GCE ORDINARY LEVEL
5152 SCIENCE (CHEMISTRY)

NOTES - Things You Must Know

Name: _____( ) Class: _____ Date: _____

1. Experimental Chemistry

1.1 Experimental Design

You should know how to:

(a)	name appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes, measuring cylinders and gas syringes	
(b)	suggest suitable apparatus, given relevant information, for a variety of simple experiments, including collection of gases and measurement of rates of reaction	

1.2 Criteria of purity

You should know:

(a)	how to describe and use paper chromatography and interpret chromatograms	
(b)	That paper chromatography can be used to determine if a substance is pure	
(c)	A pure substance has a fixed **melting point**. Impurities lower the melting point of a substance. An impure substance melts over a range of temperature.	
(d)	A pure substance has a fixed **boiling point** at a specific pressure. Impurities raise the boiling point of a substance. An impure substance boils over a range of temperature.	

1.3 Methods of purification

You should know:

Use of a suitable solvent and filtration	
That this method is used when one component of the mixture is soluble in a solvent.	
How to describe this method: ☞ Add the solvent, stir, and heat to dissolve the soluble substance. ☞ Filter the suspension. The residue contains the insoluble component ☞ Crystallize the filtrate to obtain the soluble component. [in the case of salt (sodium chloride), you will evaporate the filtrate to obtain the soluble component]	
Crystallization	
This method is used to obtain pure crystals (e.g sugar crystals) from an impure solid.	
How to describe this method: ☞ Dissolve the impure solid in a suitable solvent (e.g water) and filter the solution to remove any impurities that cannot be dissolved. ☞ Heat to concentrate the solution (make the solution saturated). ☞ Cool the saturated solution to obtain the crystals. ☞ Filter the solution to obtain the crystals. ☞ Dry the crystals between sheets of filter paper.	

Distillation	
Distillation is used to obtain a pure solvent (e.g water) from a solution or an impure liquid such as seawater	
Describe this method through the use of diagram. ☞ This liquid to be purified is placed in a distillation flask. ☞ The pure liquid distills over at its boiling point.	
Fractional Distillation	
This method is used to separate a mixture of miscible liquids of different boiling points: e.g. water and ethanol, crude oil, liquid air (can be gases in liquid state) to obtain oxygen, nitrogen and rare gases.	
☞ A fractionating column helps to condense the liquid that has a higher boiling point and return it to the distillation flask. ☞ The liquid with the lower boiling point will distill over first. As soon as the temperature rises above the boiling point, the remaining liquid is no longer pure and it should not be collected.	

1.4 Identification of Ions and Gases

Do you know:

Tests for aqueous cations

	Cation	Effects of aqueous sodium hydroxide	Effects of aqueous ammonia	
(a)	Copper(II) (Cu^{2+})	light blue ppt, insoluble in excess	light blue ppt, soluble in excess, giving a dark blue solution	
	Iron(II) (Fe^{2+})	green ppt, insoluble in excess	green ppt, insoluble in excess	
	Iron(III) (Fe^{3+})	red-brown ppt, insoluble in excess	red-brown ppt, insoluble in excess	
	Calcium (Ca^{2+})	white ppt, insoluble in excess	No ppt	
	Ammonium (NH_4^+)	ammonia produce on warming	—	
	Zinc (Zn^{2+})	white ppt, soluble in excess, giving a colourless solution	white ppt, soluble in excess, giving a colourless solution	
	Aluminium (Al^{3+})	white ppt, soluble in excess, giving a colourless solution	white ppt, insoluble in excess	
	lead(II) (Pb^{2+})	white ppt, soluble in excess, giving a colourless solution	white ppt, insoluble in excess	

[Lead (II) ions can be distinguished from aluminium ions by the insolubility of lead(II) chloride.]

Tests for anions

	Anion	test	test result	
(b)	carbonate (CO_3^{2-})	add dilute acid and subsequent use of limewater to test for gas.	effervescence, carbon dioxide produced	
	nitrate (NO_3^-) [in solution]	add aluminium and aqueous sodium hydroxide and heat (by reduction), subsequent use of litmus paper to test for gas.	ammonia produced	
	chloride (Cl^-) [in solution]	acidify aqueous solution with dilute nitric acid, then add aqueous silver nitrate	white ppt	
	sulphate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt	
	iodide (I^-) [in solution]	acidify aqueous solution with dilute nitric acid then add aqueous lead(II) nitrate	yellow ppt	

Tests for gases

	Gas	test and test result	
	ammonia (NH_3)	turns damp red litmus paper blue	
	carbon dioxide (CO_2)	turns limewater milky	
(c)	Chlorine (Cl_2)	bleaches damp litmus paper	
	hydrogen (H_2)	'pops' with a burning/lighted splint	
	Oxygen (O_2)	relight a glowing splint	
	Sulphur dioxide (SO_2)	turns acidified aqueous potassium dichromate(VI) green	

2. Kinetic Particle Theory

You should know:

