

Year 10 Chemistry Unit Two: Atoms, Molecules and Ions

First of all, we must figure out the difference between an element and a compound. Knowing what a mixture is also helps.

- ☐ An element is made up of only one type of atom.
- ☐ A compound is a chemical made up of more than one type of atom, chemically bound together. They are hard to split up.
- ☐ A mixture is a substance made of chemicals not bound together. It is very easy to separate

Then we move on to a large part of this topic: Atom Structure. In fact, it's so huge, it deserves its own section.

First comes the nucleus. It contains two particles, and holds the large part of an atom's weight.

They are the Protons, and the Neutrons.

Within an atom, electrons are arranged in shells.

This means that only a certain number of electrons can be within a certain area.

The first shell is only able to hold two electrons.

The second has eight.

The third has eight also

Then the fourth has eighteen (but that's not really important. Year 10 only covers up to the start of the third shell).

Protons have a positive (+) charge, neutrons have a neutral (0) charge, and electrons have a negative (-) charge.

The atom Lithium has an atomic number of 3, and a mass number of 7.

Therefore it has 3 protons, 4 neutrons, and 3 electrons.

SO: The atomic number = Protons + Electrons

the Mass Number = Protons + Neutrons

See? You get it yet?

Lets try one more: Oxygen has an atomic number of 8, and a mass number of 16. Therefore, it has 8 Protons, 8 Neutrons and 8 Electrons.

When an atom of a substance reacts with an atom of another substance, it forms an ion. This is when the electrons of the atom are gained, or lost, until all of the atoms have a full outer shell (valence shell). \

In the Table of Ions below, you will see that every element, and even some molecules, have to gain and lose electrons to be part of an ionic compound - the formula for the substance formed after a reaction takes place.

+1	+2	+3	-3	-2	-1
NH ₄ ⁺	Ca ²⁺	Al ³⁺	N ³⁻	O ²⁻	OH ⁻
Na ⁺	Mg ²⁺	Fe ³⁺	P ³⁻	S ²⁻	Cl ⁻
K ⁺	Cu ²⁺		PO ₄ ³⁻	CO ₃ ²⁻	NO ₃ ⁻
Ag ⁺	Pb ²⁺			SO ₄ ²⁻	HCO ₃ ⁻
H ⁺	Fe ²⁺				
Li ⁺	Ba ²⁺				
	Zn ²⁺				

So, what's all this chemical reaction business?

Basically, when you take two substances - lets take Zn²⁺ (Zinc) and Cl⁻ (Chlorine) - and react them you would get Zinc Chloride (ZnCl₂).

The new substance is an ionic compound. (Note about Ionic Compounds, they all have a neutral charge.

Let me explain:

When an atom of Chlorine (which has 17 electrons) reacts with an atom of Magnesium (which has 12), the ionic compound formed is MgCl₂. This is because when an atom reacts with another atom, it sheds, or gains electrons, until it has a full outer shell.

If an ion has a positive charge (+) it has LOST electrons, so it has more protons, and if it has a negative (-) charge, it has gained electrons, so that it has less protons than electrons.

Lets use the Chlorine atom as an example:

It has 17 electrons, and bonds with an atom of Calcium. It will take one electron from the Calcium, to have a full outer shell (18 total electrons).

Now the Calcium has only 1 electron too many, so it gives this electron to ANOTHER Chlorine atom, which will mean that both Cl atoms have 18 electrons, and the Ca atom has 18 electrons as well; its nearest shell.

This creates the chemical formula CaCl₂.

Too hard? How about an easier way, then.

This is a much easier way to complete chemical equations and it works, every time. Because Science teachers are not Maths teachers, they don't care about working, so to them, it doesn't matter to them hoe you get an answer, just that you get the answer is enough.

This method is simple. It even has a name. Cross and Drop.

You take your starting chemicals, your reactants - in this case Cl and Ca and form the ions. Cl⁻ and Ca²⁺.

Then you take the number of positives, or negatives and you swap them over.

So Ca²⁺ + Cl⁻ makes the formula CaCl₂, because you took the 2 from the Calcium's charge, and you swapped it with the Chlorine's one negative charge.

No matter how you do it, eventually, you will have the chemical formula.

Then we move on to perhaps the HARDEST bit of the unit so far.

Balancing a chemical equation

The best way to start balancing i with a law. This is the only Law you will come across in chemistry at this level.

$$\boxed{\text{Mass of Reactants} = \text{Mass of Products}}$$

This means that what you atart with, you finish with (even if it is in a different form).

Lets demonstrate this.

Calcium Carbonate + Hydrochloric Acid = Calcium Chloride + Carbon Dioxide Gas + Water (CaCO₃ + HCl = CaCl₂ + CO₂ + H₂O).

Count each atom.

On the Reactants side: 1 Calcium, 1 Carbon, 3 Oxygen, 1 Hydrogen, 1 Chlorine.

And on the Products side: 1 Calcium, 2 Chlorine, 1 Carbon, 3 Oxygen, 2 Hydrogen.

It doesn't work.

Then look at the equation. Where is wrong?

Add a 2 in front of the HCl on the products side, and check it. It works!

Your finished equation is now CaCO₃ + 2HCl = CaCl₂ + Co₂ + H₂O.

RULES FOR BALANCING EQUATIONS:

- ☐ Only put numbers in front of a chemical formula
- ☐ Don't change a chemical formula
- ☐ End up with what you start with (following Law of Conservation of Mass)

Moving on ...

Next, discussing differences between atoms and ions.

This is pretty easy really, it should not have to be covered, but, I may as well.

For example, if I was given an atom of Aluminium (Al), and an atom of Chlorine (Cl), and was asked to say differences, I could say:

- ☐ Different number of valence electrons - Al has 3, and Cl has 7.
- ☐ Total number of electrons - Al has 13, Cl has 17

Plastics

The Final article of this topic is on plastics.

Plastics are polymers (large molecules)consisting of carbon compounds. Plastics can be moulded or shaped to make various items such as film, fibers, plates, tubes bottles, boxes and much more.

There are two types of plastic: thermoplastic and thermosetting.

Thermoplastic polymers do not undergo chemical change when heated and can be moulded again and again.

Thermosetting plaastics melt once and take a shape, and then stay in that form.

Plastic codes:

- 1: PET - Polyethylene
- 2: HDPE - High Density Polyethylene
- 3: PVC - Polyvinylchloride
- 4: LDPE - Low Density Po;yethylene
- 5: PP - Polypropylene
- 6: PS - Polystyrene
- 7: Other Plastics