Revision Checklist for O-Level Chemistry 5070

Guide for Students

UNIVERSITY of CAMBRIDGE
International Examinations

REVISION CHECKLIST for O Level Chemistry 5070

A guide for students

How to use this guide

The guide describes what you need to know about your O-level Chemistry examination.

It will help you plan your revision programme for the both the theory and practical examinations and will explain what examiners are looking for in the answers you write. It can also be used to help you revise by using tick boxes in section 3 ('What you need to know'). This will help you to check the topic areas you have covered and what you need to know in each of theses areas.

The guide contains the following sections:

Section 1 - How will you be tested?
This section will give you information about the theory Papers and the different types of practical examination Papers that are available.

Section 2 - What will be tested?
This section describes the areas of knowledge, understanding and skills that you will be tested on.

Section 3 - What you need to know
This shows the syllabus content in a simple way so that you can check:

- the topics you need to know about
- details about each topic in the syllabus
- how much of the syllabus you have covered

Section 4 - Appendices
This section covers the other things you need to know such as:

- how to make the most out of the copy of the Periodic Table that you are given in the exam
- how to use the table of tests for particular chemical groups
- the importance of the key words (command words) the examiners use in Examination Papers
- information about the mathematical skills you will need

Not all the information may be relevant to you. You will need to select what you need to know in section (1) by finding out from your teacher which practical paper you are taking.

Section 1 - How will you be tested?

1.1 The examination Papers you will take
You will be entered for three examination Papers: **two** of these will be theory Papers and **one** will be a practical Paper. You will need to ask you teacher which practical Paper you will be taking. There is no choice in the theory Papers that you will take.

1.2 About the theory Papers
The table gives you information about the theory papers

Paper number	**How long and how many marks?**	**What's in the paper?**	**What's the % of the total marks?**
Paper 1 Theory Multiple Choice	1 hour (40 marks)	40 multiple choice questions. You choose one answer you think is correct from 4 possible suggestions.	about 27%
Paper 2 Theory Structured questions	1 ½hours (75 marks)	Section A (45 marks) consists of a small number of structured questions. Section B (30 marks) consists of 4 questions each of 10 marks. You choose 3 of these questions. In both Section A and section B *you should write your answers in the spaces provided*.	about 52%
Practical paper	see next table (30 marks)	see next table	about 21%

Total 100%

1.3 About the practical Papers
You will do **one** of the practical Papers shown in the table. Your teacher will tell you which practical Paper you will do. The number of marks differs between the Papers but your final mark will be calculated so that it is worth the same percentage of the examination as the other practical Paper.

Paper number and type	**How long and what its marked out of?**	**What's involved?**
Paper 3 (Practical Test)	1 ½ hours (40 marks)	You do a practical exam which is supervised by your teacher. There are usually 2 questions testing the techniques stated in the detail (i) below.
Paper 4 (alternative to practical)	1 hour (60 marks)	You answer a written paper about practical work. There are usually about 6 questions which test the ten skill areas stated in the detail (ii) below.

Here are some more details about each of the practical Papers. If you are unsure of anything, ask your teacher.

(i) Paper 3 (Practical Test)
You do a practical exam which is supervised by a teacher. You are given an instruction sheet which enables you to carry out experiments, handle data and draw appropriate conclusions. You are not allowed to refer to note books, text books or any other information. You will be given a table of 'Qualitative analysis notes'. These are usually the ones appearing in the current syllabus.

The questions in the practical paper may include:

- a simple titration (you must know that methyl orange in pink in excess acid and yellow/ orange in excess alkali)
- an experiment that involves measurement e.g. a temperature change or measuring time and volume or mass in an experiment on reaction speed
- a problem involving the identification of an unknown substance using qualitative analysis notes and /or simple chromatography, filtration and tests for oxidising and reducing agents

You may be asked to use the following techniques:

- measuring volumes of liquids and gases, including the use of burettes and pipettes (You should be able to measure volumes in measuring cylinders to the nearest scale unit.)
- a knowledge of acid alkali titrations using methyl orange indicator or other titrations given suitable information (You should be able to take burette reading to the nearest 0.1 cm^3).
- you should be able to carry out a simple experiment involving speed of reaction rate of reaction)
- measuring temperature (You should be able to measure the temperature to the nearest 0.5^oC)
- paper chromatography
- filtering
- identifying ions and gases using a table of tests to help you (see Appendices)
- tests for oxidising agents and reducing agents

(ii) Paper 4 (Alternative to Practical Paper)
This is a written Paper, testing 10 skill areas: You may be asked to:

- record reading from diagrams of apparatus, e.g. burette readings
- answer questions on the arrangement of apparatus, e.g. for collecting gases
- complete tables of data
- draw conclusions from information
- answer questions about experimental data
- answer questions about tests for ions, gases, oxidising and reducing agents - **you will be expected to learn and remember these tests**
- plot and interpret information from graphs
- identify sources of error and suggest improvements in the experiment
- suggest suitable apparatus for investigations
- perform simple calculations

Section 2: What will be tested?

