

## Chemistry Revision - TYPES OF EQUATION (Higher)

As part of your revision you should learn the general equations for the reactions studied across all topics, which you can apply to the examples. Note, Salts are named from the acids that form them, hydroCHLORIC acid makes CHLORIDES, Sulfuric acid makes Sulfates, **nitric** acids make **nitrates**, phosphoric acid makes phosphates. The reactions you should learn are:

1. Metal and acid



2. Metal and water



3. Metal carbonate and acid



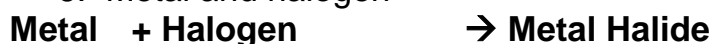
4. Metal hydroxide and acid



5. Metal oxide and acid



6. Metal and halogen



7. Hydrogen and Halogen



8. Displacement reactions of a (more reactive) metal and metal compound (salt)



9. Displacement reactions of (more reactive) halogen with metal halide



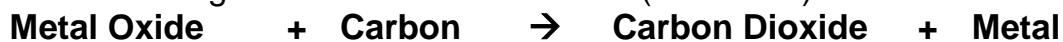
10. Complete combustion of a fuel



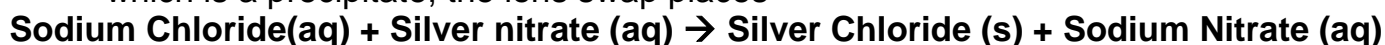
11. Incomplete combustion



12. Heating a metal oxide with carbon (extraction)



13. Precipitation –when 2 soluble salts react together to form an insoluble salt (solid) which is a precipitate, the ions swap places



**TASK: Produce a summary / cue cards of these 13 reactions with 2 of your own examples, including word equations and full balanced equations. Do this and show your teacher before attempting any of the exam questions**

How am I expected to know all the chemical formulae?  
Some you just have to learn:

### Ionic substances

Magnesium chloride	MgCl <sub>2</sub>
Calcium chloride	CaCl <sub>2</sub>
Magnesium oxide	MgO
Copper sulfate	CuSO <sub>4</sub>
Sodium chloride	NaCl
Potassium chloride	KCl

### Simple molecular covalent / Simple molecules

Water	H <sub>2</sub> O
Carbon dioxide	CO <sub>2</sub>
Carbon monoxide	CO
Oxygen	O <sub>2</sub>
Hydrogen	H <sub>2</sub>
Methane	CH <sub>4</sub>
Ethane	C <sub>2</sub> H <sub>6</sub>
Propane	C <sub>3</sub> H <sub>8</sub>
Butane	C <sub>4</sub> H <sub>10</sub>

### Acids (ionic when aqueous)

Nitric acid	HNO <sub>3</sub>
Sulfuric acid	H <sub>2</sub> SO <sub>4</sub>
Hydrochloric acid	HCl

### Alkalis (ionic)

Sodium hydroxide	NaOH
Calcium hydroxide	Ca(OH) <sub>2</sub>

### Bases (ionic)

Copper oxide	CuO
Calcium carbonate	CaCO <sub>3</sub>
Copper carbonate	CuCO <sub>3</sub>

Cont.

Other substances you can figure out

Hydrocarbons / organic substances. Learn the general formula of the homologous series and use the number of carbons to figure it out

Alkanes	$C_nH_{2n+2}$	e.g	CH <sub>4</sub>	C <sub>2</sub> H <sub>6</sub>	C <sub>4</sub> H <sub>10</sub>	C <sub>22</sub> H <sub>46</sub>
Alkenes	$C_nH_{2n}$	e.g	C <sub>2</sub> H <sub>4</sub>	C <sub>4</sub> H <sub>8</sub>	C <sub>22</sub> H <sub>44</sub>	
(Triple) Alcohols	$C_nH_{2n+1}OH$	e.g	CH <sub>3</sub> OH	C <sub>2</sub> H <sub>5</sub> OH	C <sub>4</sub> H <sub>9</sub> OH	C <sub>22</sub> H <sub>45</sub> OH
(Triple) Carboxylic acids	$C_nH_{2n+1}COOH$	e.g	CH <sub>3</sub> COOH	C <sub>2</sub> H <sub>5</sub> COOH	C <sub>4</sub> H <sub>9</sub> COOH	

Ionic substances

Learn the charges on the ions, choose the correct ratio to cancel out and then have the correct formula. Learn these

### Positive Ions

Hydrogen	H <sup>+</sup>
Lithium	Li <sup>+</sup>
Sodium	Na <sup>+</sup>
Potassium	K <sup>+</sup>
Magnesium	Mg <sup>2+</sup>
Calcium	Ca <sup>2+</sup>
Aluminium	Al <sup>3+</sup>
Silver	Ag <sup>+</sup>
Copper	Cu <sup>2+</sup>
Ammonium	NH <sub>4</sub> <sup>+</sup>
Iron	Fe <sup>2+</sup> & Fe <sup>3+</sup>

