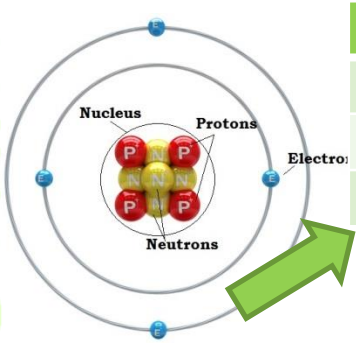
Y8 Bonding, Structure and Properties Higher and Foundation

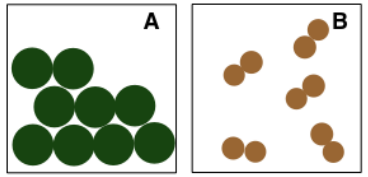
Position in the Periodic Table:
1. The number of electrons in the outer shell tells us the group in the periodic table
2. Potassium 2,8,8,1 and Lithium 2,1 both have 1 electron in their outer shell and are both found in group 1

START



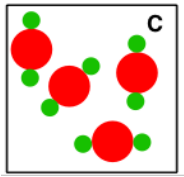
Particle	Charge	Mass
Electron	-1	0
Proton	+1	1
Neutron	0	1

Atoms are neutrally charged because they have equal numbers of protons and neutrons.

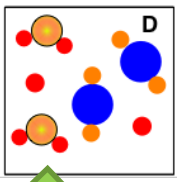


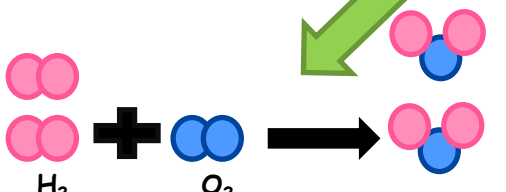
Element
All the same type of atom

Compound
More than one type of atom chemically bonded together



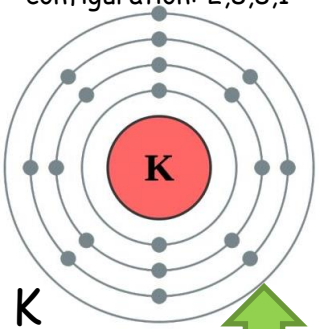
Mixture
More than one type of element or compound not chemically bound together





$2H_2 + O_2$ Elements → $2H_2O$ Compound

Electron configuration: 2,8,8,1



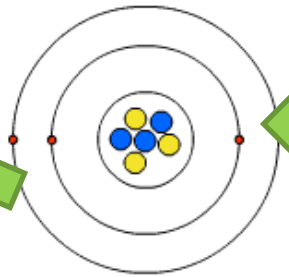
K

Mass number = 39
Atomic number = 19
Protons = 19
Electrons = 19
Neutrons = 4

Key words:
1. **Proton:** Found inside the nucleus of an atom, have a positive charge
2. **Electron:** Found in rings orbiting the nucleus, have a negative charge
3. **Neutrons:** Found in the nucleus of an atom, have no charge
4. **Nucleus:** The centre of an atom, made up of protons and neutrons
5. **Mass number:** The mass of the atom, made up of protons and neutrons
6. **Atomic number:** The number of protons in an atom
7. **Element:** All the same type of atom chemically bonded together
8. **Compound:** More than one type of atom chemically bonded together
9. **Mixture:** More than one type of element or compound not chemically bound together
10. **Electron Shell:** A ring surrounding the nucleus containing the electrons

Rules for electron shells:
1. The first shell will only hold 2 electrons
2. Shells after the first one will have up to 8 electrons
3. Electrons try to move as far away from each other as possible
4. Once the 4 points are filled up then the electron's will pair up
5. We write the electron configuration, which tells us how many electrons are in each shell

Li Electron configuration: 2,1



Mass number = 7
Atomic number = 3
Protons = 3
Electrons = 3
Neutrons = 4

$^{7}_{3}Li$

1. Mass number = protons – neutrons
   7 = 3 + neutrons
   7 – 3 = neutrons = 4
2. Atomic number = no. of protons
   Protons = 3
3. no. of electrons = no. of protons
   Electrons = 3