The Examiners take into account the following in your examination Papers:

- your knowledge (what you remember) and understanding (how you use what you know and apply it to unfamiliar situations)
- how you handle information and solve problems
- your use of experimental skills

These areas of knowledge and skills are called Assessment Objectives. The theory Papers test mainly Assessment Objective A (knowledge with understanding) and Assessment Objective B (handling information and problem solving). The purpose of the Practical Paper is to test Assessment Objective C (experimental skills). Your teacher will be able to give you more information about how each of these is used in examination Papers. The table shows you the range of skills you should try to develop.

Skill	**What the skill means**	**What you need to be able to do**
A: knowledge with understanding	remembering facts and applying these facts to new situations	• use scientific ideas, facts and laws • know scientific definitions e.g. what is reduction? • know about chemical apparatus and how it works • know about chemical symbols, quantities (e.g. mass) and units (e.g. dm^3) • understand the importance of science in • everyday life
B: handling information and problem solving	how you extract information and rearrange it in a sensible pattern and how you carry out calculations and make predictions	• select and organize information from graphs tables and written text • change information from one form to another, e.g. draw graphs, construct symbol equations from word equations • arrange data and carry out calculations • identify patterns from information given and draw conclusions • explain scientific relationships, e.g. use the moving (kinetic) particle theory, to explain ideas about rate of reaction make predictions and develop scientific ideas • solve problems
C: experimental skills (the parts in brackets only refer to Paper 3)	planning (and carrying out) experiments and recording and analysing information	• follow instructions (to set up and use apparatus and techniques) • make observations and measurements and record them • analyse experimental results and suggest how valid they are • plan an experiment (and carry it out, describing to what extent the experiment worked) and suggest improvements

Section 3: What you need to know

This is a table, which describes the things you may be tested on in the examination. It is arranged in 11 main themes e.g. metals, periodic table etc. Some of these themes are divided into topics e.g. properties of metals, reactivity series, extraction of metals etc. The third column gives the list of things which you should be able to do.

How to use the table
You can use the table throughout your Chemistry course to check the topic areas you have covered. You can also use it as a revision aid. When you think you have a good knowledge of a topic, you can tick the appropriate box in the checklist column. The main headings in the topic areas are usually followed by the details of what you should know.

Test yourself as follows:

- cover up the details with a piece of paper
- try to remember the details
- when you have remembered the details correctly, put a tick in the appropriate box

If you use a soft pencil to tick the boxes you can retest yourself whenever you want by simply rubbing out the ticks. If you are using the table to check the topics you have covered, you can put a tick in the topic column next to the appropriate bullet point.

The column headed comments can be used:

- to add further information about the details for each bullet point
- to note relevant page numbers from your text book
- to add learning aids e.g. OIL RIG (for oxidation is loss (of electrons) and reduction is gain (of electrons)
- to highlight areas of difficulty or things which you need to ask your teacher about

Theme	Topic	You should be able to:	Comments	Checklist
1 Experimental Chemistry	1.1 Experimental design	• name apparatus for measuring time, temperature, mass and volume. (For volume you need to know burette, pipette, measuring cylinder, gas syringe)		☐
		• describe apparatus for simple experiments including collection of gases and measuring rate of reaction.		☐
	1.2 Methods of purification and analysis	• describe methods of purification using a suitable solvent		☐
		• describe methods of purification using filtration and crystallisation		☐
		• describe methods of purification using distillation and fractional distillation (to separate substances in crude oil, liquid air and fermented liquor)		☐
		• suggest methods of purification when given suitable information		☐
		• describe paper chromatography		☐
		• interpret chromatograms (including use of Rf values)		☐

		• explain the use of locating agents in chromatography		☐
		• comment on the purity of substances when given data on their melting and boiling points		☐
		• explain the importance of purity of substances in everyday life e.g. drugs, foods		☐
	1.3 Identification of ions and gases	• describe the use of sodium hydroxide and aqueous ammonia to identify aluminium ions		☐
		• describe the use of sodium hydroxide and aqueous ammonia to identify aluminium ions		☐
		• describe the use of sodium hydroxide to identify ammonium ions		☐
		• describe the use of sodium hydroxide and aqueous ammonia to identify calcium ions		☐
		• describe the use of sodium hydroxide and aqueous ammonia to identify copper (II) ions		☐
		• describe the use of sodium hydroxide and aqueous ammonia to identify iron(II) and iron(III) ions		☐
		• describe the use of sodium hydroxide and aqueous ammonia to identify zinc ions		☐
		• describe a test to identify carbonate ions		☐
		• describe a test to identify chloride ions		☐
		• describe a test to identify iodide ions		☐
		• describe a test to identify nitrate ions		☐
		• describe a test to identify sulfate ions		☐
		• describe a test for ammonia		☐
		• describe a test for carbon dioxide		☐
		• describe a test for chlorine		☐
		• describe a test for hydrogen		☐
		• describe a test for oxygen		☐
		• describe a test for sulfur dioxide		☐
		• describe a chemical test for water		☐