### Negative Ions

Fluoride	F <sup>-</sup>
Chloride	Cl <sup>-</sup>
Bromide	Br <sup>-</sup>
Iodide	I <sup>-</sup>
Oxide	O <sup>2-</sup>
Hydroxide	OH <sup>-</sup>
Nitrate	NO <sub>3</sub> <sup>-</sup>
Sulphate	SO <sub>4</sub> <sup>2-</sup>
Phosphate	PO <sub>4</sub> <sup>3-</sup>
Carbonate	CO <sub>3</sub> <sup>2-</sup>

Work out the formula of

Copper nitrate

Lithium Oxide

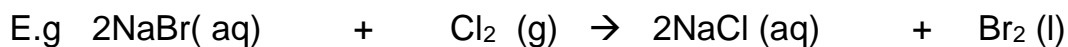
Sodium sulfate

Calcium carbonate

## All the different types of equation - explained

### Type 1 – Full balanced equation

When a more reactive halogen displaces a less reactive halogen

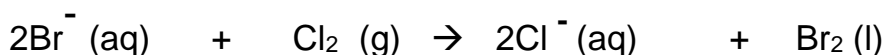


The numbers in front are called big balancing numbers and are there because of conservation of mass, the same number of atoms should be the same on the left (reactants) as there are on the right (products). They are not part of the chemical formula.

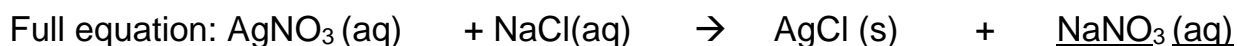
### Type 2 – Ionic equation

These only include the ions that change in the reaction and ignore the spectator ions. Use the state symbols to help. In the equation above  $\text{Na}^+$  is (aq) at the start and the end so we leave this out. We need to recall that NaBr is in fact an ionic compound made of  $\text{Na}^+$  and  $\text{Br}^-$  ions so we must include charge!

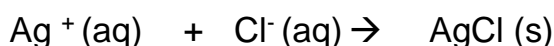
The ionic equation would become:



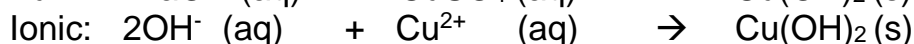
Another example would be a precipitation reaction between 2 soluble salts to make an insoluble salt- ions swap places!



To turn this into an ionic equation we need to spot that  $\text{Na}^+$  and  $\text{NO}_3^-$  are (aq) at the start and end, so we only focus on the ions that change from (aq) to (s). These are  $\text{Ag}^+$  and  $\text{Cl}^-$ . So the ionic equation would be:

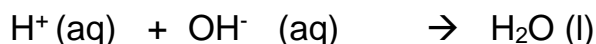


Another example of a precipitation

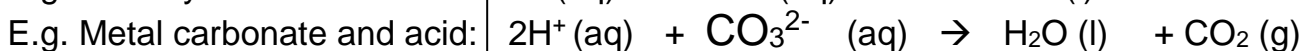


You may be asked to show **neutralisation** by ionic equations.

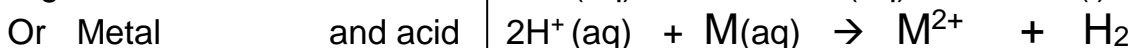
E.g Metal hydroxide and acid:



E.g. Metal carbonate and acid:



Or Metal and acid

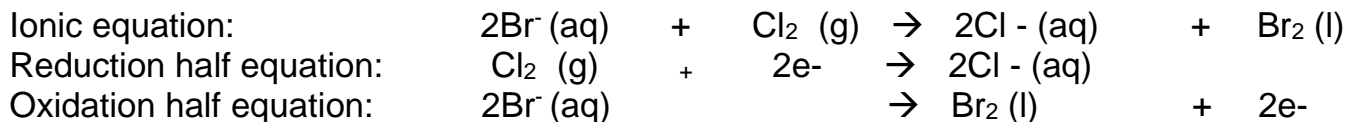


The ionic equations for neutralisation are the same no matter which combination of

acid or base you use. Note M can represent any metal ion with a 2+ charge, e.g Mg<sup>2+</sup>

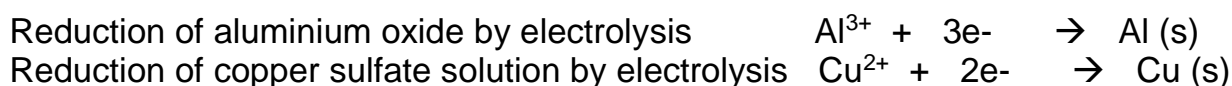
### Type 3 – Half equations

These are used to show oxidation and reduction (OIL RIG), when one atom or ion loses electrons, while another gains electrons. We split an ionic equation into 2 half equations; one for oxidation, the other for reduction.



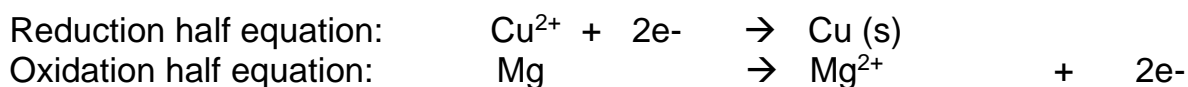
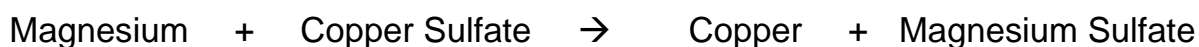
Tip: When Reduction happens, electrons are Gained so electrons go on the left. When Oxidation happens electrons are Lost and go on the right. The total charge on the left should be equal to the total charge on the right for both ionic and half equations.