mass number → 4, atomic number → 2, $^{4}_{2}He$ ← element symbol

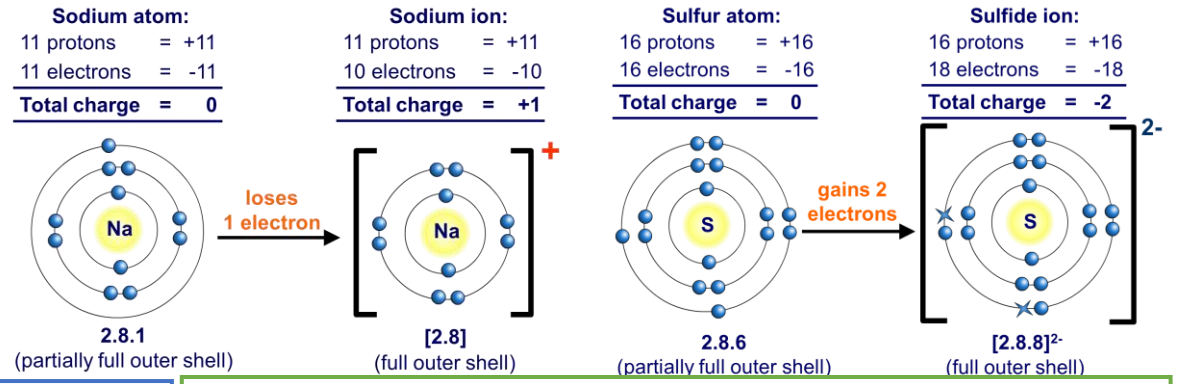
Rules:
1. Mass number = protons + neutrons
2. Atomic number = no. of protons
3. no. of electrons = no. of protons

Y8 Bonding, Structure and Properties Higher and Foundation

Elements in the periodic table are split into metals and non-metals.

Properties of Metals	Properties of Non-Metals
• Malleable • Ductile • High Melting Point • Hard • Strong • Conducts Heat • Conducts Electricity • Magnetic (iron, cobalt and nickel ONLY) • Solids • High Density	• Brittle • Low Melting Point • Soft • Weak • Does not Conduct Heat • Does not Conduct Electricity • Solids, Liquids or Gases • Low Density

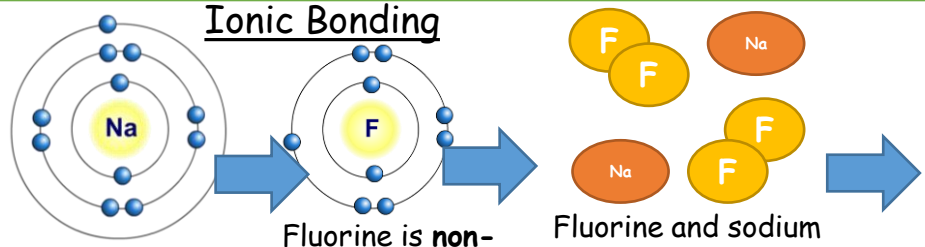
Ions are formed when atoms lose or gain electrons. They do not have equal numbers of protons and electrons.



Positive ions are made when atoms lose electrons. Negative ions are made when atoms gain electrons.

When atoms join together a bond is formed. Ions of opposite charge can form compounds by attracting to one another. This is called ionic bonding. It always happens between a metal and a non-metal atom.

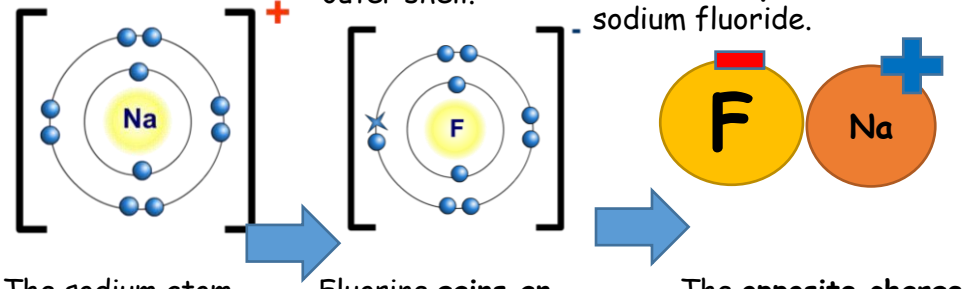
Ionic Bonding



Sodium is a **metal atom**. It has one electron in it's outer shell.

Fluorine is **non-metal atom**. It has seven electrons in it's outer shell.

Fluorine and sodium atoms are mixed together and chemical reaction occurs to form an **ionic compound** of sodium fluoride.



The sodium atom **loses its outer electron**. This makes it positively charged. It now has a **full outer shell**.

