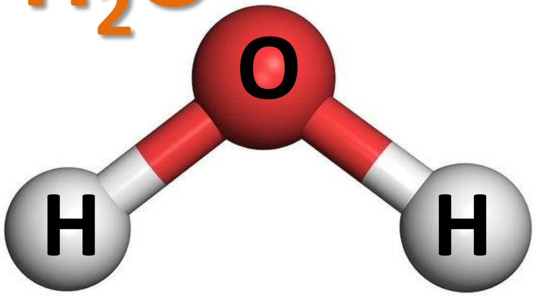
Covalently bonded substances may be: **Small molecules**, **very large molecules** or **giant covalent structures.**



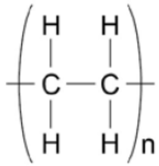
NH_3

You can deduce the molecular formula of a substance from a given model or diagram showing the atoms and bonds in the molecule by counting the number of atoms.

H_2O



Polymers are examples of very large covalent molecules, they can be represented in the form: where '**n**' = a **very large number**!



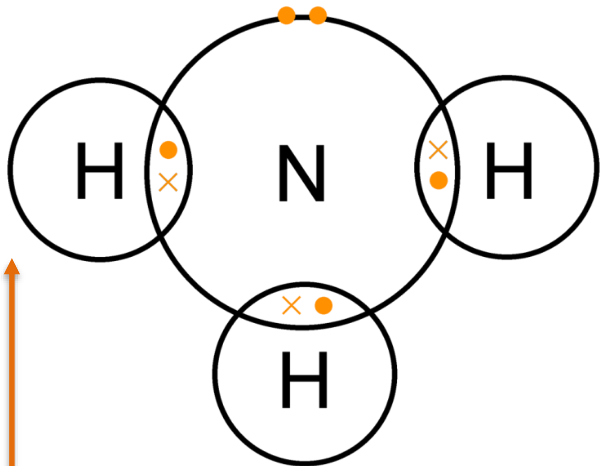
poly(ethene)

Examples of covalently bonded substances with **giant covalent structures** are **diamond** and **silicon dioxide**.

Covalently bonded substances may consist of small molecules. The covalent bond in molecules can be represented in the following models. Like all models, each one is useful but has some limitations.

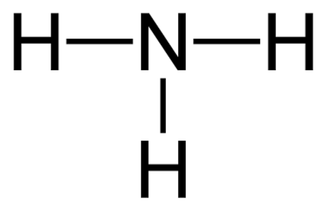
Ammonia NH_3

Dot and cross with outer shells as circles:



+ Show which atom the electrons in the bonds come from
- All electrons are identical

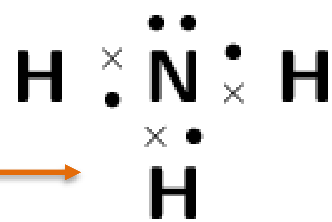
2D with bonds:



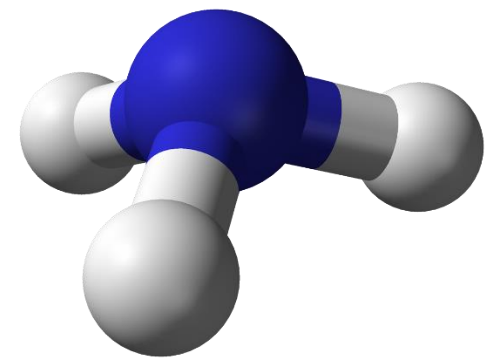
+ Show which atoms are bonded together

- It shows the H-N-H bond incorrectly at 90°

Dot and cross with outer shells electrons:



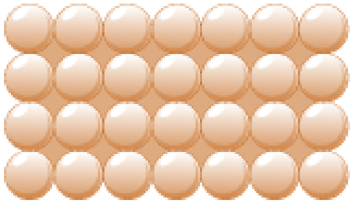
3D ball and stick model:



+ Attempts to show the correct H-N-H bond angle is 107.8°
+ Shows the impact of the lone pair

Metallic bonding

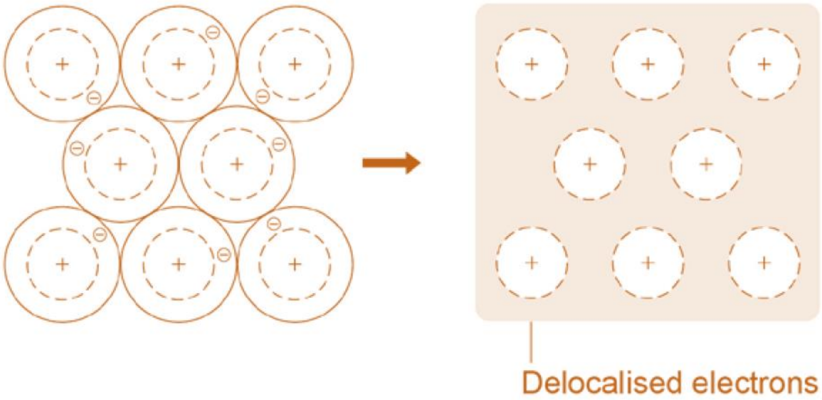
The atoms in metals are built up **layer upon layer** in a **regular** pattern. They are another example of a **giant structure**.



The electrons in the **outer shell** of metal atoms are **delocalised** and are **free to move** throughout the structure.

The sharing of delocalised electrons leads to **strong metallic bonds**.

Metallic bonding can be represented in the following form:



QuestionIT!