Electrolysis involves reduction and oxidation at the anode and cathode so you might be asked about half equations here too. Common examples:



Make sure you revise the other examples of redox reactions

#### 1) Displacement reactions of metals

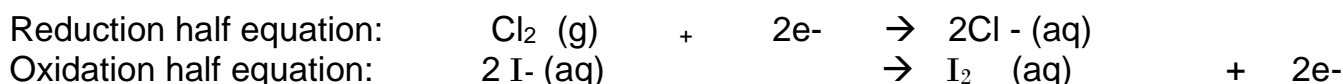


#### 2) Group 1 metals with water:

Potassium atoms lose electrons easily when they react to become K<sup>+</sup> ions:



#### 3) Halogen displacement reactions. When IodIDE I<sup>-</sup> becomes a brown solution of IodINE, I<sub>2</sub> when it reacts with ChlorINE Cl<sub>2</sub>



**Exam Questions- Do NOT complete until you have made flash / cards/ summary / mindmap. Use these to self –test yourself,**

**Tip:** Look at the types of equation they are asking for. If you don't know the substances formed, use your summary of general equations to write a word equation *first* to figure out the products.

**Q1a**

When decane undergoes complete combustion, a mixture of carbon dioxide and water is formed.

Complete the balanced equation for this reaction.

(2)



**Q1b**

When magnesium reacts with hydrochloric acid, salt and a gas are formed.

Complete the balanced equation for this reaction.

What is the ionic equation for this reaction?

**Q1c**

When copper carbonate reacts with 3 products form including one gas.

Complete the balanced equation for this reaction.

What is the ionic equation for this reaction?

**Q2.**

A student investigated the rate of reaction between dilute hydrochloric acid and marble chips (calcium carbonate).

Calcium chloride, carbon dioxide and water are formed.

Complete and balance the equation for the reaction.

(2)



**Q3.**

Iron(III) ions,  $\text{Fe}^{3+}$ , react with hydroxide ions in solution to form insoluble iron(III) hydroxide.

Complete the ionic equation for this reaction.

(1)



**Q4.**

(b) Aluminium ions,  $\text{Al}^{3+}$ , react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

Write the ionic equation for this reaction.

(3)

**Q5.**

### Metals

There are many metallic elements in the periodic table.

(a) Which row of the table correctly shows two metals that are in group 1 and two metals that are transition metals?

Put a cross (☒) in the box next to your answer.

(1)

	group 1	transition metals
<input type="checkbox"/> <b>A</b>	lithium and zinc	calcium and copper
<input type="checkbox"/> <b>B</b>	potassium and caesium	copper and iron
<input type="checkbox"/> <b>C</b>	sodium and potassium	copper and magnesium
<input type="checkbox"/> <b>D</b>	sodium and magnesium	manganese and nickel

(ii) Write the balanced equation for the reaction of sodium with water to form sodium hydroxide and hydrogen.

(3)

.....  
**Q2.**

- (a) Sodium chloride is a metal chloride which is soluble in cold water.  
(i) Give the name of a metal chloride which is insoluble in cold water.  
Put a cross (  ) in the box next to your answer.

- A** copper chloride  
 **B** lead chloride  
 **C** magnesium chloride  
 **D** potassium chloride

(1)

**Q3.**

### Salts

- (a) Which of the following pairs of substances contains one substance that is soluble in water and one that is insoluble in water?

Put a cross (  ) in the box next to your answer.

- A** aluminium nitrate and lead sulfate  
 **B** ammonium chloride and copper sulfate  
 **C** copper hydroxide and lead sulfate  
 **D** sodium hydroxide and potassium nitrate

(1)

- (ii) Complete the balanced equation for the precipitation reaction between barium chloride and potassium sulfate.



(2)

- (iii) Write an ionic equation for the reaction above:

**Q1.**

Astatine, bromine, chlorine, fluorine and iodine are all halogens.  
They are found in Group 7 of the Periodic Table.

- (b) Name a halogen that is a solid at room temperature.

(1)  
.....



(c) Bromine can be obtained from the bromide ions in sea water.

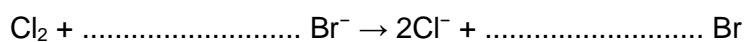
Chlorine is bubbled into sea water.

The chlorine oxidises the bromide ions to bromine atoms.

The bromine atoms then form bromine molecules.

(i) Complete the **ionic equation** to show how bromine **atoms** are formed from bromide ions.

(1)



(ii) State, in terms of electrons, why this reaction is described as the oxidation of bromide ions.

(1)

.....  
.....

(iii) Write a **half equation** to show how bromine atoms form bromine molecules.

(1)

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(iv) Write a **half equation** to show how chlorine molecules become chloride ions

.....