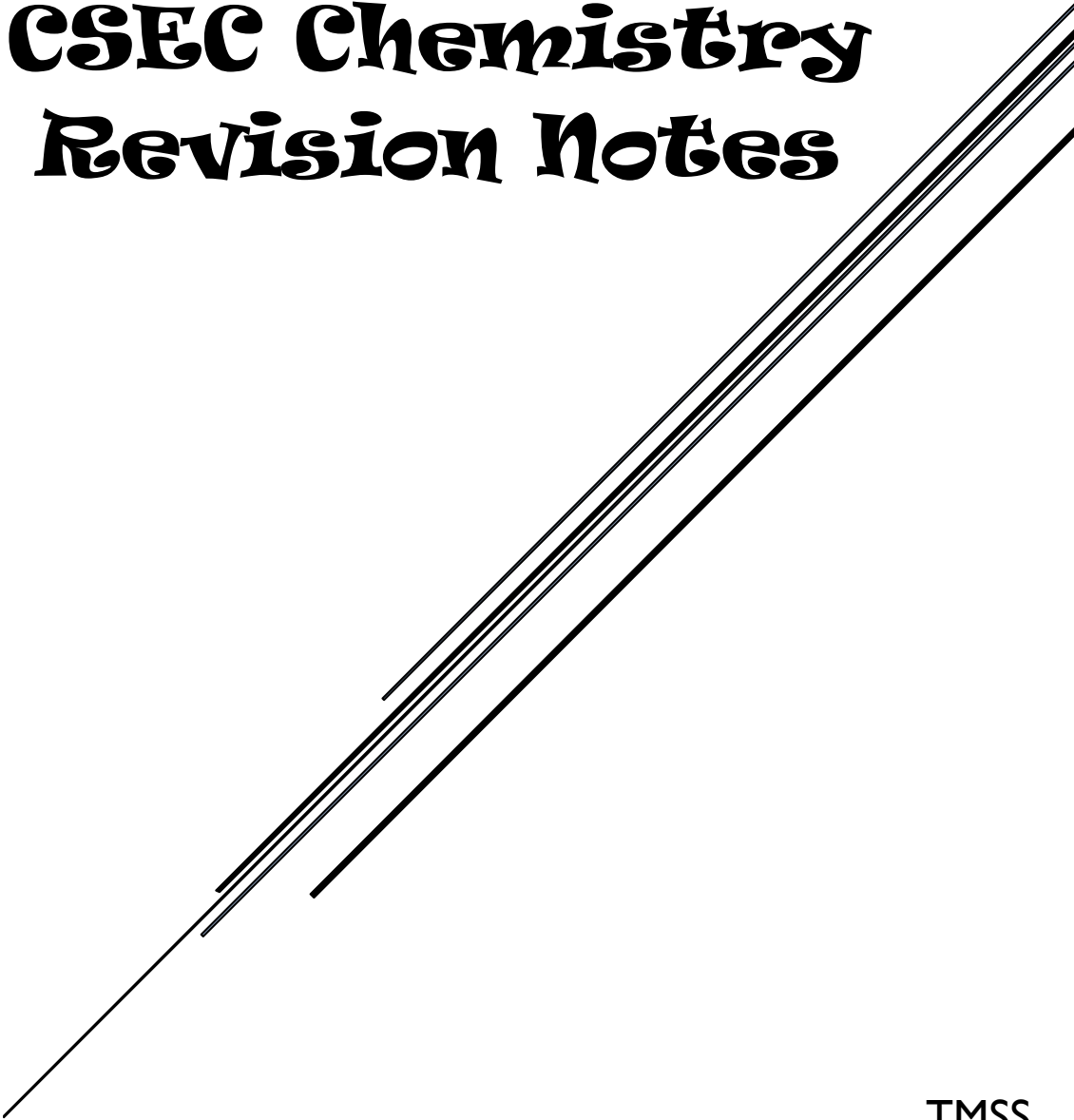


CSEC Chemistry Revision Notes



TMSS
CHEMISTRY

States of Matter

Diffusion, osmosis and Brownian motion demonstrates that matter is made up of particles

Particles in a gas can move in any direction

Particles in a solid cannot move freely because the forces of attraction are very strong

Brownian motion is demonstrated when pollen grains are moving randomly in water

Osmosis is demonstrated with the movement of water molecules across a cell membrane into a concentrated glucose solution

Particles move fastest in a gas at high temperatures (e.g. 100°C)

Atomic Structure Chemical formulae and Bonding

Mass number is the number of neutrons plus protons

The difference between an atom and an ion is an atom contains equal numbers of protons and electrons whereas an ion contains unequal numbers of protons and electrons

Metallic bonding occurs when cations are held together by a sea of mobile electrons

A property of metal is that they tend to lose electrons

Ionic bonding formation results from the donation of electrons from a metal to a non-metal to achieve stability