Bonding
PART 2

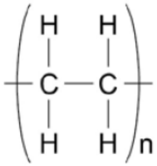
- Covalent bonding
- Metallic bonding

1. How are strong covalent bonds formed?

2. What are the three types of structure that can be formed by covalent bonding?

3. What are polymers an example of?

4. What type of structure do the following covalently bonded substances have?
   a) Water H_2O
   b) Silicon dioxide SO_2
   c) Diamond C
   d) Poly(ethene)



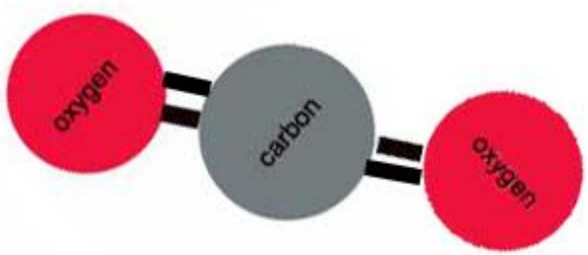
poly(ethene)

5. What are the limitations of using dot and cross diagrams to represent covalent bonds?

6. How are atoms arranged in a metal?

7. Why are metallic bonds so strong?

8. What is the formula of the following model?



Covalent bonding PART 1 – QuestionIT

9. Draw a dot and cross diagram for water.

10. Describe the arrangement of particles in a metal.

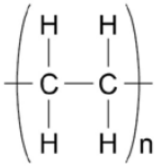
11. Why are the particles that make up a metal described as positively charged?

12. What are delocalised electrons?

AnswerIT!

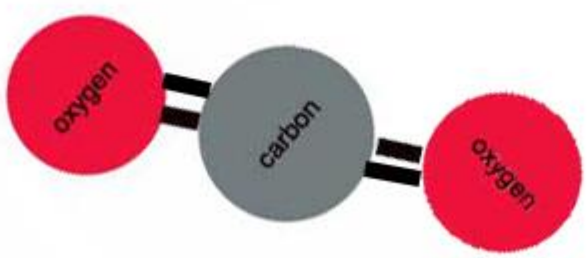
Bonding
PART 2

- Covalent bonding
- Metallic bonding

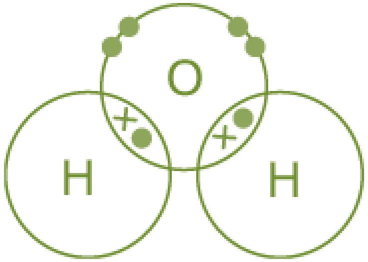
1. How are strong covalent bonds formed?
   Atoms share pairs of electrons.
2. What are the three types of structure that can be formed by covalent bonding?
   Small molecules, very large molecules, giant covalent molecules.
3. What are polymers an example of?
   Very large molecules.
4. What type of structure do the following covalently bonded substances have?
   a) Water H_2O **Small covalent.**
   b) Silicon dioxide SO_2 **Giant covalent.**
   c) Diamond C **Giant covalent.**
   d) Poly(ethene)  **Very large molecule.**

poly(ethene)

5. What are the limitations of using dot and cross diagrams to represent covalent bonds?
   It shows the electrons differently, when they are the same and it does not show the bond angles or shape of the molecule.
6. How are atoms arranged in a metal?
   Giant structures of atoms, arranged in a regular pattern, delocalised electrons.
7. Why are metallic bonds so strong?
   Sharing of delocalised electrons.
8. What is the formula of the following model?
   CO_2



9. Draw a dot and cross diagram for water.



10. Describe the arrangement of particles in a metal.
    Atoms arranged neatly in rows; sea of delocalised electrons.
11. Why are the particles that make up a metal described as positively charged?
    The metal atoms lose outer shell electrons and therefore there are more protons (+) than electrons (–).
12. What are delocalised electrons?
    They are free-moving electrons within structure; not associated with a particular atom.

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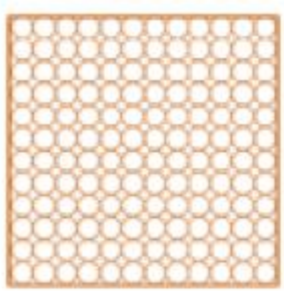
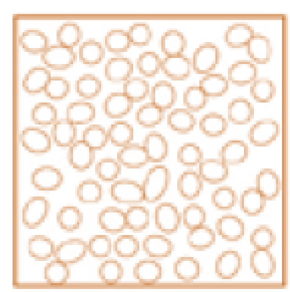
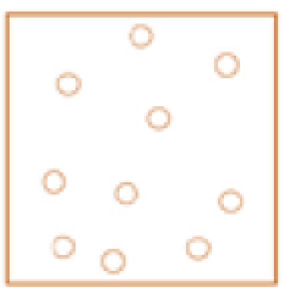
Properties of substances Part 1

