

THE FORMATION OF AN IONIC COMPOUND

✱ When a metal reacts with a non-metal an ionic bond is formed. ✱

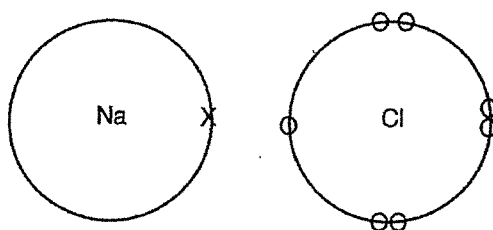
The metal atoms lose 1 (or 2 or 3) electron(s) from their outer shell as discussed previously. This means that they will have formed positive ions and have a full outer shell of electrons.

The non-metal atoms gain 1 (or 2 or 3) electrons. They therefore form negative ions with a full outer shell of electrons.

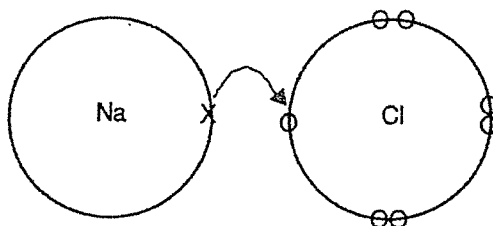
The process which occurs is one of electron transfer - the electrons go from the metal atoms to the non-metal atoms - and they must do so in the correct quantities. Electrons must be strictly accounted for - they cannot drift off into space!

For sodium chloride the process might look something like this:

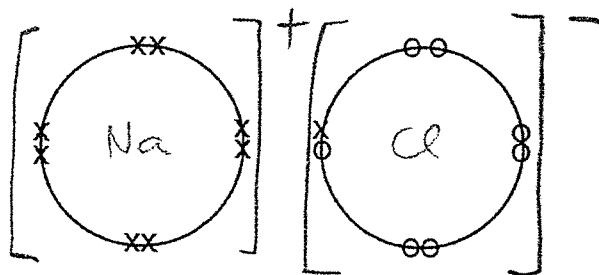
1. The situation before the reaction:



2. The situation during the reaction:

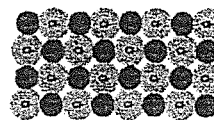


3. The situation after the reaction:



This results in the formation of a positive ion and a negative ion. Of course in reality there will be millions of positive and negative ions. Because they have opposite charges they will attract one another. They clump together into a lattice (or framework)

Dot-cross diagrams for ionic compounds (Metal + Non-Metal)



Draw Before and After diagrams for the bonding between the following pairs of atoms. Then write the formula of the resulting compound. You just need to show the outer shells.

1. Magnesium and oxygen

Draw the two atoms
showing their electron shells

Then draw the resulting ions
showing their charges and full shells

Formula of the compound magnesium oxide _____

2. Magnesium and chlorine

Formula of magnesium chloride _____

3. Beryllium and oxygen

Name of the compound _____

Formula of the compound _____

4. Sodium and oxygen

Name of the compound _____

Formula of the compound _____

5. Calcium and oxygen

Name of the compound _____

Formula of the compound _____

6. Potassium and sulphur

Name of the compound _____

Formula of the compound _____

7. Aluminium and chlorine

Name of the compound _____

Formula of the compound _____

Name: _____

Class: _____

Covalent and ionic substances

Aim

To make comparisons between ionic and covalent substances and determine links between their properties and structure.

You are going to examine six substances and determine if they are ionic or covalent from their appearance and physical properties.

Equipment

- Potassium chloride
- Sodium carbonate – IRRITANT.
- Magnesium chloride
- Paraffin wax – FLAMMABLE.
- Glucose.
- Stearic acid.
- Bunsen burner and heat-proof mat.
- Test tubes and test-tube rack.
- Test-tube holder.
- Distilled water.
- Spatulas.
- Magnifying glasses.
- Eye protection.

Method

Examine each substance in turn using the magnifying glass and note down any features. Next, try adding a spatula-full of each substance to a test tube with about 5 ml of distilled water. Note which substances dissolve. Finally, add a spatula-full of each substance to a test tube and hold the tube over a Bunsen flame to see if the substances melt. Now you have three pieces of information to help you decide which of the substances are ionic and which are covalent. You should record your answers in a table like this:

Name of substance	Appearance	Does it dissolve in water?	Does it melt in a Bunsen flame?	Ionic or covalent?

Ionic compounds:

- 1 are held together with very strong forces. Do they have low or high melting points?
- 2 are arranged in neat rows. Do they have crystals?
- 3 are made of ions that can move when in water. Do they dissolve easily?