The 3 states of matter		
1.	The Solid State	
	Solids have a definite volume and shape because particles in the solid: ☞ Have the least energy, ☞ are closely packed together, ☞ have orderly arrangement, ☞ are held together by strong forces, ☞ can vibrate but not move from their fixed positions	

2.	The Liquid State	
	Liquids have a definite volume but no definite shape because particles in the liquid: ☞ have more energy than those in the solid state, ☞ are fairly packed close together, ☞ are not in an orderly arrangement, ☞ are held together by strong forces (but a little weaker than in solids), ☞ can vibrate and move throughout the liquid.	
3.	The Gaseous State	
	Gases have no definite volume or shape and can be compressed because particles in the gas: ☞ have most energy, ☞ are far apart, ☞ have a random arrangement, ☞ have almost no forces between the particles, ☞ can vibrate and move about anywhere with fastest speeds.	
Inter-conversion of the 3 states		
☞ **Solid State**: Upon **heating**, the particles gain energy and vibrate faster. ☞ At **melting point**, the particles gain enough energy to break the bonds holding them in place. **During** melting, temperature *<u>stays constant</u>* because heat energy taken in by the particles of the solid is used to overcome the forces of attraction holding the particles together. ☞ **Liquid State**: particles become free to move around. ☞ As temperature rises, particles gain more energy and move faster. ☞ At **boiling point**, the particles have enough energy to overcome the attractive forces which hold them in the liquid. **During** boiling, temperature *<u>stays constant</u>* because heat energy is taken in by the liquid particles to break all the forces holding the particles together. ☞ **Gaseous State**: The particles have a lot of energy and move at random		
☞ The reverse process takes place on **cooling**		
☞ **During freezing** (liquid state to solid state), temperature *stays constant* because heat energy is released when the particles slow down to take up fixed and orderly positions in the solid.		

3. Atomic Structure

Do you know:

1	The relative charges of a proton, a neutron and an electron	
2	The approximate relative masses of a proton, a neutron and an electron	
3	How to describe, with the aid of diagrams, the structure of an atom as containing protons and neutrons (nucleons) in the nucleus and electrons arranged in shells	
4	☞ In a neutral atom, the number of electrons equal to the number of protons. ☞ For elements with proton number 1 to 18, the maximum number of electrons in each shell are: ☞ 1^{st} shell 2 electrons ☞ 2^{nd} shell 8 electrons ☞ 3^{rd} shell 8 electrons	
5	☞ What is valence electrons ? ☞ What is noble gas electronic structures ?	
6	The definition of ☞ *proton number* (*atomic number*) ☞ *nucleon number* (*mass number*) ☞ *isotopes*	
7	How to interpret and use symbols such as $^{12}_{6}c$ (what does C, 12 and 6 represent?)	
8	How to deduce the numbers of protons, neutrons and electrons in atoms and ions given proton and nucleon numbers ?	

4. Structure and Properties of Materials

Do you know:

1	Elements consist of only one type of atoms which may or may not be joined together to form molecules.	
2	Both compounds and mixtures consists of more than one elements	
3	All elements can be classified into metals and non metals.	
4	How to **describe** and **state** the difference between elements, mixture and compound.	
5	How to state the difference between metals and non metals	

5. Ionic bonding

Do you know how to:

1	Describe the formation of ions by electron loss/gain in order to obtain the electronic configuration of an inert gas.	
2	Describe the formation of ionic bonds between metals and non-metals (e.g. NaC*l*; MgCl_2)	

3	relate the physical properties (including electrical property) of ionic compounds to their lattice structure. (In solid state, ions are arranged in an orderly manner in the crystal lattice. They are not free to move about and cannot conduct electricity. In aqueous or molten state, the ions are not bound to each other and are therefore free to move about and conduct electricity.)	
4	The defintion of ☞ Ion (particle with charge) ☞ Cation (positive ion) ☞ Anion (negative ion) ☞ Ionic Bond (Are positive ions form from metals only? Can it be a nonmetal? Is hydrogen a metal even though it forms positive ion? What about ammonium ion, NH_4^+?)	

6. Covalent Bonding

Do you know how to:

1	describe the formation of a covalent bond by the sharing of a pair of electrons in order to gain the electronic configuration of an inert gas	
2	describe, using 'dot and cross' diagrams, the formation of covalent bonds between non-metallic elements (e.g. H_2, O_2, H_2O, CH_4 and CO_2)	
3	deduce the arrangement of electrons in other covalent molecules. (the sharing of one pair of electrons results in a single bond which is represented by a single line between the atoms, the sharing of two pair of electrons results in a double bonds which is represented by two lines between the atoms)	
4	relate the physical properties (including electrical property) of covalent substances to their structure and bonding.	