- States of matter
- State symbols

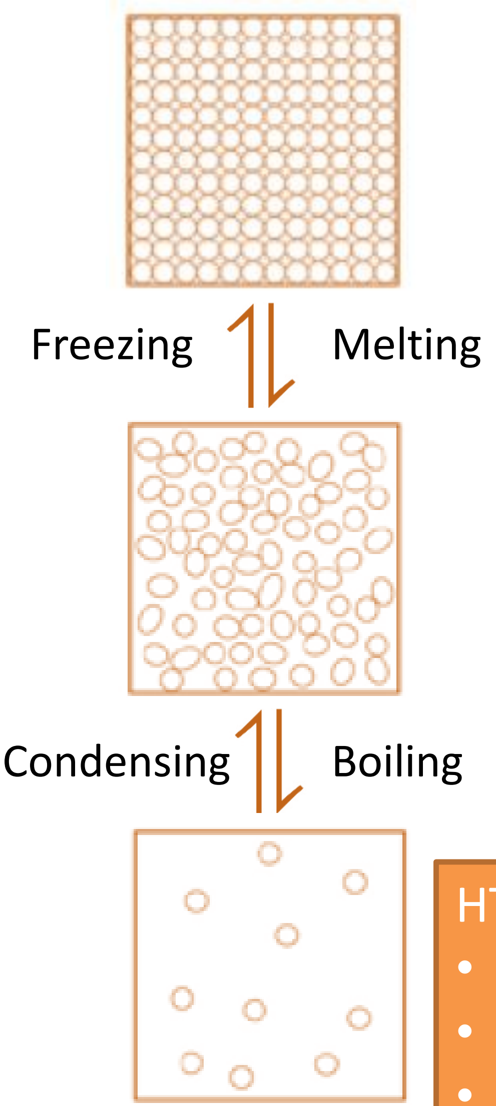
States of matter and state symbols

There are **three** states of matter – **solid, liquid** and **gas**. To explain the properties of the states, the **particle theory** is used. It is based on the fact that all matter is made up of tiny particles and describes the **movement** and **distance** between particles.

Solid	Liquid	Gas
Close together, regular pattern, vibrate on the spot.	Close together, random arrangement, move around each other.	Far apart, random arrangement, move quickly.
		

In chemical equations, the three states are shown as **(s), (l), (g)** and **(aq)** for aqueous solutions.

Changes of state



Melting and **freezing** take place at the **melting point**.
Boiling and **condensing** take place at the **boiling point**.

The **amount of energy** required to change the state depends on the **strength of the forces** between the particles of the substance.

The **stronger the forces** between the particles the **higher the melting and boiling point** of the substance.

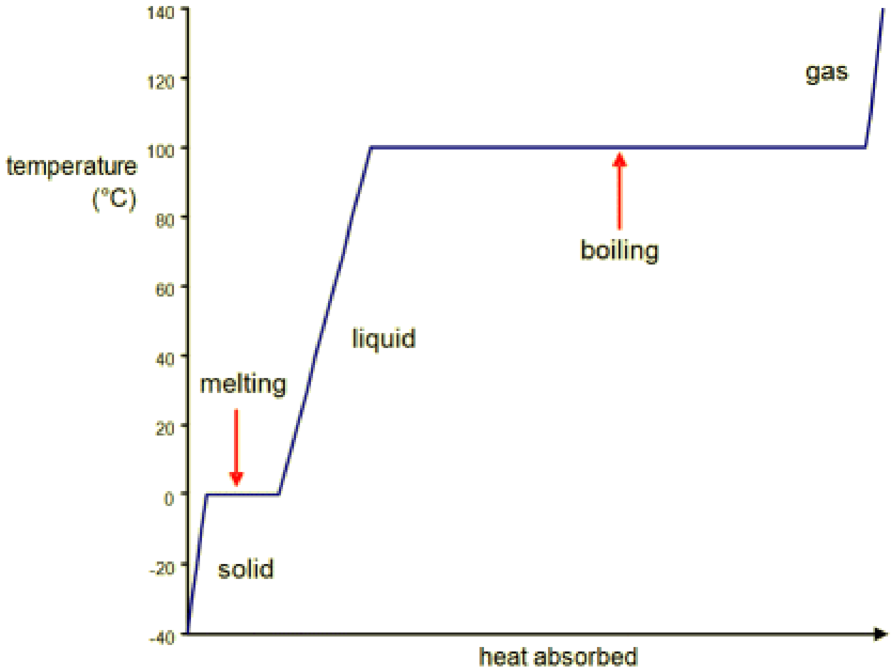
The type of bonding and the structure of the substance depend on the particles involved.

HT ONLY - There are limitations of the particle model of matter:

- There are no forces
- All particles are shown as spheres
- The spheres are solid

Changes of state

The graph shows a **heating curve** of a solid, which shows the temperature of a substance plotted against the amount of energy it has absorbed:



A substance must **absorb** heat energy so that it can **melt** or **boil**. The **temperature** of the substance does **not change** during **melting**, **boiling** or **freezing**, even though energy is still being transferred.

QuestionIT!

Properties of substances Part 1

- States of matter
- State symbols

1. What are the three states of matter?
2. What is used to represent particles in the simple particle model?
3. What takes place at the melting point?
4. What takes place at the boiling point?
5. What factor affects the amount of energy needed to change state?

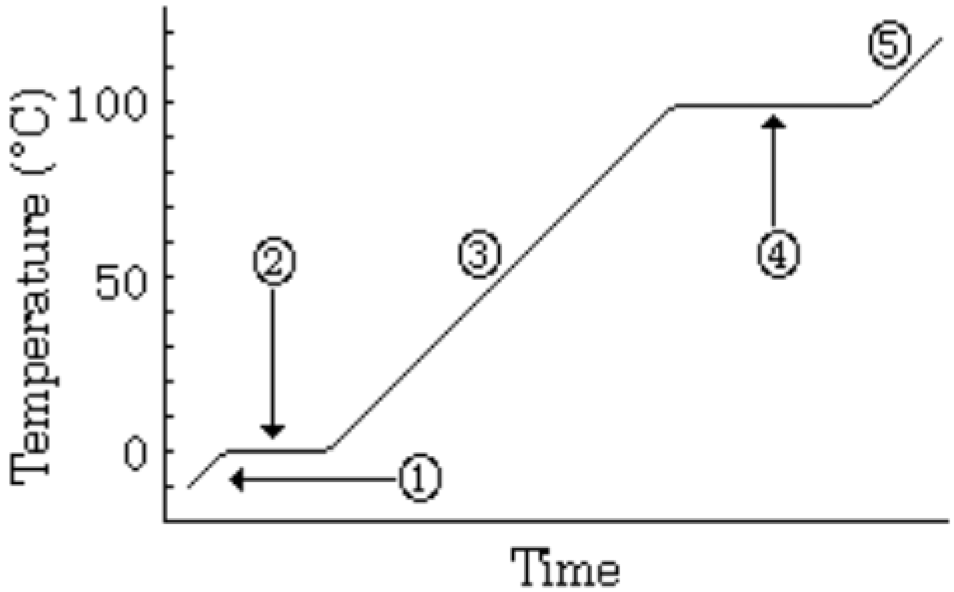
6. In chemical equations what symbols are used to show the states of matter?

