**Paper 1**

**Chapter 4 — Chemical Changes**

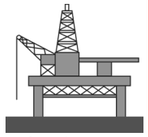
## Metal Oxides

Iron + Oxygen —> Iron Oxide

What type of reaction is this?

Ca + MgO —> Mg + CaO

Why is this a Redox Reaction?
Which metal is oxidised?
Which is reduced?



## OIL RIG (HT)

Oxidation is _____ of electrons. Reduction is _____ of electrons.

Write an ionic equation for the reaction.
Which metal is oxidised and which is reduced?

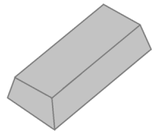
Ca + $MgSO_4$ —> Mg + $CaSO_4$

## Reactivity Series Fill in gaps in table. Number the metals in order of reactivity.

| Metal | Reaction with Water | Reaction with dilute Acid | Reaction with Oxygen |
|---|---|---|---|
| **Gold** | No reaction | No reaction | |
| **Potassium** | | Violent reaction | Rapidly oxidises in air |
| **Magnesium** | Slow reaction | | Burns to form oxide |
| **Iron** | No reaction | Slow reaction | |
| **Copper** | Very slow unless heated | Very slow reaction | |

More reactive metals have a higher tendency to form p_____ i___. A more reactive metal can d_____ a less reactive one in a d_____ reaction e.g.

Potassium + Iron Sulfate —> +



## Extraction of Metals

U_____ metals such as gold are found as uncombined metal elements. Most metals are found as c_____ in rocks called o____. The metal has to be extracted.

- Metals less reactive than _____ can be extracted from their oxides by reaction with _____.
- Metals more reactive than _____ are extracted by _____.

Complete the reaction for the extraction of iron

Iron Oxide + Carbon —> +

Which substances which are oxidised or reduced?

## Neutralisation and Salts

What is the difference between an alkali and a base?

Complete these general equations Acid + Alkali or Base —>
Acid + Metal Carbonate —>

Name the salts produced

sodium hydroxide + hydrochloric acid —>

copper oxide + nitric acid —>

calcium carbonate + sulfuric acid —>

Give the steps to produce dry, pure copper sulfate from sulphuric acid and copper oxide

1.)

2.)

3.)

## Acids and Metals

When an acid reacts with a metal it produces a s___ and h_____. The gas can be confirmed with the p__ test.

**(HT)** Why is the reaction between an acid and a metal redox reactions?

Complete the equations.

zinc + sulfuric acid —>

iron + sulfuric acid —>

Complete and identify oxidised and reduced

Mg + 2HCl —>

## Strong and Weak Acids (HT)

What is the difference between a strong and weak acid in terms of ionisation?

Label these acids as strong or weak

| | |
|---|---|
| hydrochloric | nitric |
| ethanoic acid | sulfuric acid |
| citric acid | carbonic acid |

A pH2 Acid has ___ times higher concentration of $H^+$ ions than a pH3 Acid.

A pH3 Acid has 100 times higher concentration of $H^+$ ions than a _____ Acid.

## Electrolysis

For electrolysis to work an i_____ compound must be _____ or _____ in water so that the ions are _____ to _____. These liquids and solutions are called e_____ and can conduct _____.

Add arrows to the labels

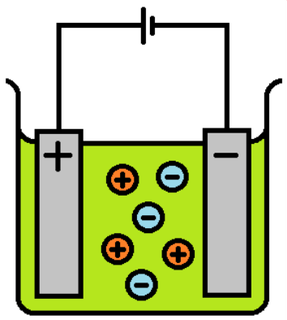
**Anode**

**Cathode**

**Electrolyte**

**Positive ion**

**Negative ion**



Add arrows to show the ions moving to the correct electrode

What happens to the ions when they reach the electrodes?

(HT) Complete and balance the half equations for the electrolysis of molten sodium chloride.

$Na^+ + e^-$ —> $Cl^-$ —>

## Electrolysis of Molton Ionic Compounds

What is produced at the anode and cathode when these simple ionic compounds are electrolysed in the molten state.

| Compound | Anode | Cathode |
|---|---|---|
| Lead Bromide | | |
| Sodium Chloride | | |
| Magnesium Oxide | | |

## Electrolysis of Aqueous Solutions

The electrolysis of aqueous solutions will break down the w_____ molecules as well as the ionic compound.

The products depends on the r_____ of the elements used.

At the cathode the l____ reactive of h_____ or the metal used will be produced.