Carbon and sulphur exhibit allotropy

Chlorine atom has 7 electrons in its outermost shell

The element used to determine the atomic mass of other elements is Carbon-12

Neutrons have a relative charge of 0 and an approximate mass of 1

Protons have a relative charge of +1 and an approximate mass of 1

Hydrogen chloride is a covalent compound

Carbon does not form of a simple ion by gaining or losing electrons

Nitrogen molecules have 3 covalent bonds

Structures and Properties of Compounds

Crystals of sodium chloride are best described as ionic

Sodium chloride has a boiling point of 1465°C. It does not conduct electricity in the solid state but conducts electricity in the aqueous state

A substance with a giant covalent structure is diamond (also graphite)

Sodium chloride has a high melting point because the ions are bound by strong electrostatic force

Ionic substances have high melting points and are good conductors of electricity in the liquid state

An element that is a non-metal forms an acid oxide

Covalent compounds usually have low melting and boiling point and are usually insoluble in water

FeCl_2 and FeCl_3 are two chlorides of iron. The following statements are true for these chlorides. (a) The oxidation state of iron is different in the two chlorides. (b) the percentage of iron by mass in the two chlorides are different and (c) the colours of the aqueous solutions of the two chlorides are different.

Copper (II) carbonate is insoluble in water, it give off a gas when added to dilute acids and it gives off a gas when heated.

The Structure of Solids

Graphite can be used as a lubricant because of weak attractions between the hexagonal layers of carbon atoms.

Carbon, sulphur and phosphorous exhibit allotropy

Allotropes are solid forms of a given element with different physical properties

Separation Technique and Mixtures

Paper chromatography may be used to separate a mixture of plant pigments

The following are arranged in order of increasing particle size solutions, colloids, suspensions

Fractional distillation is NOT used in the conversion of alkanes to alkenes

A mixture of copper (II) oxide and copper (II) sulphate is best separated by shaking with excess water and then filtering

A separating funnel can be used to separate a mixture of water and kerosene

A solid can be obtained by the process of sedimentation from suspensions

Chalk in water is a suspension

A substance with boiling point of 60°C is miscible with a substance of boiling point 80°C . They can best be separated by fractional distillation

Solutions cannot be filtered. Everything will end up in the filtrate.

The Periodic Table and Trends

Bromine is a liquid halogen (i.e. group 7) at room temperature.

An element with an electronic configuration 2, 8, 1 belongs to group 1 and period 3

Sulphur and oxygen are in the same group of the periodic table because they have the same number of electrons in their outer shell.

Atomic number increases across the Periods of the periodic table.

Iodine is a purple solid halogen at room temperature.

On descending group VII of the periodic table, the density of the elements increases and the melting point of the elements increases.

The arrangement of electrons in the periodic table is based on atomic number

The solubility of product and the rate of reaction will be the difference seen between barium and calcium when these two metals from group 2 react with water.

Halogens form negative ions by gaining electrons.

Group 7 elements form molecules with two atoms.

Group 2 elements have two electrons in their outer-shell

Acids, Bases and Salts

Oxides of metals are bases

Acids supply protons as the only positive ions in aqueous solution

Al₂O₃ (aluminium oxide) is amphoteric. It reacts with both acids and bases.

H₂SO₄ and (COOH)₂ would require more than one mole of NaOH for complete neutralisation.

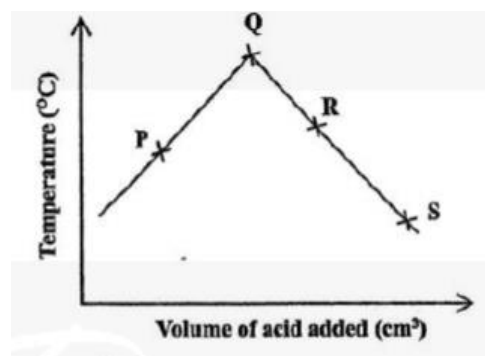
$2\text{H}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$ is the ionic equation for the reaction between an acid and a carbonate.

Sulphuric acid has a basicity of 2.

Ethanoic acid is weakly ionised in solutions.

Calcium carbonate reacts with an acid, releasing a gas (carbon dioxide) which turns lime water milky.

Hydrogen shows no reaction with moist litmus paper.



Point **Q** represents the neutralisation point of an acid and base.

$\text{RCOOH(aq)} + \text{NaOH(aq)} \rightarrow \text{RCOONa(aq)} + \text{H}_2\text{O(l)}$ is a neutralisation reaction.

CaO may be used to counteract the effects of acid rain on the soil.