7. In what state of matter do particles have the most energy?

8. What would eventually happen to a gas if pressure is increased?

9. **HT ONLY**: Explain the limitations of the particle model.

10. The following represents the heating of ice:



a) What change in state happens at stage 2?

b) What is happening at stage 4?

AnswerIT!

Properties of substances Part 1

- States of matter
- State symbols

1. What are the three states of matter?
   Solid, liquid, gas.
2. What is used to represent particles in the simple particle model?
   Small solid spheres.
3. What takes place at the melting point?
   Melting and freezing.
4. What takes place at the boiling point?
   Boiling and condensing.
5. What factor affects the amount of energy needed to change state?
   Forces between molecules.

6. In chemical equations what symbols are used to show the states of matter?

   Solid = (s); liquid = (l); gas = (g); aqueous = (aq)

7. In what state of matter do particles have the most energy?

   Gas.

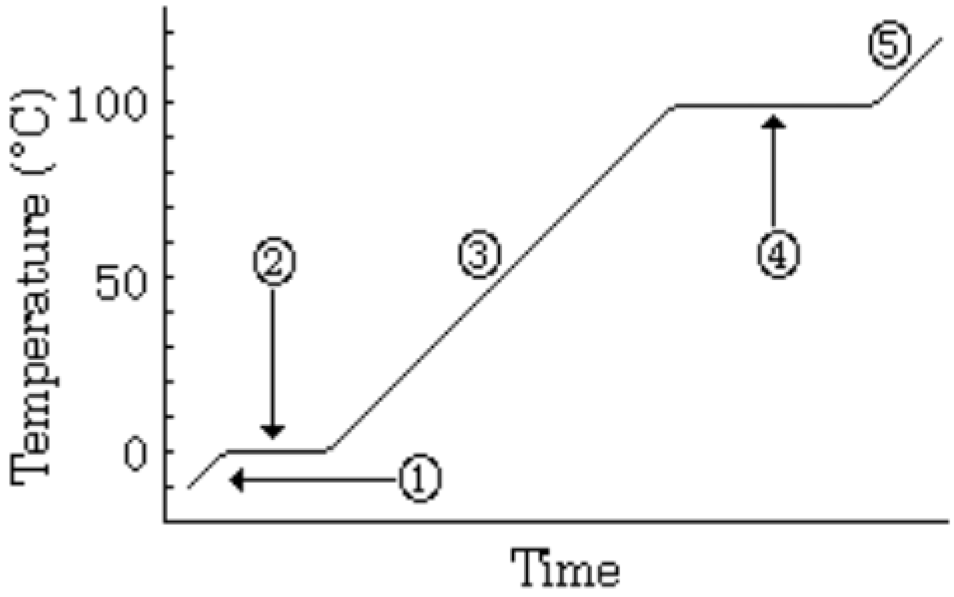
8. What would eventually happen to a gas if pressure is increased?

   Condense into a liquid.

9. **HT ONLY**: Explain the limitations of the particle model.

   No forces, particles are shown as spheres, spheres are solid.

10. The following represents the heating of ice:



a) What change in state happens at stage 2?

Melting/ freezing

b) What is happening at stage 4?

Boiling/ condensing

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Properties of substances Part 2

- Ionic compounds
- Small molecules
- Polymers
- Giant covalent structures
- Metals and alloys

Properties of ionic compounds

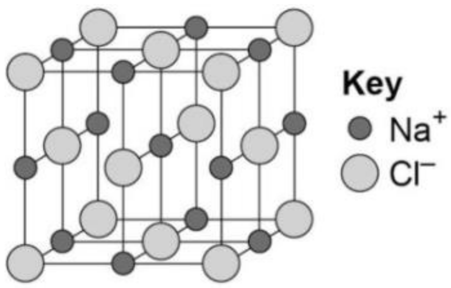
Structure

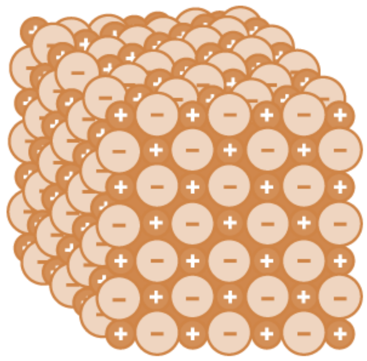
Ionic compounds have **regular structures** called **giant ionic lattices**.

There is **strong electrostatic forces** of attraction in all directions between **oppositely changed ions**.

Properties

- **High melting and boiling points** – large amounts of energy is needed to break the many **strong bonds** and overcome the electrostatic attraction.
- **Conduct electricity** when molten or dissolved in water – **ions are free to move** and can carry charge.