At the anode oxygen will be produced unless a h_____ is involved.

I_____ electrodes (e.g. g_____) are used to prevent them reacting.

**Extracting Aluminium** Electrolysis is used to extract a metal that is ____ _____ than, or reacts with, carbon.

Give 2 reasons why electrolysis uses large amounts of energy
1.)

2.)

Aluminium is produced by the electrolysis of molten aluminium oxide

Why is aluminium not displaced by reaction with carbon?

Why is aluminium oxide mixed with cryolite?

Why must the positive carbon electrode be replaced.

**Complete the Half Equations (HT)**

$Al^{3+} + 3e^-$ —> $2O^{2-}$ —>

## pH and Neutralisation

Which ions are produced by Acids in aqueous solutions?

Which ions are produced by Alkalis in aqueous solutions?

The pH scale ranges from pH ___ to pH ___. It can be measured with u_____ i_____ or with a much higher resolution using a __ _____. pH 7 is neutral. Acids have pH values of less than ___, alkalis have pH values greater than ___, pH7 is _____.

A reaction between an acid and an alkali is called a _____ reaction. The h_____ ions from the acid react with h_____ ions from the alkali to produce _____.

Complete the neutralisation equation including the state symbol $H^+(aq) + OH^-(aq)$ —>

Give the pH and strength of the acid/alkali solution from the following universal indicator results

a.) Yellow b.) Green c.) Red

d.) Orange e.) Blue f.) Purple

# Paper 1

# Chapter 4 — Chemical Changes

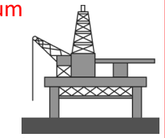
## Metal Oxides

Iron + Oxygen —> Iron Oxide

What type of reaction is this? Oxidation

Ca + MgO —> Mg + CaO

Why is this a Redox Reaction? Oxidation and Reduction
Which metal is oxidised? Calcium
Which is reduced? Magnesium



## OIL RIG (HT)

Oxidation is loss of electrons. Reduction is gain of electrons.

Write an ionic equation for the reaction.
Which metal is oxidised and which is reduced?

Ca + $MgSO_4$ —> Mg + $CaSO_4$

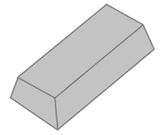
$Ca + Mg^{2+}$ —> $Mg + Ca^{2+}$ Ca oxidised Mg reduced

## Reactivity Series Fill in gaps in table. Number the metals in order of reactivity.

| Metal | Reaction with Water | Reaction with dilute Acid | Reaction with Oxygen |
|---|---|---|---|
| **Gold 5th** | No reaction | No reaction | No reaction |
| **Potassium 1st** | Violent reaction | Violent reaction | Rapidly oxidises in air |
| **Magnesium 2nd** | Slow reaction | Quick reaction | Burns to form oxide |
| **Iron 3rd** | No reaction | Slow reaction | Slow reaction |
| **Copper 4th** | Very slow unless heated | Very slow reaction | No reaction |

More reactive metals have a higher tendency to form positive ions. A more reactive metal can displace a less reactive one in a displacement reaction e.g.

Potassium + Iron Sulfate —> Iron + Potassium Sulfate



## Extraction of Metals

Unreactive metals such as gold are found as uncombined metal elements. Most metals are found as compounds in rocks called ores. The metal has to be extracted

- Metals less reactive than carbon can be extracted from their oxides by reaction with carbon.
- Metals more reactive than carbon are extracted by electrolysis.

Complete the reaction for the extraction of iron

Iron Oxide + Carbon —> Carbon Dioxide + Iron

Which substances which are oxidised or reduced? Carbon Oxidised, Iron reduced

## Neutralisation and Salts

What is the difference between an alkali and a base?
Alkali = Soluble metal hydroxide, Base = Insoluble metal hydroxide or metal oxide

Complete these general equations
Acid + Alkali or Base —> Salt + Water
Acid + Metal Carbonate —> Salt + Carbon Dioxide + Water

Name the salts produced

sodium hydroxide + hydrochloric acid —> sodium chloride
copper oxide + nitric acid —> copper nitrate
calcium carbonate + sulfuric acid —> calcium sulfate

Give the steps to produce dry, pure copper sulfate from sulphuric acid and copper oxide

1. React the sulphuric acid with the copper oxide. Use an excess of copper oxide and heat the reaction to ensure all sulphuric acid used up.
2. Filter to remove excess copper oxide
3. Heat the solution to evaporate water

## Acids and Metals

When an acid reacts with a metal it produces a salt and hydrogen. The gas can be confirmed with the pop test.