Theme	Topic	You should be able to:	Comments	Checklist
2 The particulate nature of matter	2.1 Kinetic particle theory	• describe solids liquids and gases		☐
		• use the kinetic particle theory to explain the changes which occur when of solids change to liquids and liquids change to gases and vice versa		☐
		• explain the energy changes which occur in the above interchanges.		☐
		• describe and explain evidence for the movement of particles in solids, liquids and gases		☐
		• explain everyday effects of diffusion in terms of particle movement		☐
		• explain how molecular mass affects rate of diffusion (no calculations required)		☐
		• explain how temperature affects rate of diffusion		☐
	2.2 Atomic structure	• state the charges and approximate relative masses of a proton, neutron and electron		☐
		• use diagrams to describe the structure of the atom - protons and neutrons (nucleons) in the centre and electrons arranged in shells (energy levels)		☐
		• define proton and nucleon number		☐
		• describe the electron arrangement of the first 20 atoms in the Periodic Table		☐
		• Interpret and use symbols such as $^{12}_{6}C$		☐
		• define the term *isotope*		☐
		• find the number of protons, electrons and neutrons in atoms and ions given relevant information		☐
		• state that some isotopes are radioactive		☐
	2.3 Structure and properties of materials	• describe the differences between elements, compounds and mixtures		☐
		• compare the structure and properties of molecular substances with the structure of giant molecular substances		☐
		• compare the structure and bonding of diamond and graphite and relate these to electrical conductivity and lubricating or cutting action.		☐

		• work out the physical and chemical properties of substances from their structures and bonding and vice versa		☐
	2.4 Ionic bonding	• describe the formation of ions by gain or loss of electrons to form the inert gas structure		☐
		• describe the formation of ionic bonds between metals and non-metals		☐
		• state that ionic compounds are held in a giant lattice by electrostatic attraction		☐
		• work out the formulae of ionic compounds from diagrams of their lattice structures		☐
		• relate the physical properties of ionic compounds to their lattice structure		☐
	2.5 Covalent bonding	• describe covalent bonding as sharing electron pairs to gain the inert gas electron configuration		☐
		• use dot and cross diagrams to describe the bonding of H_2, Cl_2, O_2, N_2		☐
		• use dot and cross diagrams to describe the bonding of HCl, H_2O, CH_4, C_2H_4, CO_2		☐
		• work out the arrangement of electrons in other covalent molecules		☐
		• relate the physical properties of covalent compounds to their structure and bonding		☐
	2.6 Metallic bonding	• describe metallic bonding as a lattice of positive ions in a sea of electrons		☐
		• relate the malleability of metals to their structure		☐
		• relate the electrical conductivity of metals to the mobility of the electrons in the structure		☐

Theme	Topic	You should be able to:	Comments	Checklist
3 Formulae, Stoichiometry and the mole concept		• state the symbols of the elements named in the syllabus		☐
		• state the formulae of the compounds named in the syllabus		☐
		• work out the formula a simple compound from the ratio of atoms present and vice versa		☐
		• work out the formula of an ionic compound from the charges on the ions present and vice versa		☐
		• interpret and construct chemical equations		☐
		• interpret and construct ionic equations		☐
		• understand and use state symbols in equations		☐
		• define relative atomic mass, A_r		☐
		• define relative molecular mass, M_r		☐
		• calculate relative molecular mass and relative formula mass		☐
		• calculate the % mass of an element in a compound		☐
		• calculate the empirical formula of a compound		☐
		• calculate the molecular formula of a compound from the empirical formula and relative molecular mass		☐
		• calculate the reacting masses of chemicals using information from equations and formula masses		☐
		• understand the concept of the mole		☐
		• calculate the volume of gas produced from a given number of moles and vice versa		☐
		• calculate solution concentration using number of moles (or grams) and volume of solution		☐
		• calculate number of moles (or grams) from solution concentration and volume		☐
		• calculate % yield		☐
		• calculate % purity		☐

Theme	Topic	You should be able to:	Comments	Checklist
4 Electrolysis		• describe electrolysis as the decomposition of an electrolyte		☐
		• understand the meaning of the term electrolyte		☐
		• understand that ionic compounds conduct electricity only when molten or dissolved in water		☐
		• explain that electrolysis provides evidence for the existence of ions which are in a lattice when solid but move when molten or in solution		☐
		• describe and explain the products of electrolysis of molten lead bromide using inert electrodes		☐
		• predict the products of electrolysis of a molten compound containing two simple ions		☐
		• use ideas of selective discharge of ions to predict the products of electrolysis of concentrated aqueous sodium chloride		☐
		• use ideas of selective discharge of ions to predict the products of electrolysis of dilute sulphuric acid		☐
		• use ideas of selective discharge of ions to predict the products of electrolysis of aqueous copper(II) sulphate		☐
		• predict the products of electrolysis of an aqueous electrolyte		☐
		• construct ionic equations for the reactions at the anode and cathode during electrolysis (for substances mentioned in the syllabus)		☐
		• describe the electrolysis of purified aluminium oxide dissolved in molten cryolite		☐
		• understand the electrode reactions in the electrolysis of aluminium oxide in cryolite		☐
		• know that bauxite is an ore of aluminium		☐
		• understand why in the electrolysis of aluminium oxide, the anodes have to be periodically replaced		☐
		• describe the electrolysis of aqueous copper(II) sulphate with copper electrodes for purifying copper		☐
		• describe the electroplating of metals		☐

