

# REACTIONS OF ACIDS AND BASES

## NEUTRALIZATION

When aqueous solutions of acids react with bases, neutralization takes place and salts are formed.

The four neutralization reactions that form salts are as follows:

1. acid + metal  $\rightarrow$  salt + hydrogen  
e.g.  $\text{HCl}_{(\text{aq})} + \text{Na}_{(\text{s})} \rightarrow \text{NaCl}_{(\text{aq})} + \text{H}_2$
2. acid + metal oxide  $\rightarrow$  salt + water  
e.g.  $\text{H}_2\text{SO}_{4(\text{aq})} + \text{CuO}_{(\text{s})} \rightarrow \text{CuSO}_{4(\text{aq})} + \text{H}_2\text{O}_{(\ell)}$
3. acid + metal hydroxide  $\rightarrow$  salt + water  
e.g.  $\text{HCl}_{(\text{aq})} + \text{NaOH}_{(\text{aq})} \rightarrow \text{NaCl}_{(\text{aq})} + \text{H}_2\text{O}_{(\ell)}$
4. acid + metal carbonate  $\rightarrow$  salt + water + carbon dioxide  
e.g.  $\text{H}_2\text{SO}_{4(\text{aq})} + \text{MgCO}_{3(\text{s})} \rightarrow \text{MgSO}_{4(\text{aq})} + \text{H}_2\text{O}_{(\ell)} + \text{CO}_{2(\text{g})}$

The type of salt that forms depends on the acid:

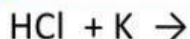
- hydrochloric acid gives a chloride
- nitric acid gives a nitrate
- sulphuric acid gives a sulphate
- 

You'll need to make sure you know your compound ions list for this section!  
Complete the following table by filling in the **formula, charge or name** of the compound ion.

sulphate	$\text{SO}_4$
carbonate	
Nitrate	
Phosphate	
	$\text{OH}^{-1}$
Ethanoate/acetate	
ammonium	

## Let's practice forming some salts:

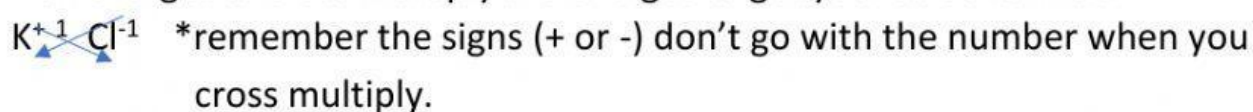
1. hydrochloric acid + potassium → potassium chloride + hydrogen



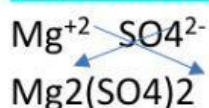
The salt that forms, comes from the metal and the negative part of the acid.



Don't forget to cross multiply the charges to get your salt's formula



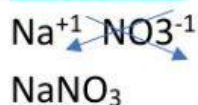
2. Sulphuric acid + Magnesium Oxide → Magnesium sulphate + hydrogen



But we then need to simplify this formula and 'divide' by 2



3. Nitric acid + sodium hydroxide → potassium nitrate + hydrogen



4. Phosphoric acid + Calcium carbonate → calcium phosphate + hydrogen + carbon dioxide

Remember that a metal carbonate and an acid form an additional  $\text{CO}_2$  that the others don't form



$\text{Ca}_3(\text{PO}_4)_2$  Remember to write the compound ion in brackets if it has been multiplied by a number

\*There are 2 acids where the salt has to be written in a different way.

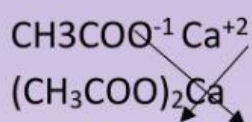
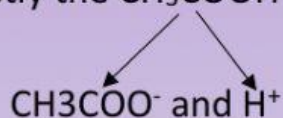
They are: acetic acid and oxalic acid

$\text{CH}_3\text{COOH}$  and  $(\text{COOH})_2$

Normally when you write the salt, the metal is written first and then the negative part of the acid. However with these 2 salts, the acid part will be written first and then the metal

Eg.  $\text{CH}_3\text{COOH} + \text{Ca} \rightarrow$

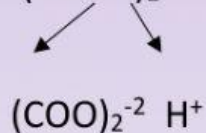
Firstly the  $\text{CH}_3\text{COOH}$  splits up into



Thus  $(\text{CH}_3\text{COO})_2\text{Ca}$

The same happens to oxalic acid:

$\text{Na} + (\text{COOH})_2$



$\text{Na}^{+1} (\text{COO})_2^{-2}$

Thus  $(\text{COO})_2\text{Na}_2$

The gases that are produced in the reactions above can be identified by doing the following tests:

**hydrogen gas** : a glowing splint will ignite the gas with a 'pop' or a 'squeal' in the presence of the gas.

**carbon dioxide** : turns clear lime water milky (it also causes a glowing splint to extinguish)

**Note:** not all metals react with acid, only those that are more reactive than hydrogen. These include K, Na, Li, Ca, Mg, Al, Zn and Fe.

## REACTION OF AMMONIA WITH HYDROCHLORIC ACID

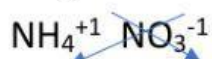
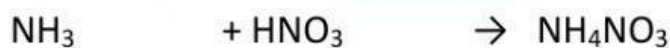
This is also a neutralization reaction, but is also a synthesis reaction.

5. ammonia + hydrochloric acid  $\rightarrow$  ammonium chloride



**In this case the salt that forms is always an ammonium salt**

e.g. 2 ammonia + nitric acid  $\rightarrow$  ammonium nitrate



Thus  $\text{NH}_4\text{NO}_3$

## QUESTION 1

Complete the following word equations:

1.1 acid + carbonate  $\rightarrow$  salt + \_\_\_\_\_ + \_\_\_\_\_

1.2 acid + metal  $\rightarrow$  salt + \_\_\_\_\_

1.3 acid + metal oxide  $\rightarrow$  salt + \_\_\_\_\_

1.4 acid + base  $\rightarrow$  salt + \_\_\_\_\_



## QUESTION 2

Name the salt that forms when: (two words)

2.1 HCl reacts with KOH

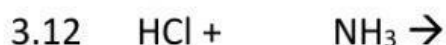
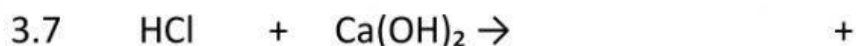
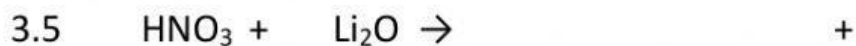
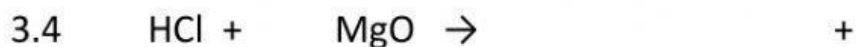
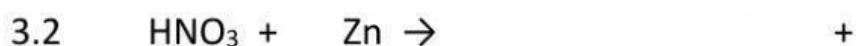
2.2 sulphuric acid reacts with calcium metal

2.3  $\text{HNO}_3$  reacts with  $\text{CaCO}_3$

2.4 ethanoic acid react with sodium oxide

**QUESTION 3** \*write subscripts as normal number and write balancing number in their own blocks {if no balancing no is required, ensure to write a 1}

Complete the following reactions and balance the equations:



#### QUESTION 4

Write balanced chemical reactions for the following reactions:

**\*subscripts can be written as normal numbers**

**\*balancing numbers must be put into separate boxes in front of the substance**

4.1 zinc metal reacts with sulfuric acid.



4.2 potassium hydroxide is added to hydrochloric acid



4.3 sodium oxide reacts with nitric acid.



4.4 ammonia gas reacts with hydrochloric acid.



4.5 calcium reacts with phosphoric acid.

