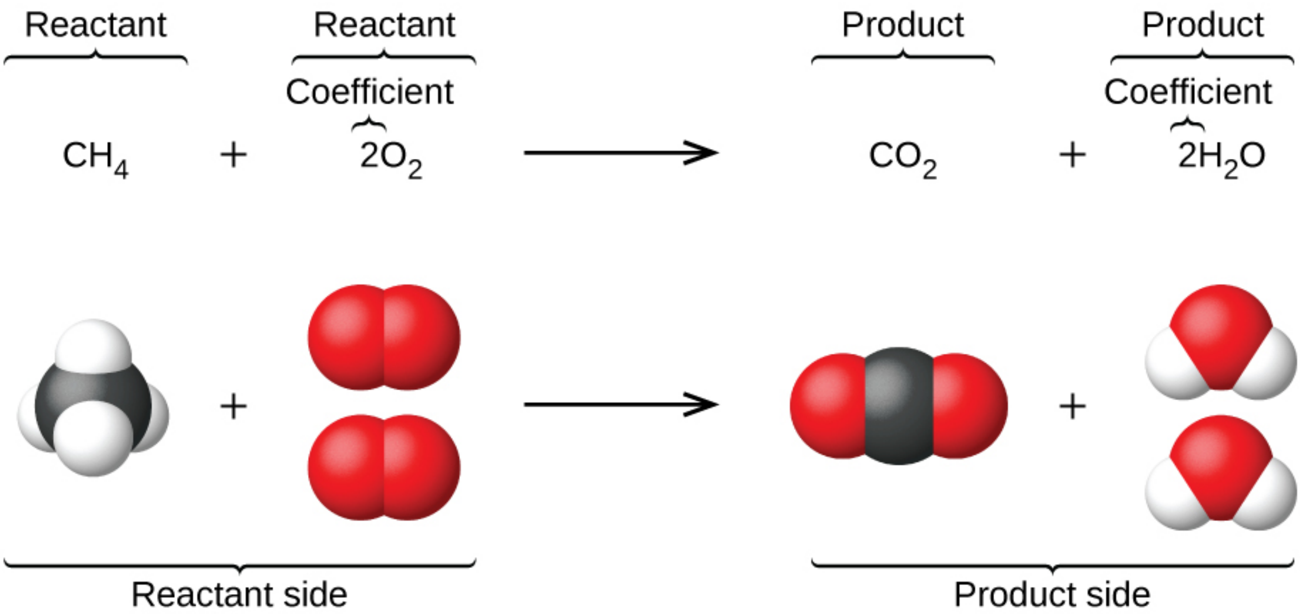
Name:

Chemical Bonding	**Objectives**
6. Chemical Equations: Tests for Anions	-balance simple chemical equations -test for anions in aqueous solutions: chloride, carbonate, nitrate, sulfate, **phosphate, sulfite, hydrogencarbonate**

Chemical Equations:



Balancing Chemical Equations:

Defn: The **Law of Conservation of Mass** states that the total mass of the products of a chemical reaction is the same as the total mass of the reactants.

This tells us that *all* of the atoms that go into a reaction *must* come back out at the end. Atoms don't just appear and dissappear. Another way to say this is:

Def[n]: The **Law of Conservation of Matter** states that in any chemical reaction, matter is neither created nor destroyed but merely changes from one form to another.

As every atom going into a reaction must be accounted for in the products that are formed, we need our chemical equations to be *balanced*, i.e. the number of atoms of each element on the left of the equation must equal the number of atoms of each element on the right hand side.

Note: We can never change the formula for any compound in the equation, we can only change the coefficient (big number on front).

Example:

Balance the chemical equation

$$Al + Fe_2O_3 \rightarrow Al_2O_3 + Fe$$

To balance the equation, we draw a table, listing how many atoms of each element are on each side of the equation:

Left Hand Side	Right Hand Side
1 Al atom	2 Al atoms
2 Fe atoms	1 Fe atom
3 O atoms	3 O atoms

We have 1 Al atom on the left and 2 Al atoms on the right. We make them equal by adding a coefficient of 2 before Al on the left of the equation:

$$2Al + Fe_2O_3 \quad \rightarrow \quad Al_2O_3 + Fe$$

Our table now looks like:

Left Hand Side	Right Hand Side
2 Al atoms	2 Al atoms
2 Fe atoms	1 Fe atom
3 O atoms	3 O atoms

We have 2 Fe atoms on the left and 1 Fe atom on the right. We make them equal by adding a coefficient of 2 before Fe on the right of our equation:

$$2Al + Fe_2O_3 \quad \rightarrow \quad Al_2O_3 + 2Fe$$

Our table now looks like:

Left Hand Side	Right Hand Side
2 Al atoms	2 Al atoms
2 Fe atoms	2 Fe atoms
3 O atoms	3 O atoms

Both sides of our table are now equal, so our equation is balanced.

Our balanced equation is:

$$2Al + Fe_2O_3 \quad \rightarrow \quad Al_2O_3 + 2Fe$$

Tests For Anions:

These tests are used to find the anion (negative ion) in a sample of an ionic compound. The table below summarises the experiment and needs to be known by heart.

Anion	**Test**	**Observation**	**Reason**
Chloride	1. Add $AgNO_3$ solution to a solution of the sample. 2. Add ammonia (NH_3)	1. White precipitate forms 2. Precipitate dissolves	$Ag^+ + Cl^- \rightarrow AgCl\downarrow$
Sulphate Or Sulphite	1. Add $BaCl_2$ solution to a solution of the sample. 2. To distinguish: Add dilute HCl.	1. White precipitate forms 2. If precipitate remains ⇨ sulphate If precipitate dissolves ⇨ sulphite.	$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4\downarrow$ $Ba^{2+} + SO_3^{2-} \rightarrow BaSO_3\downarrow$
Carbonate Or Hydrogencarbonate	1. Add dilute HCl to the solid sample. 2. To distinguish: Add MgSO4 to a fresh solution of the sample.	1. Fizzing/Effervescence. A gas is given off that turns limewater milky. 2. White precipitate forms ⇨ carbonate No precipitate forms ⇨ hydrogencarbonate	$CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$ $HCO_3^- + H^+ \rightarrow CO_2 + H_2O$ $Ca(OH)_2 + CO_2 \rightarrow CaCO_3\downarrow + H_2O$ $Mg^{2+} + CO_3^{2-} \rightarrow MgCO_3\downarrow$ $Mg^{2+} + 2HCO_3^- \rightarrow Mg(HCO_3)_2$
Nitrate	Brown Ring Test: 1. Add FeSO4 to a solution of the sample. 2. Add concentrated sulphuric acid.	A brown ring is formed at the junction of the two liquids ⇨ nitrate anion is present	Brown ring is due to the nitrate ion being present.
Phosphate	1. Add Ammonium Molybdate to a solution of the sample. 2. Add concentrated nitric acid. 3. Warm the solution.	Yellow precipitate is formed ⇨ phosphate anion is present.	Yellow precipitate is due to the phosphate ion being present.