		• recall the uses of electroplating		☐
		• describe the production of electrical energy from simple cells (2 electrodes and an electrolyte)		☐

Theme	Topic	You should be able to:	Comments	Checklist
5 Energy from chemicals		• describe the meaning of enthalpy change in terms of exothermic (Δ *H* negative) and endothermic (Δ *H* positive) reactions		☐
		• show energy changes by energy profile diagrams (including those showing reaction pathways and activation energies)		☐
		• describe bond breaking as endothermic and bond making as exothermic		☐
		• explain overall enthalpy changes in terms of energy changes in bond making and bond breaking		☐
		• describe the combustion of fuels as exothermic		☐
		• describe the use of hydrogen (from water or hydrocarbons) in fuel cells to generate electricity		☐
		• discuss the advantages and disadvantages of hydrogen as a fuel		☐
		• describe natural gas (methane) and petroleum as sources of energy		☐
		• describe petroleum as a mixture of hydrocarbons		☐
		• describe the separation of petroleum into useful fractions by fractional distillation		☐
		• name the uses of petrol (gasoline), naphtha, paraffin (kerosene), diesel, lubricating oil and bitumen		☐
		• describe photosynthesis as the reaction between carbon dioxide and water in the presence of sunlight (energy) and chlorophyll to produce glucose and oxygen		☐
		• explain how photosynthesis can provide a renewable energy resource		☐

Theme	Topic	You should be able to:	Comments	Checklist
6 Chemical reactions	6.1 Speed of reaction	• describe the effect of concentration on the speed of reaction and explain this in terms of collisions between particles		☐
		• describe the effect of pressure on the speed of reaction and explain this in terms of collisions between particles		☐
		• describe the effect of particle size on the speed of reaction and explain this in terms of collisions between particles		☐
		• describe the effect of temperature on the speed of reaction and explain this in terms of collisions between particles		☐
		• define the term *catalyst* and describe the effect of catalysts on the speeds of reactions		☐
		• state that enzymes are biological catalysts		☐
		• explain how pathways with lower activation energy result in faster reactions		☐
		• state that transition metals and their compounds act as catalysts in a range of industrial processes (synthesis of ammonia, sulfuric acid and margarine)		☐
		• suggest suitable ways of investigating the effect of concentration, pressure, particle size and temperature on the speed of a reaction		☐
		• interpret data (from graphs and tables) about the speed of reaction		☐
	6.2 Redox	• define oxidation and reduction (redox) in terms of loss or gain of hydrogen or oxygen		☐
		• define oxidation and reduction (redox) in terms of electron transfer		☐
		• define redox in terms of change in oxidation state		☐
		• describe the colour change when aqueous potassium iodide is used to test for oxidising agents		☐
		• describe the colour changes when aqueous acidified potassium manganate(VII) is used to test for reducing agents		☐
		• describe the colour changes when aqueous acidified potassium dichromate (VI) is used to test for reducing agents		☐

	6.3 Reversible reactions	• understand that some reactions can be reversed by changing the conditions		☐
		• understand the characteristics of equilibrium reactions		☐
		• predict the effect of changing the conditions on an equilibrium reaction		☐
		• predict the effect of changing concentrations of reactants or products on an equilibrium reaction		☐
		• predict the effect of changing the pressure on an equilibrium reaction		☐
		• predict the effect of changing the temperature on an equilibrium reaction		☐

Theme	Topic	You should be able to:	Comments	Checklist
The chemistry of acids bases and salts	7.1 The properties of acids and bases	• describe the meaning of the terms acid and alkali in terms of the ions they contain or produce in aqueous solution		☐
		• describe the meaning of the terms acid and alkali in terms of their effects on universal indicator paper		☐
		• describe how to test for relative acidity/ hydrogen ion concentration using the pH scale		☐
		• describe how acids react with metals		☐
		• describe how acids react with bases		☐
		• describe how acids react with carbonates		☐
		• describe the difference between strong and weak acids in terms of extent of ionisation (no calculations)		☐
		• describe neutralisation as a reaction between hydrogen ions and hydroxide ions to produce water.		☐
		• describe the importance of controlling soil pH		☐
		• describe how excess soil acidity can be treated using calcium hydroxide		☐
		• describe the properties of bases in reactions with acids		☐
		• describe the properties of bases in reactions with ammonium salts		☐
		• classify oxides as acidic, basic or amphoteric based on metallic/ non-metallic character		☐
	7.2 Preparation of salts	• describe methods for the preparation and purification of salts by precipitation		☐
		• describe methods for the preparation and purification of salts by titration		☐
		• describe methods for the preparation and purification of salts reaction of acids with metals, insoluble bases and insoluble carbonates		☐
		• describe nitrates and chlorides except silver and lead nitrates as being soluble in water		☐
		• describe sulfates except barium, calcium and lead sulfates as being soluble in water		☐
		• describe carbonates and hydroxides as being insoluble in water		☐