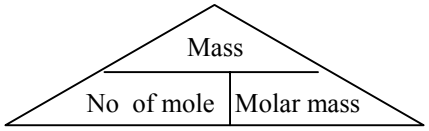
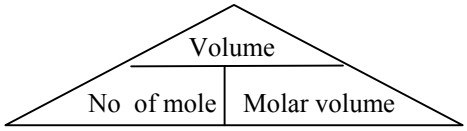
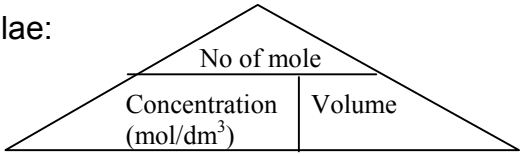
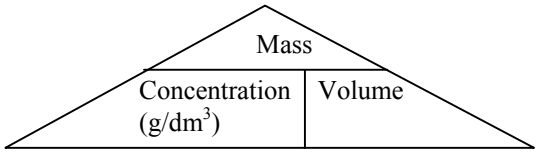
7. Formulae, Stoichiometry and the Mole Concept

Do you know:

1	state the symbols of the elements and formulae of the compounds mentioned in the syllabus	
2	deduce the formulae of simple compounds from the relative numbers of atoms present and vice versa (e.g 2 H atoms is H_2 ; 2 K atoms, 1 C atom, 3 O atoms is K_2CO_3.)	
3	deduce the formulae of ionic compounds from the charges on the ions present and vice versa	
	Common mistakes: e.g $2H_2 + O_2 \longrightarrow 2H_2O$ Calculate the RMM of H_2O **Wrong**: RMM = 2 x (2 +16) = 36 | **Correct**: RMM = 2 + 16 = 18	

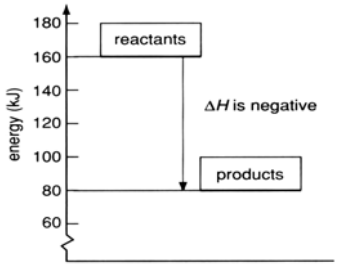
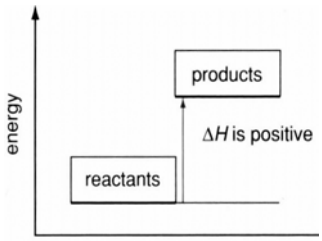
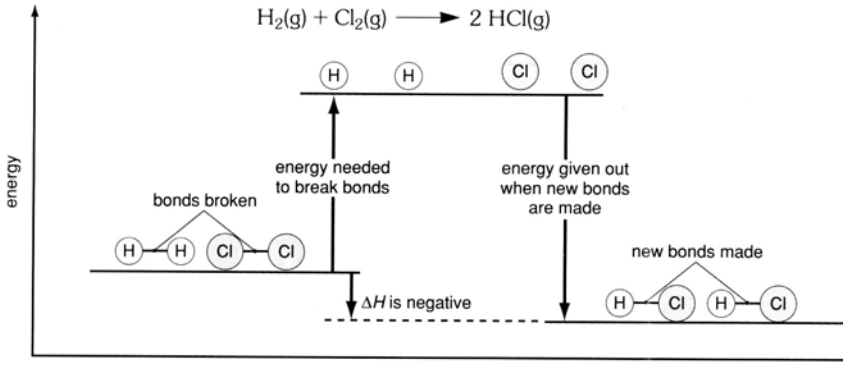
		Cl^- Chloride	H^- hydride	OH^- hydroxide	NO_3^- Nitrate	O^{2-} Oxide	CO_3^{2-} carbonate	SO_4^{2-} sulphate
4	Na^+			NaOH	$NaNO_3$	Na_2O	Na_2CO_3	
	K^+							
	H^+							
	NH_4^+ Ammonium ion					$(NH_4)_2O$	$(NH_4)_2CO_3$	
	Cu^+ Copper (I) ion							
	Cu^{2+} Copper (II) ion			$Cu(OH)_2$	$Cu(NO_3)_2$	CuO		
	Ba^{2+}	$BaCl_2$	BaH_2				$BaCO_3$	$BaSO_4$
	Zn^{2+}							
	Ca^{2+}							
	Pb^{2+} Lead (I) ion							
	Fe^{2+} Iron (II) ion							
	Fe^{3+} Iron (III) ion	$FeCl_3$		$Fe(OH)_3$	$Fe(NO_3)_3$	Fe_2O_3		
	Al^{3+}						$Al_2(CO_3)_3$	

5	interpret chemical equations with state symbols Solid state – (s), Liquid state – (l), Gaseous state – (g), Aqueous state – (aq)	
6	construct chemical equations, with state symbols, including ionic equations	
7	Define ☞ *relative atomic mass*, A_r ☞ *relative molecular mass*, M_r	

8	calculate stoichiometric reacting masses (**one mole of a substance has 6 X 10^{23} particles**) and volumes of gases (**one mole of gas occupies 24 dm^3 at room temperature and pressure**); calculations involving the idea of limiting reactants may be set Formulae:  	
9	apply the concept of solution concentration (in mol/dm^3 or g/dm^3) to process the results of volumetric experiments and to solve simple problems Formulae:  	

8. Energy from Chemicals

Do you know:

1	☞ The making of a chemical bond is exothermic (ΔH is negative). E.g, combustion, neutralization(reaction of acid and alkali), respiration  	
	☞ The heat of reaction, ΔH = [Heat given out when bonds are made in the products] + [Heat absorbed when bonds are broken in the reactants]	
	☞ The breaking of a chemical bond is endothermic (ΔH is positive). E.g, photosynthesis, dissolving, decomposition of copper(II) carbonate, formation of nitrogen oxide in a car engine.	
2	☞ In endothermic reaction, more heat is absorbed in breaking bonds than is given out in making bonds. ☞ In exothermic reaction, more heat is given out in making bonds than is absorbed in breaking bonds. Example: 	

9. Chemical Reactions

Do you know:

1

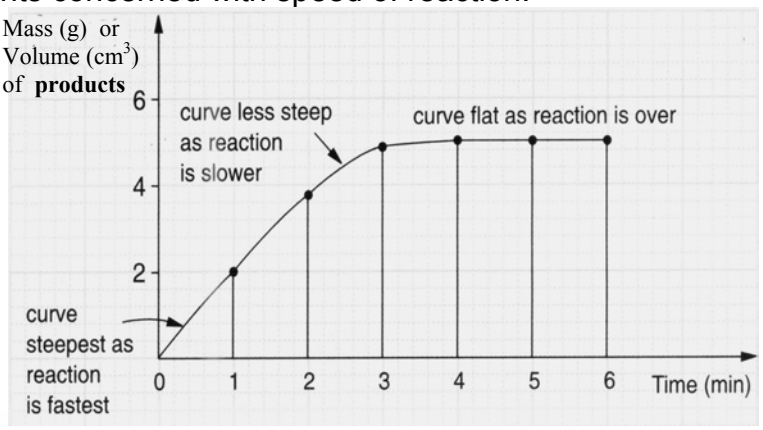
Speed of reaction **increases**,

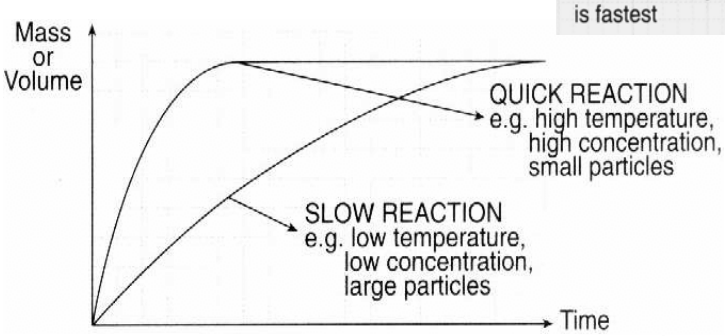
- ☞ as the temperature **increases**, the particles have more energy, so they move more quickly, they will collide more often with greater force.
- ☞ as pressure **increases**, the particles are closer to each other so they collide more often.
- ☞ as concentration **increases**, there are more particles in the same amount of solvent, so the particles will collide more often.
- ☞ as the particle size **decreases**, there will be larger surface area (more surface), so the particles collide more often.

2

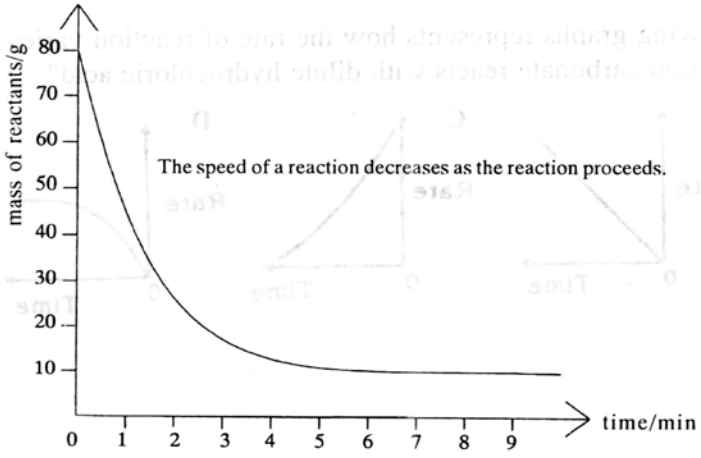
*interpret data obtained from experiments concerned with speed of reaction.