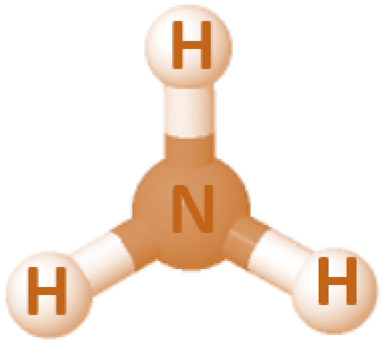
Properties of small molecules

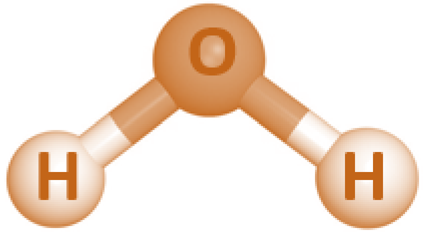
Structure

They have **weak forces between the molecules**. These weak forces are overcome when they change state **not** the strong covalent bonds.

Properties

- **Low melting and boiling points** – small amounts of energy is needed to break the **intermolecular forces**. Most are gases or liquids.
- **Do not conduct electricity** – Particles do not have an overall electric charge.





Intermolecular forces increase with the size of the molecules. So larger molecules have higher melting and boiling points.

Polymers

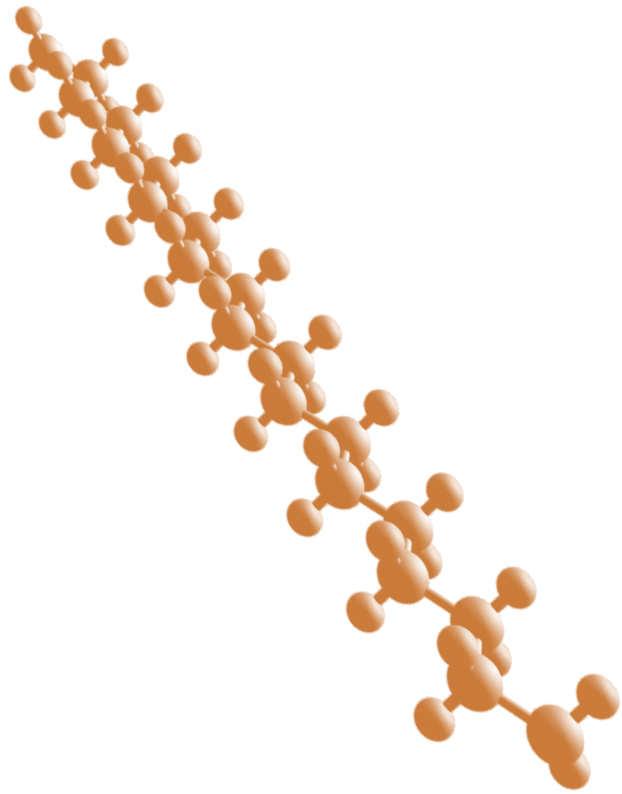
Some covalently bonded substances have very **large** molecules, such as **polymers**.

Structure

Polymers are made up from many small reactive molecules that bond to each other to form **long chains**. The atoms in the polymer molecules are linked to other atoms by **strong covalent bonds**. The **intermolecular forces** between polymer molecules **are relatively strong**.

Properties

- **Solid** at room temperature – **Strong intermolecular forces**.



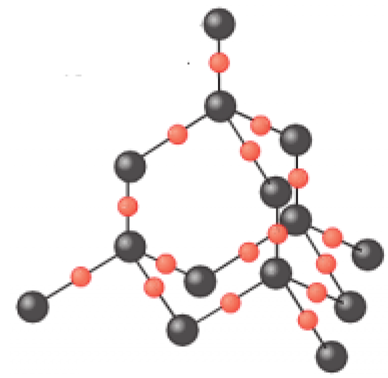
Giant covalent structures

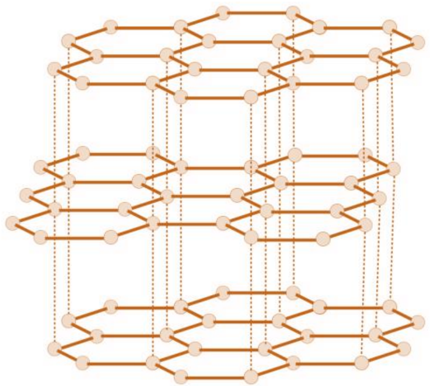
Structure

All atoms within the structure are linked by **strong covalent bonds**. These bonds **must be broken** for a solid to melt or boil.

Properties

- **Very high melting and boiling points** – very large amounts of energy is needed to break the **covalent bonds**.
- **Do not conduct electricity** – Particles do not have an overall electric charge.



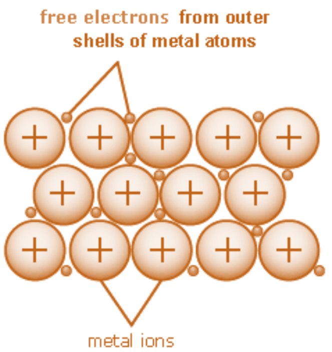


Properties of metals and alloys

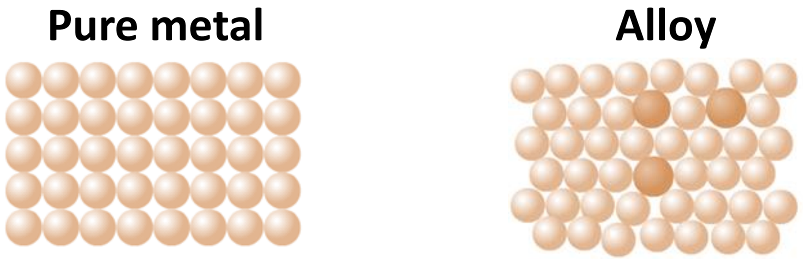
The giant structure of atoms with strong metallic bonding gives most metals a **high melting** and **boiling point**.