		• to describe group I cations and ammonium salts as being soluble in water		☐
		• suggest a method of preparing a given salt given suitable starting materials		☐
	7.3 Properties and uses of ammonia	• describe the use of nitrogen (from air) and hydrogen (from cracking oil fractions) in the manufacture of ammonia		☐
		• state that some chemical reactions e.g. ammonia synthesis are reversible		☐
		• describe the essential equations involved in the Haber Process		☐
		• describe the essential conditions of the Haber Process (temperature 450^{o}C, pressure 200 atm, iron catalyst)		☐
		• describe the use of nitrogen-containing fertilisers in promoting plant growth and crop yield		☐
		• calculate the % mass of nitrogen in some salts used for fertilisers		☐
		• describe problems associated with the use of nitrogenous fertilisers in terms of high solubility		☐
		• describe the process of eutrophication		☐
		• describe the displacement of ammonia from its salts by heating with alkali		☐
		• explain why adding calcium hydroxide to soil can cause the loss of nitrogen from added nitrogenous fertiliser.		☐
	7.4 Sulphuric acid	• describe the manufacture of sulfuric acid from sulphur, air and water by the Contact Process including relevant equations		☐
		• describe the essential conditions used in the Contact Process (atmospheric pressure, temperature of 450^{o}C and vanadium(V) oxide catalyst		☐
		• state the uses of sulfur dioxide (bleach, manufacture of wood pulp, food preservative)		☐
		• state the uses of sulfuric acid (battery acid and manufacture of detergents and fertilisers)		☐

Theme	Topic	You should be able to:	Comments	Checklist
8 The Periodic Table	8.1 Periodic trends	• describe the Periodic Table as an arrangement of elements in proton number order		☐
		• describe how the position of an element in the Periodic Table is related to proton number and electronic structure		☐
		• describe how the ionic charge is related to the group number		☐
		• explain the similarities between the elements in the same group in terms of electronic structure		☐
		• describe the change in metallic to non-metallic character across a Period in the Periodic Table		☐
		• describe the relationship between Group number , number of valency electrons and metallic or non- metallic character		☐
		• predict the properties of elements in Group I, VII and the transition metals using relevant information		☐
	8.2 Group properties	• describe Group I (the alkali metals Li, Na, K) as a collection of relatively soft, low density metals showing trends in melting points		☐
		• describe the reaction of Group I metals with water and the trends in theses reactions		☐
		• describe Group VII (the halogens Cl, Br, I) as a collection of diatomic molecules showing trends in colour, state		☐
		• describe Group the displacement reactions of halogens with halide ions and the trend in these reactions		☐
		• describe Group 0 (the noble gases) as a collection of monatomic elements that are chemically unreactive		☐
		• state the uses of helium neon and argon		☐
		• describe the lack of reactivity of the noble gases in terms of their electronic structure		☐
	8.3 Transition elements	• describe transition elements as metals with high melting points, high density, variable oxidation state and forming coloured compounds.		☐

		• state the uses of transition metals (or their compounds) as catalysts (i) iron in Haber Process, (ii) vanadium(V) oxide in Contact Process, (iii) nickel in hydrogenation of alkenes.		☐
		• describe how catalysts are used to lower the energy demands in industry and help conserve energy sources		☐

Theme	**Topic**	**You should be able to:**	**Comments**	**Checklist**
9 Metals	9.1 Properties of metals	• describe the physical properties of metals (solids with fairly high melting points, malleable, good conductors of heat and electricity) by reference to their structure.		☐
		• describe an alloy as a mixture of a metal with another element.		☐
		• identify metals and alloys from diagrams of their structures		☐
		• explain why alloys have different properties from the pure elements they are made from.		☐
	9.2 Reactivity series	• place in reactivity order the elements Ca, Cu, (H), Fe, Pb, Mg, K, Ag, Na, Zn by reference to their reactions with water and steam		☐
		• place in reactivity order the elements Ca, Cu, (H), Fe, Pb, Mg, K, Ag, Na, Zn by reference to their reactions with dilute hydrochloric acid		☐
		• place in reactivity order the elements Ca, Cu, (H), Fe, Pb, Mg, K, Ag, Na, Zn by reference to their reactions with reduction of their oxides by carbon or hydrogen		☐
		• describe the reactivity series in terms of the ease with which a metal forms its positive ion by reference to the reaction of the metal (if any) with aqueous ions of the metals listed above		☐
		• describe the reactivity series in terms of the ease with which a metal forms its positive ion by reference to the reaction of the metal (if any) with the oxides of the metals listed above		☐
		• work out the order of reactivity from a set of experimental results		☐
		• relate the thermal stability of the carbonates of the above metals to		☐

		their position in the reactivity series		
	9.3 Extraction of metals	• relate the ease of obtaining a metals from its ore to its position in the reactivity series		☐
		• state that metals ores are finite resources and hence we need to recycle metals		☐
		• discuss the social, economic and environmental advantages and disadvantages of recycling metals		☐
	9.4 Iron	• know that the main ore of iron is haematite and the other raw material used in the blast furnace		☐
		• describe the reduction reactions (with equations) taking place in a blast furnace using coke		☐
		• describe the thermal decomposition of the limestone added to the blast furnace and its reaction with silicon dioxide (including equations)		☐
		• describe the raw materials enter the blast furnace and the products collect		☐
		• describe steels as alloys which are mixtures of iron with carbon or other metals		☐
		• describe how the controlled addition of additives such as carbon changes the properties of iron (with reference to low carbon and high carbon steels)		☐
		• state the uses of mild steel and stainless steel		☐
		• describe the conditions needed for iron to rust		☐
		• state the methods used to prevent iron from rusting by coating it (painting, greasing, coating with plastic, galvanising)		☐
		• describe and explain the sacrificial protection of iron by a metal higher in the reactivity series		☐
	9.5 Aluminium	• outline the manufacture of aluminium from aluminium oxide dissolved in cryolite, including the reactions at the electrodes.		☐
		• explain the apparent lack of reactivity of aluminium		☐