Graphs for Products →





Graph for Reactants



3	Oxidation is the Loss of Electron (OLE), loss of hydrogen, gain of oxygen Reduction is the Gain of Electron, gain of hydrogen, loss of oxygen	
4	An increase in oxidation state is **oxidation**. e.g $Mg \longrightarrow Mg^{2+}$ oxidation state is 0 → oxidation state is 2+ $K \longrightarrow K^{+}$ oxidation state is 0 → oxidation state is 1+ $Cl^{-} \longrightarrow Cl$ oxidation state is -1 → oxidation state is 0 $O^{2-} \longrightarrow O$ oxidation state is -2 → oxidation state is 0 A decrease in oxidation state is **reduction**. e.g $Mg^{2+} \longrightarrow Mg$ oxidation state is 2+ → oxidation state is 0 $K^{+} \longrightarrow K$ oxidation state is 1+ → oxidation state is 0 $Cl \longrightarrow Cl^{-}$ oxidation state is 0 → oxidation state is -1 $O \longrightarrow O^{2-}$ oxidation state is 0 → oxidation state is –2	
5	☞ An **oxidizing agent** is a substance that brings about **oxidation** in another substance but is **itself reduced**.	
	☞ An **reducing agent** is a substance that brings about **reduction** in another substance but is **itself oxidized**.	
	☞ Aqueous **Potassium Iodide**, KI is used to **test for** the presence of **an oxidizing agent**. Add a drop of colourless KI in an oxidizing agent, a brown solution will formed. The solution turns brown due to the iodine, I_2 (aq) produced. $2I^{-}(aq) \longrightarrow I_2(aq) + 2e^{-}$ colourless → brown Starch iodide paper is also used. Oxidising agent will turn moist starch iodide paper from white to blue. This is because the iodine produced reacts with the starch to give a blue colour.	
	☞ **Acidified Potassium Dichromate (VI)**, $K_2Cr_2O_7$, is used to **test for** the presence of **a reducing agent**. The colour of the acidified potassium dichromate (VI) solution changes from orange to green in the presence of a reducing agent. The dichromate (VI) ion, $Cr_2O_7^{2-}$, is reduced to the chromium (III) ion, Cr^{3+}. $Cr_2O_7^{2-}(aq) + 14H^{+}(aq) + 6e^{-} \longrightarrow 2Cr^{3+}(aq) + 7H_2O(l)$ Orange → green	

10. The Chemistry and Uses of Acids, Bases and Salts

Do you know:

1	Describe the meanings of the terms *acid* and *alkali* in terms of the ions they contain or produce in aqueous solution and their effects on Universal Indicator paper : Acids contain H^+ ions (hydrogen ions) Alkalis contain OH^- ions (hydroxide ions) More H^+ ions so acid is stronger. (Universal indicator – red, pH 1 – 3) Less H^+ ions so acid is weaker. (Universal indicator – orange, pH 4 – 6) Neutral (Universal indicator – green, pH 7) Less OH^- ions so alkali is weaker. (Universal indicator – blue, pH 8 – 11) More OH^-ions so alkali is stronger. (Universal indicator – violet/purple, pH 12 – 14)	
2	Acid + metal $\longrightarrow$ Salt + hydrogen gas Acid + bases(alkali) $\longrightarrow$ Salt + water (neutralization) Acid + carbonate $\longrightarrow$ Salt + Carbon dioxide + water	
3	Describe the importance of controlling the pH in soils and how excess acidity can be treated using calcium hydroxide	
4	Alkali + ammonium salt $\xrightarrow{\text{heat}}$ Salt + Water + Ammonia gas Acid + bases(alkali) $\longrightarrow$ Salt + water (neutralization)	
5	☞ Acidic oxides are oxides of non – metals. They dissolve in water to form acidic solution. They react with alkalis to form salt and water. ☞ Basic oxides are oxides of metals. Most basic oxides are insoluble in water. (Those that are soluble are called alkali) They react with acids to form salt and water ☞ Amphoteric Oxides In acid, they will behave as basic oxides. $ZnO + 2HCl \longrightarrow ZnCl_2 + H_2O$ In an alkali, they will behave as an acidic oxides. $ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$ Sodium zincate	

Amphoteric oxides	Formula	Salt produced in NaOH
Aluminium oxide	Al_2O_3	Sodium aluminate, $NaAlO_2$
Lead (IV) oxide	PbO_2	Sodium plumbate, Na_2PbO_3
Lead (II) oxide	PbO	Sodium plumbite, Na_2PbO_2

