

Oxidation **I**s **L**oss (of electrons) **R**eduction **I**s **G**ain (of electrons)

HT ONLY: Reactions between metals and acids are redox reactions as the metal donates electrons to the hydrogen ions. This displaces hydrogen as a gas while the metal ions are left in the solution.

Ionic half equations (HT only)

For displacement reactions

Ionic half equations show what happens to each of the reactants during reactions

For example:
The ionic equation for the reaction between iron and copper (II) ions is:
 $Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$
The half-equation for iron (II) is:
 $Fe \rightarrow Fe^{2+} + 2e^{-}$
The half-equation for copper (II) ions is:
 $Cu^{2+} + 2e^{-} \rightarrow Cu$

Reactions with acids	$metal + acid \rightarrow metal\ salt + hydrogen$	magnesium + hydrochloric acid \rightarrow magnesium chloride + hydrogen zinc + sulfuric acid \rightarrow zinc sulfate + hydrogen
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Acids react with some metals to produce salts and hydrogen.

Reactions of acids and metals

Extraction using carbon	
<i>Metals less reactive than carbon can be extracted from their oxides by reduction.</i>	For example: zinc oxide + carbon \rightarrow zinc + carbon dioxide

Extraction of metals and reduction

Unreactive metals, such as gold, are found in the Earth as the metal itself. They can be mined from the ground.

Reactions of acids

AQA Chemical Changes 1

Reactivity of metals

The reactivity series

	Reactions with water	Reactions with acid
Group 1 metals	<i>Reactions get more vigorous as you go down the group</i>	<i>Reactions get more vigorous as you go down the group</i>
Group 2 metals	<i>Do not react with water</i>	<i>Observable reactions include fizzing and temperature increases</i>
Zinc, iron and copper	<i>Do not react with water</i>	<i>Zinc and iron react slowly with acid. Copper does not react with acid.</i>

Oxidation and reduction in terms of electrons (HT ONLY)

Neutralisation of acids and salt production

Acid name	Salt name
Hydrochloric acid	Chloride
Sulfuric acid	Sulfate
Nitric acid	Nitrate

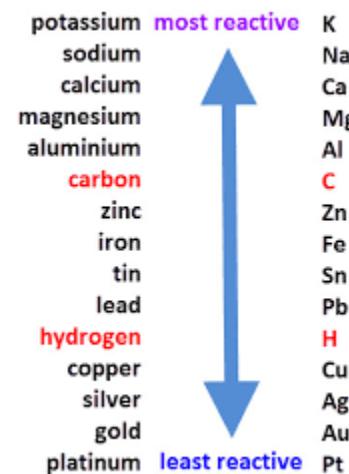
sodium hydroxide + hydrochloric acid \rightarrow sodium chloride + water
calcium carbonate + sulfuric acid \rightarrow calcium sulfate, + carbon dioxide + water

Neutralisation	<i>Acids can be neutralised by alkalis and bases</i>	An alkali is a soluble base e.g. metal hydroxide. A base is a substance that neutralises an acid e.g. a soluble metal hydroxide or a metal oxide.
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Metal oxides

Metals and oxygen	<i>Metals react with oxygen to form metal oxides</i>	magnesium + oxygen \rightarrow magnesium oxide $2Mg + O_2 \rightarrow 2MgO$
Reduction	<i>This is when oxygen is removed from a compound during a reaction</i>	e.g. metal oxides reacting with hydrogen, extracting low reactivity metals
Oxidation	<i>This is when oxygen is gained by a compound during a reaction</i>	e.g. metals reacting with oxygen, rusting of iron

Metals form positive ions when they react	<i>The reactivity of a metal is related to its tendency to form positive ions</i>	The reactivity series arranges metals in order of their reactivity (their tendency to form positive ions).
Carbon and hydrogen	<i>Carbon and hydrogen are non-metals but are included in the reactivity series</i>	These two non-metals are included in the reactivity series as they can be used to extract some metals from their ores, depending on their reactivity.
Displacement	<i>A more reactive metal can displace a less reactive metal from a compound.</i>	Silver nitrate + Sodium chloride \rightarrow Sodium nitrate + Silver chloride



Oxidation Is Loss (of electrons) **Reduction Is Gain** (of electrons)

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Ionic half equations (HT only)

Ionic half equations show what happens to each of the reactants during reactions

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metal + acid → metal salt + hydrogen

magnesium + hydrochloric acid → magnesium chloride + hydrogen
zinc + sulfuric acid → zinc sulfate + hydrogen

Acids react with some metals to produce salts and hydrogen.

Reactions of acids and metals

Metals less reactive than carbon can be extracted from their oxides by reduction.

For example:
zinc oxide + carbon → zinc + carbon dioxide

Extraction of metals and reduction

Unreactive metals, such as gold, are found in the Earth as the metal itself. They can be mined from the ground.