		• state the uses of aluminium and relate the uses to the properties of the metal and its alloys e.g. in the manufacture of aircraft		☐

Theme	Topic	You should be able to:	Comments	Checklist
10 Atmosphere and environment	10.1 Air	• state the % composition of nitrogen and oxygen in dry air		☐
		• describe the remainder of the air as being mainly argon with a small amount of other noble gases and carbon dioxide		☐
		• describe the separation of oxygen, nitrogen and the noble gases from liquid air by fractional distillation		☐
		• state the uses of oxygen (steelmaking, oxygen tents in hospitals, oxyacetylene welding)		☐
		• name the atmospheric pollutants carbon monoxide, methane, nitrogen oxides (NO and NO_2), ozone, sulphur dioxide, hydrocarbons		☐
		• state the source of carbon monoxide from incomplete combustion of carbon containing substances		☐
		• state the source of methane from bacterial decay of vegetable matter		☐
		• state the source of nitrogen oxides from lightning activity and car engines		☐
		• state the source of ozone from photochemical reactions		☐
		• state the source of sulphur dioxide from volcanoes and the combustion of fossil fuels		☐
		• state the source of (unburnt) hydrocarbons from car engines		☐
		• describe how redox reactions in catalytic converters remove combustion pollutants		☐
		• describe the use of calcium carbonate to reduce the effect of acid rain and in flue gas desulphurisation		☐
		• state that carbon monoxide is poisonous		☐
		• describe the role of nitrogen dioxide and sulphur dioxide in the formation of acid rain and the effect of acid rain on buildings and breathing		☐

		• explain the importance of the ozone layer		☐
		• explain the problems involved in depletion of ozone by reaction with chlorine from CFC's.		☐
		• describe the carbon cycle in terms of combustion, respiration and photosynthesis		☐
		• describe how the carbon cycle regulates the amount of carbon dioxide in the atmosphere		☐
		• state that carbon dioxide and methane are greenhouse gases which contribute to global warming and give the sources of theses gases		☐
		• describe the consequences of an increase in global warming		☐
	10.2 Water	• state that water from natural sources contains a variety of dissolved substances (mineral salts, oxygen, organic matter)		☐
		• state some pollutants of water (metal compounds, sewage, nitrates and phosphates from fertilisers, detergents, harmful microbes)		☐
		• state that some substances dissolved in water may be beneficial (oxygen and mineral salts for aquatic life)		☐
		• state that some substances dissolved in water may be harmful (to health, eutrophication)		☐
		• describe in outline how water is purified (filtration to remove solids, carbon to remove tastes and odours, chlorination for disinfection)		☐
		• state that seawater can be converted to drinkable water by desalination		☐

Theme	Topic	You should be able to:	Comments	Checklist
11 Organic chemistry	11.0	• state that the naphtha fraction from crude oil is the main source of hydrocarbons used as the feedstock for making a wide range of chemicals		☐
		• describe issues about the competing uses of oil as an energy source and as a chemical feedstock		☐
	11.1 Alkanes	• describe an homologous series in terms of a general formula of the molecules increase		☐
		• describe the gradation of properties (melting and boiling points, viscosity, flammability) in an homologous series as the size of the molecules increase		☐
		• describe the alkanes as an homologous series of saturated hydrocarbons of general formula C_nH_{2n+2}		☐
		• draw the structures of the branched and unbranched C1-C4 alkanes and name these.		☐
		• define isomerism and identify isomers		☐
		• state that alkanes are generally unreactive except for combustion and substitution by chlorine in the presence of light		☐
		• describe the combustion of alkanes (with equations)		☐
		• describe the reaction of alkanes with chlorine in the presence of light (with equations)		☐
	11.2 Alkenes	• describe the alkenes as an homologous series of unsaturated hydrocarbons of general formula C_nH_{2n}		☐
		• draw the structures of the branched and unbranched C2-C4 alkanes		☐
		• name the unbranched alkenes		☐
		• describe the manufacture of alkenes and hydrogen by cracking hydrocarbons		☐
		• understand that cracking is essential to match the demand for fractions containing smaller molecules to the supply from the refinery		☐
		• distinguish saturated from unsaturated hydrocarbons by reference to their structure and by using aqueous bromine		☐