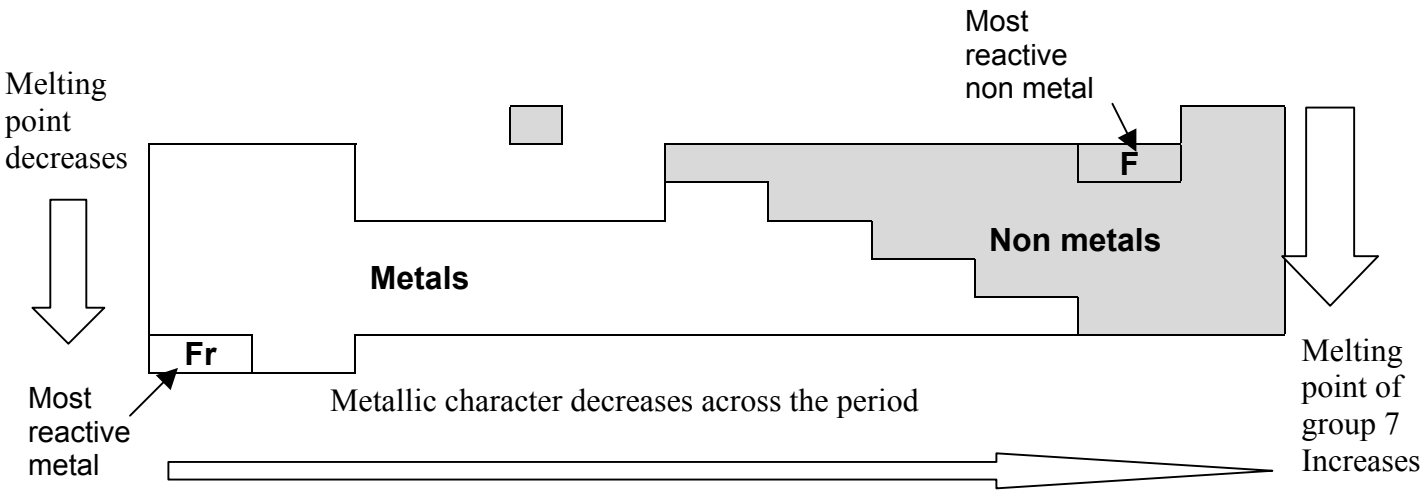
☞ Neutral oxides
These are oxides form by non-metals that show neither acidic nor basic properties.
Some examples of neutral oxides are water, carbon monoxide and nitrogen monoxide.

6	☞ *describe the techniques used in the preparation, separation and purification of salts as examples of filtration, crystallization, distillation ☞ precipitation, titration, reactions of acids with metals, insoluble bases and insoluble carbonates are some of the methods for preparation of salts.	
7	Suggest a method of preparing a given salt from suitable starting materials, given appropriate information	

11. The Periodic Table

You should know how to:

1	Describe the Periodic Table as an arrangement of the elements in the order of increasing proton number (atomic number)	
2	Describe the change from metallic to non-metallic character from left to right across a period of the Periodic Table	
3	Describe the relationship between group number, number of valency electrons and metallic/non-metallic character	
4	Predict the properties of elements in Group I, VII and the Transition elements using the Periodic Table	
5	Describe lithium, sodium and potassium in Group I (the alkali metals) as a collection of relatively soft, low density metals with a low melting point as compared with other metals in other groups. They show a decrease in melting point down the group and an increase in the reactivity with water down the group.	
6	Describe chlorine, bromine and iodine in Group VII (the halogens) as a collection of diatomic non-metals. Their colour darkens down the group. They change state from gas to solid down the group. Example, fluorine and chlorine are gases. Bromine is a liquid and iodine is a solid. The reactivity of chlorine, bromine and iodine decreases down the group.This is illustrated in their displacement reactions with aqueous solutions of other halide ions. Example of displacement reaction: $Cl_2 + 2KBr \longrightarrow 2KCl + Br_2$	
7	Describe the elements in Group 0 (the noble gases) as a collection of monatomic elements that are chemically unreactive and hence important in providing an inert atmosphere (e.g. argon and neon in light bulbs; helium in balloons; argon in the manufacture of steel)	
8	Describe the lack of reactivity of the noble gases in terms of their electronic structures	



12. Properties of Metals

Do you know how to:

1	describe the general physical properties of metals as solids having high melting and boiling points, being malleable and good conductors of heat and electricity, in terms of their structure	
2	Describe alloys as a mixture of a metal with another element (e.g. brass; stainless steel)	
3	identify representations of metals and alloys from diagrams of structures	

13. Reactivity Series

Do you know how to:

	Place in order of reactivity: potassium, sodium, calcium, magnesium, Aluminium, zinc, iron, lead, (hydrogen), copper, silver and gold, by reference to the reactions, if any, of the metals with water, steam and dilute hydrochloric acid	
	deduce the order of reactivity from a given set of experimental results	

14. Extraction of Metals

Do you know how to:

1	describe the ease of obtaining metals from their ores by relating the elements to their positions in the reactivity series		
	Ore of	***Method of extraction***	
	Potassium Sodium Calcium Magnesium Aluminium	Electrolysis of oxides or compounds	
	Zinc Iron Tin Lead	Oxides reduced by carbon or carbon monoxides	
	Copper Silver Gold	Metals occur in nature. Ores can be easily reduced to metals by heat.	

2	describe metal ores as a finite resource and hence the need to recycle metals	
3	discuss the social, economic and environmental advantages and disadvantages of recycling metals	

15. Iron

Do you know how to:

1	describe and explain the essential reactions in the extraction of iron using haematite, limestone and coke in the blast furnace	
	$C(s) + O_2(g) \longrightarrow CO_2(g)$	
	$C(s) + CO_2(g) \longrightarrow CO(g)$ — Reductions	
	$Fe_2O_3(s) + 3CO(g) \longrightarrow 2Fe(l) + 3CO_2(g)$ Iron ore → molten iron	
	$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$ — Purifications	
	$CaO(s) + SiO_2 \longrightarrow CaSiO_3(l)$ Sand → slag	
2	describe steels as alloys which are a mixture of iron with carbon (non-metal) or other metals and how controlled use of these additives changes the properties of the iron (e.g. high carbon steels are strong but brittle, whereas low carbon steels are softer and more easily shaped) *(alloys can be a mixture between metal and metal or metal and non-metal)*	
3	state the uses of mild steel (e.g. car bodies; machinery), and stainless steel (e.g. chemical plant; cutlery; surgical instruments)	
4	describe the essential conditions for the corrosion (rusting) of iron as the presence of oxygen and water; prevention of rusting can be achieved by placing a barrier around the metal (e.g. painting; greasing; plastic coating; galvanising)	
5	describe the sacrificial protection of iron by a more reactive metal in terms of the reactivity series where the more reactive metal corrodes preferentially (e.g. underwater pipes have a piece of magnesium attached to them)	

16. Aluminium

Do you know how to:

1	state the uses of aluminium and relate the uses to the properties of this metal and its alloys (e.g. the manufacture of aircraft; food containers; electric cables)	
2	Describe the unreactivity of layer of aluminium oxide and how it affect the uses of aluminium	

17. Atmosphere and Environment

Do you know:

1	describe the volume composition of gases present in dry air as 79% nitrogen, 20% oxygen and the remainder being noble gases (with argon as the main constituent) and carbon dioxide		
2	state the uses of oxygen (e.g. in making steel; oxygen tents in hospitals; together with acetylene, in welding)		
3	Name some common atmospheric pollutants (e.g. carbon monoxide; methane; nitrogen oxides (NO and NO_2); ozone; sulphur dioxide; unburned hydrocarbons)		
4.	**State** the *sources* and *effects* of each of these pollutants:		
	Carbon monoxide from the incomplete combustion of carbon-containing substances;	CO is poisonous gas which prevents the blood from absorbing oxygen. It causes dizziness, headaches or even death.	
	lead compounds from car exhausts	Stored up in liver. Can cause damage to the brain and nervous system especially in children.	
	nitrogen oxides from lightning activity and internal combustion engines due to the chemical combination of N_2 and O_2 at high temp (react with oxygen and water in air leading to 'acid rain');	Oxides of nitrogen attacks the lungs. Causes acid rain and corrode buildings	
	Sulphur dioxide from volcanoes and the combustion of fossil fuels, which contain sulphur compounds (react with oxygen and water in air leading to 'acid rain');	SO_2 irritates the eye and attacks the lungs causing breathing difficulty. Causes acid rain and corrode buildings	
6	outline the purification of the water supply in terms of: (i) filtration to remove solids (ii) chlorination to disinfect the water		
7	state that seawater can be converted into drinkable water by desalination		

18. Fuels

Do you know how to:

1	name natural gas, mainly methane, and petroleum as sources of energy	
2	describe petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation	
3	name the following fractions and state their uses : (i) petrol (gasoline) as a fuel in cars (ii) paraffin (kerosene) as a fuel for heating and cooking and for aircraft engines (iii) diesel as a fuel for diesel engines (iv) lubricating oils as lubricants and as a source of polishes and waxes (v) bitumen for making road surfaces	

19. Organic Chemistry

Do you know:

1	state that naphtha fraction from crude oil is the main source of hydrocarbons used as the feedstock for the production of a wide range of organic compounds	
2	Describe the issues relating to the competing uses of oil as an energy source and as a chemical feedstock	

Summary of Organic Chemistry

Do you know:

1.	**Name**, and **draw** the structure of methane, ethane, ethene, ethanol and poly(ethene)	
2.	Given a chemical name ending in –ane, ene, or –ol, or given a molecular structure name the type of compound.	

No of carbon	Name begins with	Alk**ane**	Formula C_nH_{2n+2}	Alk**ene**	Formula C_nH_{2n}	alcoh**ol**	Formula $C_nH_{2n+1}OH$
1	Meth-	Methane	CH_4			Methanol	CH_3OH
2	Eth-	Ethane	C_2H_6	Ethene	C_2H_4	Ethanol	C_2H_5OH
3	Prop-	Propane	C_3H_8	Propene	C_3H_6	Propanol	C_3H_7OH
4	But-	Butane	C_4H_{10}	Butene	C_4H_8	Butanol	C_4H_9OH
Functional group		No functional group		- C=C – the carbon double bond		- OH the hydroxyl group	

Homologous series

Do You Know:

1.	1) Members of the same homologous series have (for alkane, alkene, alcohol and carboxylic acid) i) the same general formula, ii) the same functional group, iii) names ending with the same letters, iv) similar chemical properties	
2.	Each member differs from the next by a $-CH_2$ group	
3.	Physical properties (e.g melting point and boiling points; viscosity; flammability) change gradually down the series as a result of increase in the size and mass of the molecules	

20. Alkanes

Do you know:

1	Alkanes (use methane as an example) are generally unreactive **<u>Reactions</u>**: i) Alkanes burn in air (or undergo combustion) to produce carbon dioxide and water ii) Alkanes undergoes substitution by chlorine in the presence of UV light	