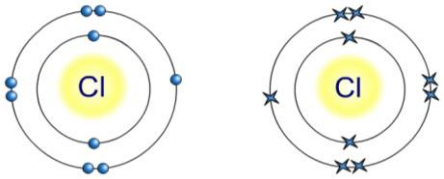
Fluorine **gains an electron from sodium**. This makes it negatively charged. It too now has a **full outer shell**.

The **opposite charges are strongly attracted** to one another. This forms a very strong ionic bond.

Covalent Bonding

During ionic bonding electrons are transferred from one atom to another, covalent bonding is different. Two non-metal atoms share electrons equally between them.

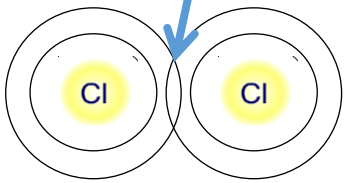
All atoms want **full** outer shells of **electrons**. This makes them more **stable**. If they have space in their outer shell they can fill this by either giving away electrons, accepting electrons or **sharing** electrons. When **non-metal** atoms bond they share electrons – this type of bonding is called **covalent** bonding.



Each chlorine atom has **seven** electrons in it's outer most shell. Each chlorine needs **one** more electron to gain a full outer shell and be stable.

"sharing zone"

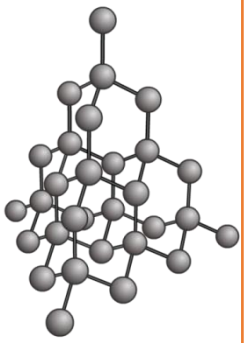
Fill in the shells:



The chlorine on the left needs to share **one** electron to the chlorine on the right and the chlorine on the right needs to share **one** electron to the chlorine on the left – there should always be even numbers of shared electrons.

Y8 Bonding, Structure and Properties Higher and Foundation

Diamond



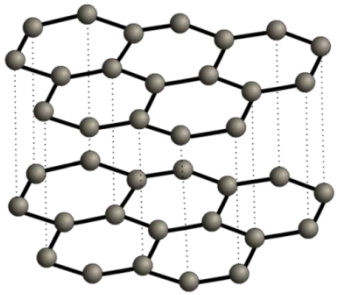
Very hard strong high melting point
each carbon has four strong covalent bonds to other carbon atoms.
To break these a large amount of energy is needed. Does not conduct electricity because all the electrons are used to form covalent bonds with other carbon atoms. Without free electrons diamond cannot conduct electricity.

Can you use the structure and bonding of graphite to explain why it would be used for making pencils?

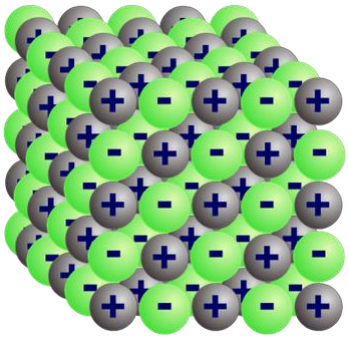
Can you use the structure and bonding of diamond to explain why it would be used for tipping drills?

It is much softer than diamond because the carb on atoms are only bonded to 3 others by strong covalent bonds in layers. The layers are held together by weak forces which are easily broken. This allows the layers to slide over one another. Because each carbon atom only forms 3 covalent bonds with others there are free electrons. These electrons can flow through the structure allowing graphite to conduct electricity.

Graphite



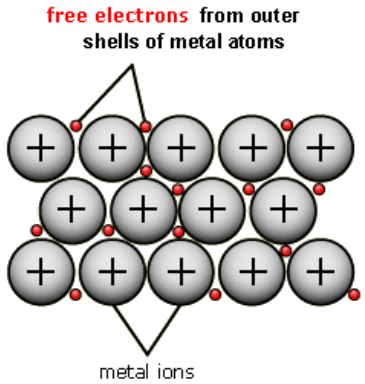
Ionic Lattice



This is what the structure of a ionic substance could look like. Many oppositely charged ions attracting to each other in a giant 3D lattice.

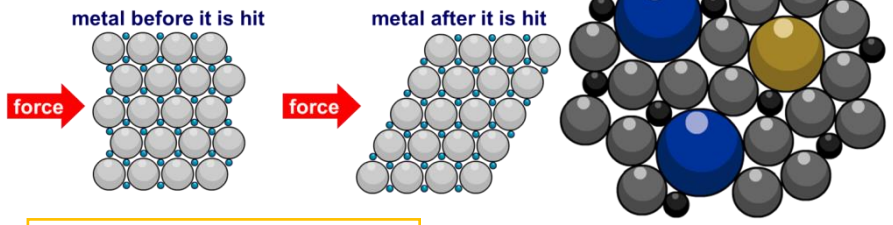
Metals

This is what the structure of a metal could look like. The positive metal atoms are in layers called a lattice. The electrons are free to move around.