		• describe the combustion of alkenes		☐
		• describe the polymerisation of alkenes		☐
		• describe the addition reactions of alkenes with bromine		☐
		• describe the addition reactions of alkenes with steam		☐
		• describe the addition reactions of alkenes with hydrogen		☐
		• state the meaning of the term *polyunsaturated* as applied to food products		☐
		• describe the manufacture of margarine by the addition of hydrogen to unsaturated vegetable oils to form a solid product		☐
	11.3 Alcohols	• describe the alcohols as an homologous series containing the –OH group		☐
		• draw the structures of the C1-C4 alcohols		☐
		• name the unbranched alcohols methanol to butanol		☐
		• describe the combustion of alcohols		☐
		• describe the oxidation of alcohols to carboxylic acids		☐
		• Describe the formation of ethanol by addition of steam to ethene in the presence of a catalyst		☐
		• Describe the formation of ethanol by fermentation of glucose		☐
		• state some uses of ethanol (solvent, fuel, beverage)		☐
	11.4 Carboxylic acids	• describe carboxylic acids as an homologous series containing the $-CO_2H$ group		☐
		• name the carboxylic acids containing 1-4 carbon atoms		☐
		• draw the structures of the C1-C4 alcohols		☐
		• describe the formation of ethanoic acid by the oxidation of ethanol by atmospheric oxygen or acidified potassium dichromate(VI)		☐
		• describe the formation of ethyl ethanoate by reacting ethanoic acid with ethanol		☐

		• state some uses of esters (perfumes, flavourings, solvents)		☐
	11.5 Macromolecules	• describe macromolecules as large molecules built from small units		☐
		• state that different macromolecules have different units or linkages		☐
		• describe the formation of poly(ethene) from ethene monomers as an example of addition polymerisation		☐
		• state some uses of poly(ethene) (plastic bags, clingfilm)		☐
		• work out the structure of a polymer product from a given monomer		☐
		• work out the structure of a monomer from a given polymer		☐
		• describe the polyamide, nylon and the polyester, Terylene as condensation polymers		☐
		• describe the simplified structure of nylon and Terylene as shown in the syllabus		☐
		• state some uses of man-made fibres such as nylon and Terylene		☐
		• describe the pollution problems caused by the disposal of non-biodegradable plastics		☐
		• identify carbohydrates, proteins and fats as natural macromolecules		☐
		• describe proteins as having the same amide links as nylon but with different (and varied) monomer units		☐
		• describe fats as esters possessing the same linkages as Terylene but with different units		☐
		• describe the hydrolysis of proteins to amino acids		☐
		• describe the hydrolysis of complex carbohydrates e.g. starch to simple sugars		☐

Appendices: Other things you need to know

There are **four** other things you need to know about your Chemistry course. These are shown below:

4.1 Using the Periodic Table

A copy of the Periodic Table is given on the back cover of the theory papers. You need to make sure that you know the layout of the table. You must remember that the mass number (number of protons + neutrons) is not the same as the relative atomic mass.

The main points to remember are:

- groups are the columns down the table
- periods are the rows across the table
- the first period only contains two elements, hydrogen and helium.
- the key shows the relative atomic masses and the proton (atomic) number of each element
- the volume of one mole of gas at r.t.p. is shown at the bottom of the Table.

A copy of the Periodic Table you will use is shown on the next page.

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	0
								1 H Hydrogen 1								4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

a
X
b

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

4.2 Notes for quantitative analysis

This is a table of chemical tests for particular chemical groups. You must learn and remember these tests for the theory papers (Papers 1, 2) and for Paper 4 (Alternative to Practical). However, if you are entered for Paper 3 (Practical Test), you will be given a copy of this table in the examination. When testing for specific ions in Paper 3, remember to use no more than 1cm depth of the solution to be tested and add a **small** (equal) amount of the test reagent at first and shake the test tube. Then make your observations. It is only after doing this that you add excess of the test reagent if required.

You should note the following points about this table:

- anions are negatively charged ions
- cations are positively charged ions
- ppt. means precipitate
- 'in excess' means that you add a lot more of the test reagent (the chemical used for the testing)
- 'in solution' means that the substance is dissolved in water
- 'aqueous' means dissolved in water
- the tests for cations are for the cations 'in aqueous solution'

QUALITATIVE ANALYSIS NOTES (5070/3)

Tests for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous lead(II) nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
aluminium (Al^{3+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	-
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt. or very slight white ppt.
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
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

Tests for gases

gas	*test and test result*
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	"pops" with a lighted splint
oxygen (O_2)	relights a glowing splint
sulfur dioxide (SO_2)	turns aqueous potassium dichromate(VI) from orange to green

4.3 Command words and phrases used in chemistry examination Papers

Examiners use command words to help you to understand what they are looking for in your answer. This table explains what each of these words or phrases means and will help you to understand the kind of answer you should write. The list of command words is in alphabetical order. You should remember that the meaning of a term may vary slightly according to how the question is worded.