Metals are **malleable** (can be hammered into shape) and **ductile** (can be drawn out into a wire) because the **layers** of atoms (or ions) in a giant metallic structure can **slide** over each other

Delocalised electrons in metals enable **electricity** and **heat** to pass through the metal easily.



A **metal mixed** with other **elements** is called an **alloy.** Alloys are **harder** than pure metals. Alloys are made from **two or more** different metals.



The **different sized** atoms of the metals **distort** the **layers** in the structure, making it more **difficult** for them to **slide** over each other, and so make the **alloys harder** than pure metals.
For example, **gold** is naturally **soft** but adding **copper** to make jewellery **stronger** and last longer.

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QuestionIT!

Properties of substances
Part 2

- Ionic compounds
- Small molecules
- Polymers
- Giant covalent structures
- Metals and alloys

Properties of substances – Part 2 – QuestionIT

1. Describe the structure of ionic compounds.

2. Why do ionic compounds have high melting and boiling points?

3. Why can ionic compounds conduct electricity when melted or dissolved in water?

4. What state of matter are small molecules normally found in?

5. Why do small molecules have low melting and boiling points?

6. What happens to the melting and boiling points as small molecules get bigger? Why?

7. Why don’t small molecules conduct electricity?

8. What are polymers?

9. How are the atoms in a polymer linked together?

10. Why are polymers normally solid at room temperature?

11. Give an example of a giant covalent structure.

12. Why do giant covalent structures have very high melting and boiling points?

13. Why do most metals have high melting and boiling points?

14. How are atoms arranged in pure metals?

15. What is an alloy?

16. Why do we use alloys, rather than pure metals, for many uses?

17. Why are metals good conductors of electricity?

18. What is thermal energy?

19. Why are metals good conductors of thermal energy?

AnswerIT!

Properties of substances Part 2

- Ionic compounds
- Small molecules
- Polymers
- Giant covalent structures
- Metals and alloys

1. Describe the structure of ionic compounds.
   Regular, giant ionic lattice.
2. Why do ionic compounds have high melting and boiling points?
   Strong electrostatic forces of attraction between ions.
3. Why can ionic compounds conduct electricity when melted or dissolved in water?
   Ions are free to move, carry the charge.
4. What state of matter are small molecules normally found in?
   Gas or liquid.
5. Why do small molecules have low melting and boiling points?
   Weak forces between molecules/ intermolecular forces.

6. What happens to the melting and boiling points as small molecules get bigger? Why?
   Increases, intermolecular forces get bigger.
7. Why don’t small molecules conduct electricity?
   Do not have an overall electric charge.
8. What are polymers?
   Very large molecules made of repeating units.
9. How are the atoms in a polymer linked together?
   Strong covalent bonds.
10. Why are polymers normally solid at room temperature?
    Intermolecular forces relatively strong.
11. Give an example of a giant covalent structure.
    Diamond, graphite, silicon dioxide.

12. Why do giant covalent structures have very high melting and boiling points?
    Strong covalent bonds must be broken.
13. Why do most metals have high melting and boiling points?
    Strong metallic bonding.
14. How are atoms arranged in pure metals?
    Layers.
15. What is an alloy?
    Mixture of two elements, one of which is a metal.
16. Why do we use alloys, rather than pure metals, for many uses?
    They are harder as the layers are distorted.

17. Why are metals good conductors of electricity?

    Electrical charge carried by delocalised electrons.

18. What is thermal energy?

    Heat energy.

19. Why are metals good conductors of thermal energy?

    Energy is transferred by delocalised electrons.

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LearnIT! KnowIT!

Properties of substances Part 3

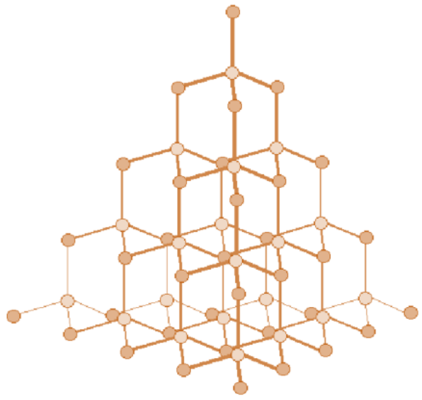
- Diamond
- Graphite
- Graphene and fullerenes

Diamond

Diamond:

In diamond, each carbon atom forms **four covalent bonds** with other carbon atoms in a **giant covalent structure**.

- Diamond is very **hard** – it is the hardest natural substance, so it is often used to make jewellery and cutting tools.
- Diamond has a **very high melting** and **boiling point** – a lot of energy is needed to break the covalent bonds.
- Diamond **cannot conduct electricity** – there are no free electrons or ions to carry a charge.

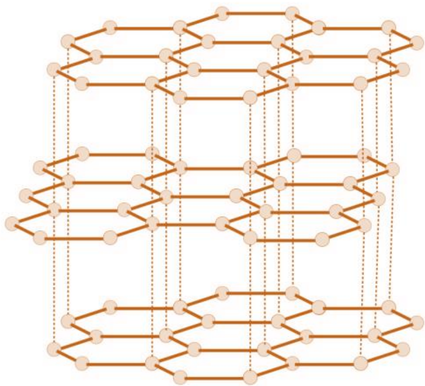


Graphite

Graphite:

In graphite, carbon atom forms **three** covalent bonds with three other carbon atoms, forming layers of **hexagonal rings** which have no covalent bonds between the layers.

- **Graphite is soft and slippery** – layers can easily slide over each other because the weak forces of attraction between the layers are easily broken. This is why graphite is used as a lubricant.
- **Graphite conducts electricity** – the only non-metal to do so. One **electron** from each carbon atom is **delocalised**.