[illegible]

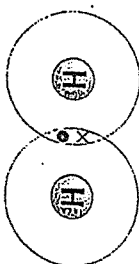
Covalent Bonding

Covalent Bonds — Sharing Electrons

- 1) Sometimes atoms prefer to make covalent bonds by sharing electrons with other atoms.
- 2) This way both atoms feel that they have a full outer shell, and that makes them happy.
- 3) Each covalent bond provides one extra shared electron for each atom.
- 4) Each atom involved has to make enough covalent bonds to fill up its outer shell.
- 5) Learn these important examples:

1) Hydrogen Gas, H_2

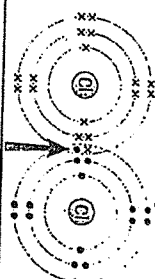
Hydrogen atoms have just one electron. They only need one more to complete the first shell...



...so they often form single covalent bonds to achieve this.

2) Chlorine Gas, Cl_2

Each chlorine atom needs just one more electron to complete the outer shell...

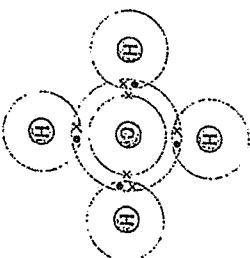


...so they form a single covalent bond and together share one pair of electrons.

3) Methane, CH_4

Carbon has four outer electrons, which is a half full shell.

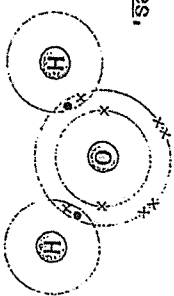
To become a 4+ or a 4- ion is hard work so it forms four covalent bonds to make up its outer shell.



4) Water, H_2O

Oxygen cheerfully forms covalent bonds and shares two electrons.

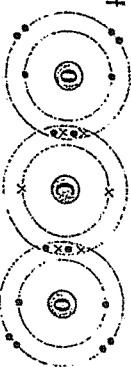
Like in water molecules, where it shares electrons with the hydrogen atoms.



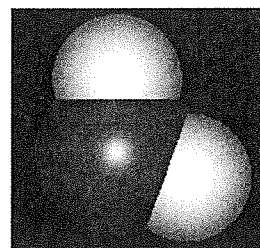
5) Carbon Dioxide, CO_2

Carbon needs four more electrons to fill it up, oxygen needs two. So two double covalent bonds are formed.

A double covalent bond has two shared pairs of electrons.



Dot-cross diagrams for Covalent compounds (Non-Metal + Non-Metal)



Draw **Before** and **After** diagrams for the bonding between the following pairs of atoms. Then write the formula of the resulting compound.

- You just need to show the outer shells.
- Remember to show one atom as crosses and the other as dots!

1. Hydrogen and fluorine

Draw the two atoms
showing their electron shells

Then draw the resulting molecule
showing the sharing of electrons

Name of the compound _____

Formula of the compound _____

2. Bromine and bromine

3. Hydrogen and sulphur

Name of the compound _____

Formula of the compound _____

4. Hydrogen and phosphorus

Name of the compound _____

Formula of the compound _____

5. Hydrogen and carbon

Name of the compound _____

Formula of the compound _____

6. Oxygen and oxygen

7. Nitrogen and nitrogen

Draw dot cross diagrams for the following molecules:

H_2 Cl_2 HCl H_2O CH_4 NH_3 CO_2 C_2H_4 C_2H_6

Name: _____

Class: _____

Covalent and ionic diagrams

Aim

To practise identifying and drawing covalent and ionic bonding.

Instructions

In each box on the left-hand side, draw the atoms of each of the elements. In each box on the right-hand side, draw the dot and cross diagram for the molecule those elements could react to form.

Work out which bond ionically and which bond covalently.

Carbon and hydrogen		Methane (CH ₄) Type of bonding _____
Potassium and bromine		Potassium bromide Type of bonding _____
Magnesium and chlorine		Magnesium chloride Type of bonding _____
Sulfur and hydrogen		Hydrogen sulphide (H ₂ S) Type of bonding _____

Draw dot cross diagrams for the following substances:

- a) Hydrogen gas
- b) Chlorine gas
- c) Calcium sulfide
- d) Oxygen gas
- e) Nitrogen gas
- f) Hydrogen chloride
- g) Carbon dioxide
- h) Sodium oxide
- i) Ethane
- j) Ethene

Bonding Exam Definitions

What is an Ionic Bond?

The strong force of electrostatic attraction between oppositely charged ions.

DO NOT WRITE “between a metal and a non-metal” as a definition

It takes a lot of energy to break an ionic bond, hence, ionic compounds have high melting points.

What is a Covalent Bond?

The strong force of attraction between a shared electron pair and the nuclei of the atoms in the bond.

The electron pair has a negative charge and the nuclei of the atoms are positively charged.

It takes a lot of energy to break a covalent bond, hence, giant covalent structures have high melting points.

NOTE – melting and boiling substances made from covalent MOLECULES does not involve breaking covalent bonds. .