Oxidation and reduction in terms of electrons (HT ONLY)

Neutralisation of acids and salt production

Reactions of acids

AQA Chemical Changes 1

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Metal oxides

Acid name Salt name

Hydrochloric acid

Sulfuric acid

Nitric acid

sodium hydroxide + hydrochloric acid → sodium chloride + water

calcium carbonate + sulfuric acid → calcium sulfate, + carbon dioxide + water

Acids can be neutralised by alkalis and bases

An **alkali** is a soluble base e.g. metal hydroxide.
A **base** is a substance that neutralises an acid e.g. a soluble metal hydroxide or a metal oxide.

Metals react with oxygen to form metal oxides

magnesium + oxygen → magnesium oxide
 $2Mg + O_2 \rightarrow 2MgO$

This is when oxygen is removed from a compound during a reaction

e.g. metal oxides reacting with hydrogen, extracting low reactivity metals

This is when oxygen is gained by a compound during a reaction

e.g. metals reacting with oxygen, rusting of iron

The reactivity of a metal is related to its tendency to form positive ions

The reactivity series arranges metals in order of their reactivity (their tendency to form positive ions).

Carbon and hydrogen are non-metals but are included in the reactivity series

These two non-metals are included in the reactivity series as they can be used to extract some metals from their ores, depending on their reactivity.

A more reactive metal can displace a less reactive metal from a compound.

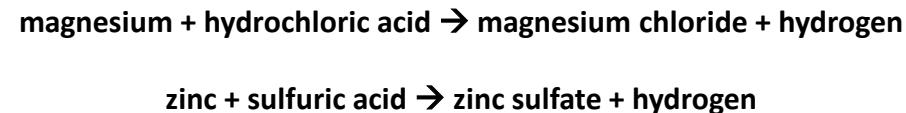
Silver nitrate + Sodium chloride → Sodium nitrate + Silver chloride

potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold		Au
platinum	least reactive	Pt

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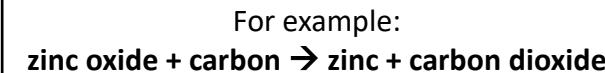
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Reactions of acids and metals



Unreactive metals

Extraction of metals and reduction

Acid name	Salt name

Oxidation and reduction in terms of electrons (HT ONLY)

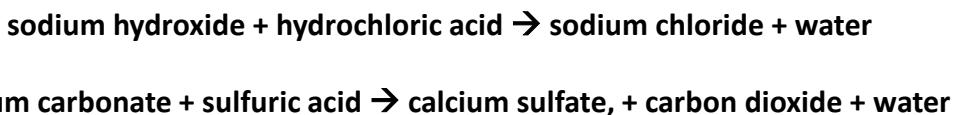
Neutralisation of acids and salt production

Reactions of acids

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Reactivity of metals

The reactivity series



An **alkali** is a soluble base e.g. metal hydroxide.
A **base** is a substance that neutralises an acid e.g. a soluble metal hydroxide or a metal oxide.

Metal oxides



e.g. metal oxides reacting with hydrogen, extracting low reactivity metals

e.g. metals reacting with oxygen, rusting of iron

The reactivity of a metal is related to its tendency to form positive ions

Carbon and hydrogen are non-metals but are included in the reactivity series

A more reactive metal can displace a less reactive metal from a compound.

Group 1 metals

Reactions get more vigorous as you go down the group

Group 2 metals

Observable reactions include fizzing and temperature increases

Zinc, iron and copper

Zinc and iron react slowly with acid. Copper does not react with acid.

- | | | |
|-----------|----------------|----|
| potassium | most reactive | K |
| sodium | | Na |
| calcium | | Ca |
| magnesium | | Mg |
| aluminium | | Al |
| carbon | | C |
| zinc | | Zn |
| iron | | Fe |
| tin | | Sn |
| lead | | Pb |
| hydrogen | | H |
| copper | | Cu |
| silver | | Ag |
| gold | | Au |
| platinum | least reactive | Pt |

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Metal oxides

Extraction of metals and reduction

Unreactive metals

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Neutralisation of acids and salt production

Acid name	Salt name

Examples:

An alkali is a

A base is a



e.g.

e.g.

Group 1 metals		
Group 2 metals		
Zinc, iron and copper		

- | | | |
|-----------|----------------|----|
| potassium | most reactive | K |
| sodium | | Na |
| calcium | | Ca |
| magnesium | | Mg |
| aluminium | | Al |
| carbon | | C |
| zinc | | Zn |
| iron | | Fe |
| tin | | Sn |
| lead | | Pb |
| hydrogen | | H |
| copper | | Cu |
| silver | | Ag |
| gold | | Au |
| platinum | least reactive | Pt |