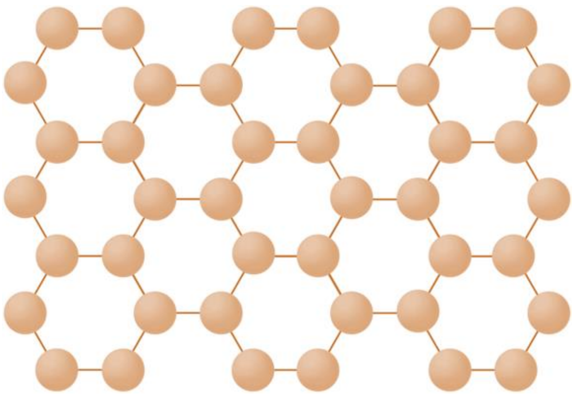
Graphene

Graphene:

This is a **single layer** of graphite – a layer of inter-locking hexagonal rings of carbon atoms **one atom thick**.

It is an excellent **conductor** of **thermal** energy and **electricity** (even better than graphite), has a very **low density** and is incredibly **strong**.

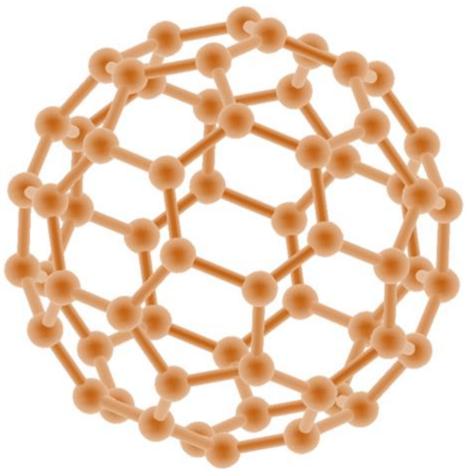
It has many uses in the **electronics industry**.

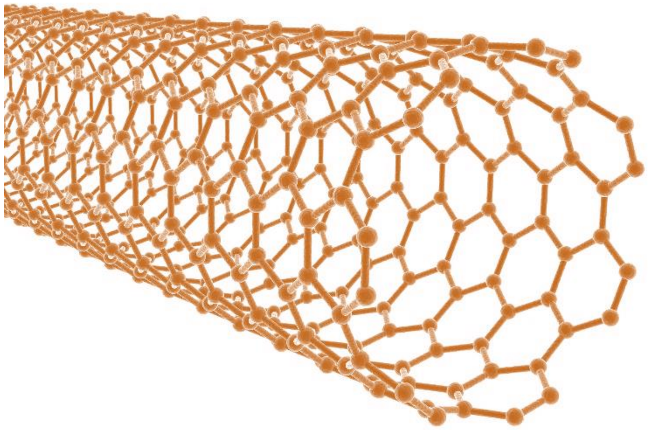


Fullerenes

Fullerenes:

Fullerenes are molecules of carbon with **hollow shapes**. The structure is based on hexagonal rings of carbon atoms, but may have 5 or 7 carbon rings. The first to be discovered was **Buckminsterfullerene** (C_{60}) which is spherical (like a football).





Carbon nanotubes are **cylindrical fullerenes** with very **high length compared to their diameter**. makes them useful for nanotechnology, electronics and materials.

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QuestionIT!

Properties of substances
Part 3

- Diamond
- Graphite
- Graphene and fullerenes

1. In a diamond, how many covalent bonds does each carbon make?
2. Diamond does not conduct electricity. Why?
3. Name 2 other properties of diamond.
4. In graphite, how many covalent bonds does each carbon make?
5. Describe the structure of graphite.
6. Why is graphite soft?

7. Why does graphite conduct electricity?

8. How is graphite similar to metals?

9. What is graphene?

10. What are fullerenes?

11. What was the first fullerene to be discovered?

12. What are carbon nanotubes?

13. What are carbon nanotubes useful for?

AnswerIT!

Properties of substances Part 3

- Diamond
- Graphite
- Graphene and fullerenes

1. In a diamond, how many covalent bonds does each carbon make?
   4
2. Diamond does not conduct electricity. Why?
   No delocalised electrons.
3. Name 2 other properties of diamond.
   Hard, very high melting point.
4. In graphite, how many covalent bonds does each carbon make?
   3
5. Describe the structure of graphite.
   Layers of hexagonal rings.
6. Why is graphite soft?
   Layers can slide over each other, weak forces between layers, no covalent bonds between layers.

7. Why does graphite conduct electricity?
   Each carbon has one delocalised electron.
8. How is graphite similar to metals?
   It contains delocalised electrons.
9. What is graphene?
   Single layer of graphite, 1 atom thick.
10. What are fullerenes?
   Molecules of carbon atoms with hollow shapes.
11. What was the first fullerene to be discovered?
   Buckminsterfullerene.
12. What are carbon nanotubes?
   Cylindrical fullerenes.
13. What are carbon nanotubes useful for?
   Electronics, nanotechnology and materials.

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LearnIT! KnowIT!

Nanoparticles (Chemistry ONLY)

- Sizes of particles and their properties
- Uses of nanoparticles

Covalent bonding - PART 3 CHEMISTRY ONLY

Nanoscience is the study of **small** particles that are between **1 and 100 nanometres** in size. Particles consisting of **fewer than 100 atoms** are often called **nanoclusters**.

1 nanometre (1 nm) = **1×10^{-9} metres** (0.000 000 001m or a billionth of a metre).