Ethanoic acid will not form an acidic salt

Limestone treated with acid to gives effervescence and a gas which turns limewater milky

Salt preparation

Adding dilute sulphuric acid to copper (II) chloride would be the LEAST suitable method to prepare copper (II) sulphate

Lead nitrate is soluble in cold water

Ammonia may be produced in the laboratory by heating a mixture of ammonium chloride and calcium hydroxide

Copper (II) nitrate produces a blue precipitate with aqueous sodium hydroxide solution

Barium sulphate and silver chloride may be prepared by precipitation (i.e. by mixing and filtering).

Lead sulphate and Barium sulphate are insoluble salts. Calcium sulphate is slightly soluble

Barium sulphate is white in colour.

The Mole Concept

The mass of '1 mole of an element' refers to the quantity of an element which contains 6.0×10^{23} atoms.

30g of Iodine in 50cm^3 of ethanol is referred to as a standard solution

Oxidation and Reduction

The reducing agent is oxidised with an increase in oxidation state

Ions which are not changed in a reaction are called spectators ions

In NaH hydrogen has a negative oxidation number

When a metal atom becomes an ion, it loses electrons and is oxidised

Oxidation is the loss of electrons

Calcium ion has an oxidation number of +2 because the calcium atom has two electrons in its outermost shell

The oxidation number of silicon in Na_2SiO_3 is +4

Potassium dichromate (VI) turns green when treated with sulphur dioxide

$\text{S}^{2-} - 2\text{e}^- \rightarrow \text{S}$ involves oxidation (loss of electrons)

Non-metallic atoms and metallic ions act as oxidising agent

The oxidation of manganese is +7 in KMnO_4

Electrochemistry and electrolysis

Sulphuric acid electrolyte causes the bulb to glow the brightest in a circuit because it completely dissociates in water

Quantity of Electricity (C) = Current (A) x time (s)		$Q=It$
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In the electrolysis of aqueous copper (II) sulphate solution using copper electrodes, the anode decreases in mass

Sodium chloride when added to pure water significantly increases the water's conductivity.

Positive ions migrate to the cathode in electrolysis

Copper conducts electric current and remains chemically unchanged.

Ethanol does not conduct electricity. It is a non-electrolyte.

When a concentrated solution of sodium chloride is electrolysed using carbon electrodes, chlorine is liberated at the anode.

Electrolysis will not occur in solid sodium chloride

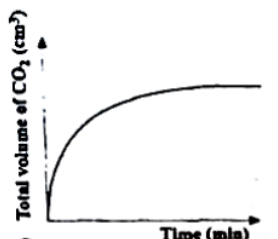
Oxidation occurs at the anode in electrolysis.

Anions move to the Anode, Cations move to the Cathode

Temperature does not affect the discharge of cations during electrolysis.

Aqueous ethanoic acid is a weak electrolyte.

Rates of Reactions



This graph represents the reaction of calcium carbonate reacted with excess hydrochloric acid.

Increasing the temperature usually increases the rate of the catalytic decomposition of hydrogen peroxide.

If 5.0g of powdered zinc were used instead of 5.0g of granulated zinc in a reaction with hydrochloric acid, the rate of hydrogen gas produced would increase because of the greater surface area of powdered zinc.

A catalyst increases the rate of a reaction because it provides an alternative route of lower activation energy.

Increasing the temperature of the reaction, reducing the size of particles, increasing the concentration of reactants are ways to increase the rate of a reaction.

The rate of a reaction does not depend on the energy change associated with the reaction.

Chemical Energetics

Heat is absorbed from the surrounding in endothermic reactions

Heat is released to the surrounding in exothermic reactions

The products have less energy than reactants in exothermic reactions

Energy is required to break chemical bonds

Temperature increases in exothermic reactions

Organic Chemistry

Condensation polymerization converts glucose to starch and cellulose.

Addition reaction occurs between propene and bromine.

Cracking is the process of breaking down large molecules into smaller alkene and alkane molecules

Hexane (C_6H_{14}) is a covalent compound and it belongs to the alkane groups.

Potassium dichromate (VII) determines the presence of ethanol.

Soapless detergents are not affected by hard water.

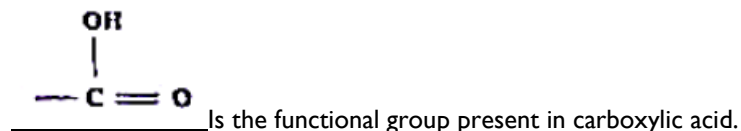
Hydrogen chloride is a product of the halogenation reaction with methane.

$CH_3(CH_2)_3OH$ is an alcohol.

C_2H_4 is an alkene.

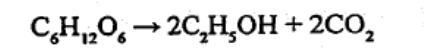
The homologous series have members with the same functional group, the same general formula, and similar chemical properties.

A polyamide is formed by a condensation reaction between a molecule containing at least one –COOH group and another containing at least one –NH₂ group.



CH₃CH=CHCH₂CH₃ is an alkene. It has a carbon- carbon double(C=C) bond.