command word	meaning
Calculate	A numerical answer is needed. You should show any working, especially when there are two or more steps in a calculation. *e.g. calculate the concentration of potassium hydroxide in the solution*
Deduce	This may be used in two ways: i. You find the answer by working out the patterns in the information given to you and drawing logical conclusions from it. You may need to use information from tables and graphs and do chemical calculations *e.g. deduce what will happen to the level of carbon dioxide if ….* ii. You find the answer by referring to a scientific law or theory *e.g. use your knowledge of the kinetic theory to deduce what will happen when ….*
Define	You need to state the meaning of something *e.g.* *i. reduction is gain of electrons;* ii. *a hydrocarbon is a compound containing only hydrogen and carbon.*
Describe	You need to state the main points about something (using labelled diagrams if this helps you). *e.g. describe how metals and non-metals differ in their properties* You may also be asked to describe either i. observations *e.g. describe what you see when sodium reacts with water* or ii. how to do particular experiments *e.g. describe how to separate a mixture of coloured inks*
Determine	You are expected to use a formula that you know to calculate a quantity. *e.g. Determine the relative molecular mass of potassium sulphate*
Discuss	You have to write down points for and against an argument *e.g. discuss points for and against the use of petrol as a fuel*
Estimate	This may be used in two ways : i. You need to work out an approximate value for a quantity, based on your knowledge of theory and the information provided. *e.g. Estimate the boiling point of iodine.* ii. for titrations, 'estimate' may also mean that you need to calculate an exact quantity. *e.g. Estimate (the concentration of) sodium hydroxide*
Explain	You have to give reasons for your answer OR refer to a particular theory *e.g. Explain why reaction rate increases with temperature*
Find	This is a general term which can mean several similar things, such

	as calculate, measure, determine etc.
List	Write down a number of separate points. Where the number of points is stated in the question, you should not write more than this number. *e.g. List three properties of metals*
Meant (What is meant by the term…)	See 'Understand'
Measure	You are expected to find a quantity by using a measuring instrument e.g. length (by using a ruler), volume (by using a measuring cylinder)
Outline	State the main points briefly *e.g. Outline the process of extracting aluminium from pure aluminium oxide*
Predict	This can be used in two ways: i. You find the answer by working out the patterns in the information provided and drawing logical conclusions from this. You may need to use information from tables and graphs and do chemical calculations. *e.g. Predict what will happen to the level of carbon dioxide if ….* ii. It may also mean giving a short answer stating what might happen next. *e.g. Predict what you would see when sodium iodide reacts with bromine water*
Sketch	i. When drawing graphs, this means that you may draw the approximate shape and/or position of the graph BUT you need to make sure that any important details, such as the line passing through the origin or finishing at a certain point, are drawn accurately. ii. When drawing apparatus or other diagrams, a simple line drawing is all that is needed, but you must make sure the proportions are correct and the most important details are shown. You should always remember to label your diagrams.
State	You should give a short answer without going into any detail, e.g. state the name of the compound with the formula CuSO4 : BUT, remember that *'state the meaning of…'* is different. It is more like '*understand*'.
Suggest	This may be used in two ways: i. There may be more than one correct answer to the question. e.g. suggest an ion that may be present in a mixture (after adding a small amount of sodium hydroxide) ii. You are being asked to apply your general knowledge of chemistry or reasoning skills to a topic area that is not on the syllabus *e.g. applying ideas about reduction to a question on the extraction of zinc.*
Understand (what do you understand by the term..)	You should (i) define something and (ii) make a more detailed comment about it. The amount of detail depends on the number of marks awarded. *e.g. What do you understand by the term diffusion.*

4.4 The mathematical skills you need
This is a checklist of the maths skills you need for your chemistry exam.

Ask your teacher to explain any skills that you are unsure about. Tick the box in the checklist when you have learned each skill. The comment column is for extra notes and examples.

You can use a calculator for all the Papers. If your calculator is one that can be programmed, you should make sure any information in it is removed before the exam.

You can	**Comments**	**Checklist tick**
• add, subtract, multiply and divide		☐
• use averages		☐
• use decimals and fractions		☐
• use percentages		☐
• use ratios		☐
• use reciprocals		☐
• recognise and use standard notation (notation is putting symbols for numbers e.g. x = 2, y = 5, atomic mass, Z = 12)		☐
• use direct proportion (stepwise increases)	solving problems such as 3g of carbon dioxide are made by burning 2g of a fuel, how much fuel needs to be burnt to make 6g carbon dioxide?	☐
• use inverse proportion (inverse means turned up side down)	the inverse of 4 is ¼ (= 0.25)	☐
• use numbers to the 'power of 10' e.g. $1x10^2$ = 100	Your calculator will often show number to the power of 10 when you do calculations. Do not worry too much though – your calculator does the work for you.	☐
• draw charts	You will be given the data	☐
• draw graphs with line of best fit interpret: • bar graphs • pie charts • line graphs	You will be given the data	☐
• interpret bar graphs		☐
• interpret pie charts		☐

• interpret line graphs		☐
• select suitable scales and axes for graphs		☐
• make approximations	e.g. as you go down group 7, the melting points of the elements increase by about 100^{o}C each time	☐
• use the formula: area = length x breadth		☐
• use the formula volume = length x breadth x height		☐
• use and convert metric units into one another	e.g. 100cm = 1 m 1000g = 1 kg 1000cm^3 = 1 dm^3	☐
solve equations containing 3 terms, when two of the terms are known	moles = mass/ relative atomic mass can be solved for mass by rewriting it mass = moles x relative atomic mass	☐
know the symbols <, >, ≈, /, α		☐
know about the use of significant figures		☐