Nanoparticles are smaller than **fine particles** ($PM_{2.5}$) which have diameters between 1×10^{-7} metres and 2.5×10^{-6} .

To comprehend how small this is, **coarse particles**, like dust, have diameters between 1×10^{-5} and 2.5×10^{-6} .

The size of a typical nanoparticle is …

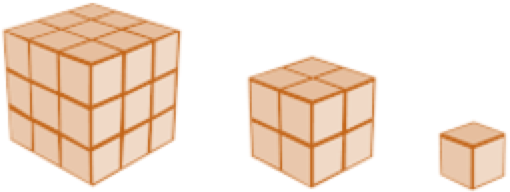
… to a football as a football is …

…to the Earth

Covalent bonding - PART 3
CHEMISTRY ONLY

Nanoparticles show different properties to the same materials in bulk as they have a **high surface area to volume ratio**.

The diagram shows this idea:



Surface area (height x width x number of sides)	3x3x6 **=54**	2x2x6 **=24**	1x1x6 **=6**
Volume (height x width x length)	3x3x3 **=27**	2x2x2 **=8**	1x1x1 **=1**
Surface to volume ratio (surface area / volume)	54/27 **=2**	24/8 **=3**	6/1 **=6**

As particle size gets smaller, the surface area to volume ratio gets larger.

As the side of cube decreases by a factor of 10 the surface area to volume ratio increases by a factor of 10.

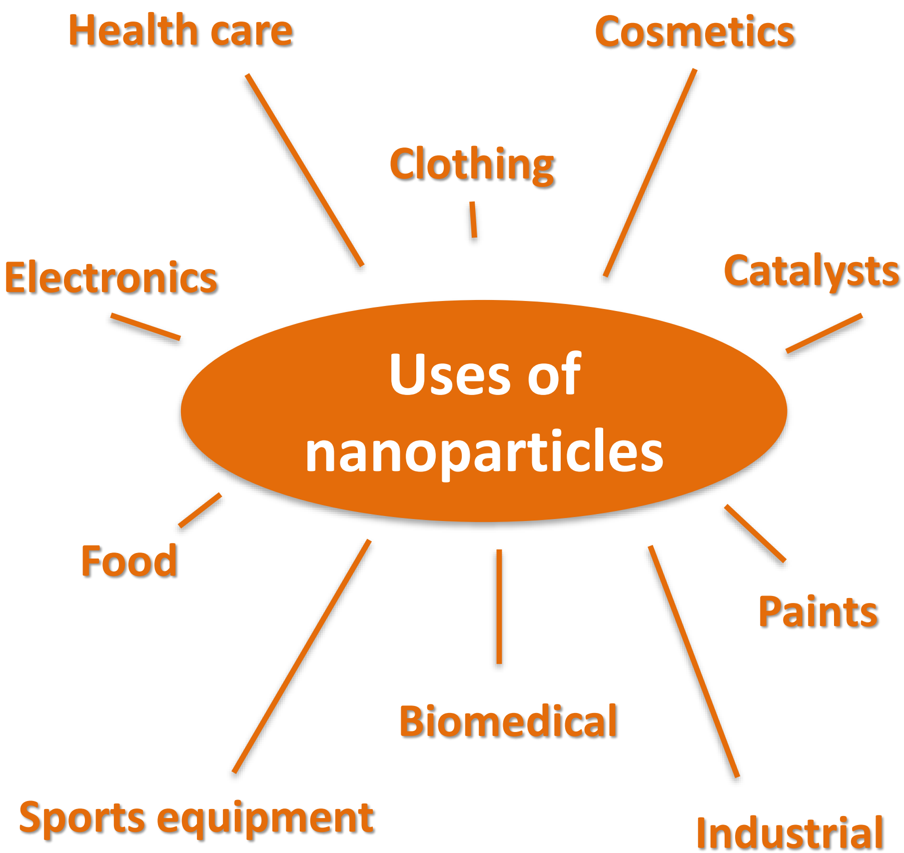
Nanoparticles show different properties to the same materials in bulk and have a high surface area to volume ratio. It also means that smaller quantities are needed to be effective than the materials with normal particle sizes.

Covalent bonding - PART 3 CHEMISTRY ONLY

Nanoparticles have many applications in **medicine**, in **electronics**, in **cosmetics** and sun creams, as deodorants, and as **catalysts**.

New developments in nanoscience are very exciting but will need more research into possible issues that might arise from their increased use.

There are some concerns that nanoparticles may be **toxic** to people. They may be able to enter the brain from the bloodstream and cause harm. Some people think more tests should take place before nanoparticles of a material are used on a wider scale.



Learn three examples for your exam

QuestionIT!

Nanoparticles (Chemistry ONLY)

- Sizes of particles and their properties
- Uses of nanoparticles

Nanoparticles CHEMISTRY ONLY – QuestionIT

1. What does nanoscience refer to?

2. What are nanoparticles?

3. What are coarse particles?

4. Why do nanoparticles have different properties from those for the same materials in bulk?

5. Name 5 uses of nanoparticles.

AnswerIT!

Nanoparticles (Chemistry ONLY)

- Sizes of particles and their properties
- Uses of nanoparticles

1. What does nanoscience refer to?
   Structures that are 1-100nm in size, a few hundred atoms.
2. What are nanoparticles?
   Smaller than fine particles.
3. What are coarse particles?
   Diameters between 1 x 10^{-5}m and 2.5 x10^{-6}m
4. Why do nanoparticles have different properties from those for the same materials in bulk?
   They have a high surface area to volume ratio. Smaller quantities are needed to be effective.
5. Name 5 uses of nanoparticles.
   Medicine, electronics, cosmetics, sunscreens, deodorants, catalysts.