This is why metals conduct electricity. The positive metal atoms and the free electrons attract together creating a strong bond. This gives metals a very high melting point.

Alloys



- In pure metals the atoms are all the same size.
- They form organised layers.
- These layers can easily slide so the metal changes shape more easily.

- In alloys, metals are mixed with other elements.
- The atoms are different sizes so there are no longer nice neat layers.
- The layers cannot easily slide making the alloy harder.

Tips – when describing substances you should
- Name the type of bonding (ionic/covalent/metallic/weak forces)
- Describe the number of bonds each atom forms
- Describe the strength of the bond
- Give any charges of any ions (positive or negative)

Y8 Bonding, Structure and Properties Higher and Foundation

	Type of Bonding	Description of Structure	Properties of Structure	Explanation of Properties	Examples of Substances
Simple Covalent Molecules	Covalent Bonding	Small groups of atoms bonded together with strong covalent bonds. Weak intermolecular forces between molecules. Always made up of two non-metal atoms.	Often liquids or gases, but sometimes solids. Very low melting and boiling points. Cannot conduct electricity.	Weak intermolecular forces are easily broken when the substance is melted or boiled. Covalent bonds **never** break. No free electrons or ions to carry an electric current.	Oxygen Carbon Dioxide Ammonia
Giant Covalent Structure	Covalent Bonding	Many non metal atoms held together by strong covalent bonds. It is a giant structure so many atoms joined together in a large 3D lattice.	Solids at room temperature. Very high melting and boiling points. Do not conduct electricity (except graphite) Very hard/strong materials	Covalent bonds are very strong, to melt a giant covalent structure all these need to be broken. This takes a large amount of energy. There are no free electrons or ions that can move so the do not conduct electricity. To break them up you need to break covalent bonds, these are very strong.	Diamond Graphite Silicon Dioxide
Giant Ionic Structures	Ionic Bonding	Made up of both metal and non-metal atoms held together by the attraction between oppositely charged ions. It is a giant structure so many atoms joined together in a large 3D lattice.	Solids at room temperature. Very high melting and boiling points. Do not conduct electricity when solid but do when melted (molten) or dissolved in water. Brittle if hit.	Ionic bonds are very strong, to melt a giant ionic substance all these bonds need to be broken. This takes a large amount of energy. There ions are not free to move in a solid but can move in solution or if molten, only then can they conduct electricity. When hit with a hammer the layers slide, ions with the same charge contact one another and repel making it brittle.	Sodium Chloride Magnesium Chloride
Metallic Structure	Metallic Bonding	Made up of metal and atoms held together by the attraction between metal ions and delocalised electrons. It is a giant structure so many atoms joined together in a large 3D lattice.	Solids at room temperature. Very high melting and boiling points. Do conduct electricity when solid and melted (molten). Malleable	Metallic bonds are very strong, to melt the a metallic structure all these bonds need to be broken. This takes a large amount of energy. There are no free ions but it can still conduct electricity because the electrons are free to move (delocalised) . When hit with a hammer the layers can slide over each other allowing metals to change shape.	Iron Steel (alloy) Copper Bronze (alloy)

Y8 Bonding, Structure and Properties Higher and Foundation

Questions – Page 1 and 2

1. Draw a labelled diagram of an atom. Describe its different parts.
2. Draw the electronic structure of Oxygen, Calcium, Sulphur.
3. Describe the difference between an element, compound and a mixture.
4. Calculate the numbers of protons, neutrons and electrons in oxygen, calcium and sulphur.
5. Describe how a positive ion is formed.
6. Describe how a negative ion is formed.
7. Describe how ions are different from atoms.
8. Describe how an ionic bond forms between lithium and chlorine.
9. Describe how covalent bonding is different from ionic bonding.

Questions – Page 3 and 4

1. What is a giant structure?
2. What is a molecule?
3. What is a lattice structure. Give two examples.
4. What happens to bonds when a substance is melted?
5. Describe the structure of diamond.
6. Explain why diamond is hard.
7. Explain why diamond can be used to make the tips of drills.
8. Describe the structure of graphite.
9. Explain why graphite is soft and conducts electricity.
10. Explain why graphite can be used in pencils.
11. Describe the arrangement of atoms in metals.
12. Explain why metals can be easily shaped.
13. Explain why alloys are harder than pure metals.