21. Alkenes

Do you know:

1	describe the manufacture of alkenes and hydrogen by cracking hydrocarbons and recognize that cracking is essential to match the demand for fractions containing smaller molecules from the refinery process	
2	describe the difference between saturated and unsaturated hydrocarbons from their molecular structures and by using aqueous bromine	
3	**<u>Reactions:</u>** i) Alkenes burn in air (or undergo combustion) to produce carbon dioxide and water, ii) Alkenes undergo addition reactions with hydrogen (with nickel as catalyst) iii) Alkenes undergo addition reactions with steam (with phosphoric acid as catalyst) iv) Alkenes undergoes addition reactions with bromine. v) polymerization	
4	state the meaning of *polyunsaturated* when applied to food products	
5	describe the manufacture of margarine by the addition of hydrogen to unsaturated vegetables oils to form a solid product	

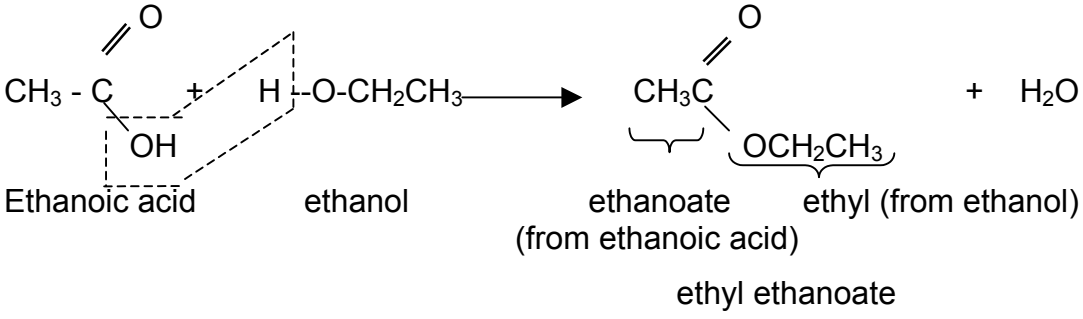
22. Alcohols

Do you know:

1	Ethanol can be obtained i) by fermentation of glucose and ii) by the catalytic addition of steam to ethene (see above)	
2	**Reactions**: i) Ethanol burns in air (or undergoes combustion) to produce carbon dioxide and water ii) Ethanol is oxidized in air (or undergoes oxidation) to produce ethanoic acid (also known as vinegar)	
3	state some uses of ethanol (e.g. solvent; fuel; constituent of alcoholic beverages)	

23. Carboxylic acids (has no homologous series)

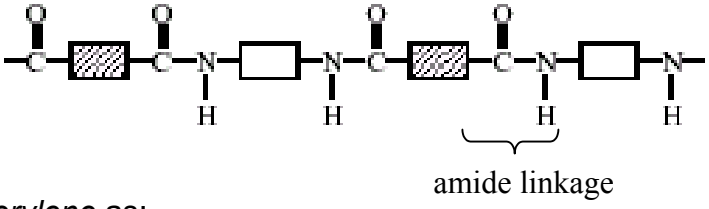
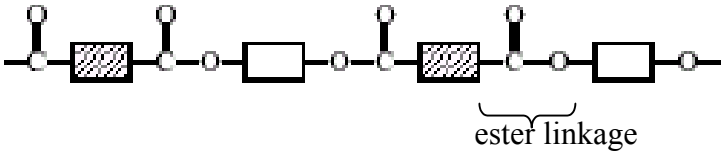
Do you know:

1	describe the formation of ethanoic acid by the oxidation of ethanol by atmospheric oxygen or acidified potassium dichromate(VI)	
2	**Reaction**: i) Describe the reaction of ethanoic acid with ethanol to form the ester, ethyl ethanoate  Ethanoic acid ethanol ethanoate (from ethanoic acid) ethyl (from ethanol) ethyl ethanoate	

24. Macromolecules

Do you know:

1	describe macromolecules as large molecules built up from small units, different macromolecules having different units and/or different linkages	
2	describe the formation of poly(ethene) as an example of addition polymerisation of ethene as the monomer	
3	state some uses of poly(ethene) as a typical plastic (e.g. plastic bags; clingfilm)	
4	deduce the structure of the addition polymer product from a given monomer and vice versa	

5	describe nylon, a polyamide, and *Terylene,* a polyester, as condensation polymers, the partial structure of nylon being represented as:  and the partial structure of *Terylene* as:  (details of manufacture and mechanisms of these polymerisations are not required)	
6	state some typical uses of man-made fibres such as nylon and *Terylene* (e.g. clothing; curtain materials; fishing line; parachutes; sleeping bags)	
7	describe the pollution problems caused by the disposal of non-biodegradable plastics	
8	identify carbohydrates, proteins and fats as natural macromolecules	
9	describe proteins as possessing the same amide linkages as nylon, but with different monomer units	
10	describe fats as esters possessing the same linkages as *Terylene,* but with different monomer units	