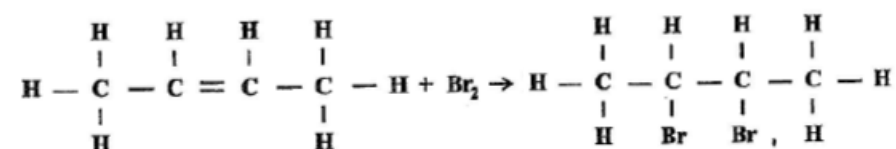
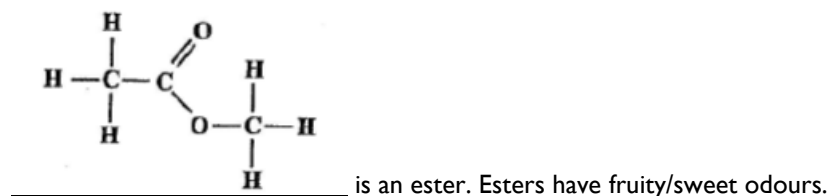
The fermentation of glucose as the substrate can be represented by the equation:



The bond between the two carbon atoms in ethene (C₂H₄) is a double bond.

Saponification involves the boiling of a fat or oil with aqueous sodium hydroxide (caustic soda). Saponification makes soap.

Unsaturated molecules contain at least one double bond.



CH₃COOH (ethanoic acid) reacts with sodium carbonate to produce a gas (i.e. carbon dioxide) which turns lime water milky.

Alkenes react with KMnO₄/H⁺ changing its colour from purple to colourless. They also undergo addition reactions.

Bromine solution/water test can be used to distinguish between an alkane and alkene.

During the manufacture of ethanol by fermentation, the gas evolved (carbon dioxide) turns lime water cloudy.

A natural source of hydrocarbons is Petroleum.

Polysaccharides, polyamides and polyesters are formed from condensation polymerization.

Polyalkenes are formed by addition polymerization.

Metals and the Reactivity Series

Copper (Cu) does not react with an acid to produce hydrogen gas.

Aluminium (Al) is covered with a passive layer of oxide

Sodium (Na) reacts with water to produce a strongly alkaline solution.

Metals are good conductors of electricity.

$\text{Pb(s)} + \text{Fe(NO}_3)_2(\text{aq}) \rightarrow \text{Pb(NO}_3)_2(\text{aq}) + \text{Fe(s)}$ is not likely to occur because Pb is below Fe in the reactivity series.

THE REACTIVITY SERIES

Metal	Symbol	Reactivity
Potassium	K	Most reactive ↓ Least reactive Decreasing: • Ease of ionisation • Reactivity • Stability of compounds • Strength as a reducing agent
Sodium	Na	
Calcium	Ca	
Magnesium	Mg	
Aluminium	Al	
Zinc	Zn	
Iron	Fe	
Lead	Pb	
(Hydrogen)	(H)	
Copper	Cu	
Mercury	Hg	
Silver	Ag	
Gold	Au	

Iron appears between copper and aluminium in the reactivity series and it is an important component in haemoglobin.

FeCl_2 and FeCl_3 are two chlorides of iron. The colours of the aqueous solutions of the two chlorides are different and the percentage of iron by mass in the two chlorides are different.

Zinc will react more vigorously with dilute acid than copper, iron and lead because it is higher up in the reactivity series.

The extraction of aluminium is done by the electrolysis of its molten oxide (Alumina, Al_2O_3).

Magnesium is an important constituent of chlorophyll.

Air, iron ore, coke and limestone are ALL the raw materials used in the extraction of iron.

CO , and Fe only are produced when carbon monoxide reacts with iron (III) oxide.

Steel is often used in place of iron because it is stronger.

A displacement reaction occurs when zinc metal is added to copper sulphate solution.

Qualitative Analysis

Carbon dioxide is a gas that is not considered to be toxic.

Potassium dichromate(VI) turns green when treated with sulphur dioxide.

When copper (II) carbonate is heated alone in a test tube. A gas (carbon dioxide) is evolved which forms a white precipitate with aqueous calcium hydroxide (lime water) and a black residue is formed (copper oxide)

When EXCESS aqueous ammonia is added to a solution of copper (II) sulphate and the mixture is shaken, a deep blue solution is observed.

Ammonia gas is identified by placing moist red litmus paper in a jar of the gas.

H₂O (water) will give a positive test with the dry cobalt chloride paper.

Hydrogen gas shows no reaction with moist litmus paper.

Barium sulphate is a white precipitate.

Chlorine is a greenish yellow gas which bleaches moist red litmus paper.

Iron is the catalyst used in the Haber process

Sulphur dioxide and carbon monoxide are pollutants in the air

Aluminium oxide, carbon dioxide and nitrogen dioxide are all acidic oxides