**(HT)** Why is the reaction between an acid and a metal redox reactions? 1 substance is oxidised another is reduced.

Complete the equations.

zinc + sulfuric acid —> zinc sulfate + hydrogen

iron + sulfuric acid —> iron sulfate + hydrogen

Complete and identify oxidised and *reduced*

Mg + 2*H*Cl —> $MgCl_2$ + $H_2$

## Strong and Weak Acids (HT)

What is the difference between a strong and weak acid in terms of ionisation? Strong acid is completely ionised in solution, weak acid is partially ionised in solution.

Label these acids as strong or weak

hydrochloric strong
ethanoic acid weak
citric acid weak
nitric strong
sulfuric acid strong
carbonic acid weak

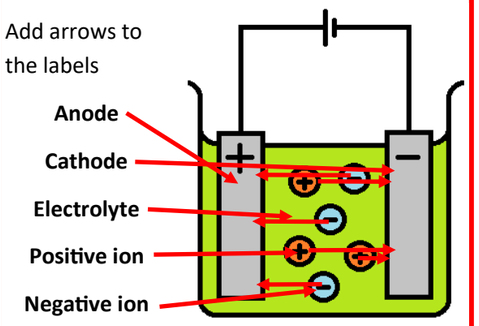
A pH2 Acid has 10 times higher concentration of $H^+$ ions than a pH3 Acid.

A pH3 Acid has 100 times higher concentration of $H^+$ ions than a pH5 Acid.

## Electrolysis

For electrolysis to work an ionic compound must be melted or dissolved in water so that the ions are free to move. These liquids and solutions are called electrolytes and can conduct electricity.

Add arrows to the labels




Add arrows to show the ions moving to the correct electrode

What happens to the ions when they reach the electrodes? Discharge and become elements.

(HT) Complete and balance the half equations for the electrolysis of molten sodium chloride.

$Na^+ + e^-$ —> Na  $2Cl^-$ —> $Cl_2 + 2e^-$

## Electrolysis of Molton Ionic Compounds

What is produced at the anode and cathode when these simple ionic compounds are electrolysed in the molten state.

| Compound | Anode | Cathode |
|---|---|---|
| Lead Bromide | Bromine | Lead |
| Sodium Chloride | Chlorine | Sodium |
| Magnesium Oxide | Oxygen | Magnesium |

## Electrolysis of Aqueous Solutions

The electrolysis of aqueous solutions will break down the water molecules as well as the ionic compound.

The products depends on the reactivity of the elements used.

At the cathode the least reactive of hydrogen or the metal used will be produced.

At the anode oxygen will be produced unless a halogen is involved.

Inert electrodes (e.g. graphite) are used to prevent them reacting.

**Extracting Aluminium** Electrolysis is used to extract a metal that is more reactive than, or reacts with, carbon.

Give 2 reasons why electrolysis uses large amounts of energy
1.) To melt the compounds
2.) To supply the electrical current.

Aluminium is produced by the electrolysis of molten aluminium oxide

Why is aluminium not displaced by reaction with carbon? Al more reactive than C

Why is aluminium oxide mixed with cryolite? Lower melting temperature to save money

Why must the positive carbon electrode be replaced. Oxygen produced which then reacts with electrode to form carbon dioxide.

## Complete the Half Equations (HT)

$Al^{3+} + 3e^-$ —> Al  $2O^{2-}$ —> $O_2 + 4e^-$

## pH and Neutralisation

Which ions are produced by Acids in aqueous solutions? hydrogen ions ($H_+$)
Which ions are produced by Alkalis in aqueous solutions? hydroxide ions ($OH_-$)

The pH scale ranges from pH 0 to pH 14. It can be measured with universal indicator or with a much higher resolution using a pH probe. pH 7 is neutral. Acids have pH values of less than 7, alkalis have pH values greater than 7, pH7 is neutral.

A reaction between an acid and an alkali is called a neutralisation reaction. The hydrogen ions from the acid react with hydroxide ions from the alkali to produce water.

Complete the neutralisation equation including the state symbol $H^+(aq) + OH^-(aq)$ —> $H_2O(l)$

Give the pH and strength of the acid/alkali solution from the following universal indicator results

a.) Yellow pH5 weak acid  b.) Green pH7 neutral  c.) Red pH0-2 strong acid

d.) Orange pH3-4 medium acid  e.) Blue pH9-10 weak alkali  f.) Purple pH12-14 strong alkali