Revision checklist for IGCSE Chemistry 0620

A guide for Students

UNIVERSITY of CAMBRIDGE
International Examinations

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How to use this guide

The guide describes what you need to know about your IGSCE Chemistry examination.

It will help you to plan your revision programme for the theory examinations and will explain what the examiners are looking for in the answers you write. It can also be used to help you to revise by using tick boxes in Section 3, 'What you need to know', to check what you know and which topic areas you have covered.

The guide contains the following sections:

Section 1: How will you be tested?

This section will give you information about the different types of theory and 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
- how the Extended syllabus (Supplement) differs from the Core syllabus
- details about each topic in the syllabus
- how much of the syllabus you have covered

Appendices

This section covers the other things you need to know such as:

- how you can make the most 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 command words the Examiners use in the examination Papers
- information about the mathematical skills you need

Not all the information will be relevant to you. For example, you will need to select what you need to know in Sections 1 and 3, by finding out from your teacher which examination Papers 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** theory Papers and **one** practical Paper.

You will need to ask your teacher which practical Paper you are taking. Nearer the time of the examination, you will also need to ask which theory Papers you are being entered for.

If your teacher thinks that you should enter for the examination based on the Core syllabus, you will take Paper 1 (theory), Paper 2 (theory) and **one** of the practical Papers (4 or 5 or 6).

If your teacher thinks that you should enter for the examination based on the Extended syllabus, you will take Paper 1 (theory), Paper 3 (theory) and **one** of the practical Papers (4 or 5 or 6).

Whether you take Paper 2 or 3 will depend on the progress your teacher thinks you have made and which Paper most suits your particular strengths. You should discuss this with your teacher.

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 examination***
Paper 1	45 minutes (40 marks)	40 multiple-choice questions. You choose one answer you consider correct from 4 possible answers	30%
Paper 2	1 ¼ hours (80 marks)	Short-answer questions and structured questions. *You should write your answers in the spaces provided.* The Paper tests topics in the Core syllabus.	50% (you do **either** Paper 2 **or** Paper 3)
Paper 3	1 ¼ hours (80 marks)	Short-answer and structured questions. *You should write your answer in the spaces provided.* The Paper tests topics in the Extended syllabus.	20% (you do **either** Paper 2 **or** Paper 3)
Practical Paper	see next table	see next table	20%
			Total 100%

1.3 About the practical Papers

Twenty percent of the marks for IGCSE Chemistry are for practical work. Practical work is based only on the Core syllabus.

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 varies between the Papers, but your final mark will be calculated so that it is worth the same percentage of the total examination as the other practical Papers.

Paper number and type	***How long and how many marks?***	***What's involved?***
Paper 4 (coursework)	no fixed time (48 marks)	You design and carry out experiments, which are then marked by your teacher. You will be assessed on 4 skill areas. You need to produce 2 pieces of work for each skill area.
Paper 5 (practical test)	1 ¼ hours (40 marks)	You do a practical exam, which is supervised by a teacher. There are usually 2 questions, testing 4 skill areas.
Paper 6 (alternative to practical)	1 hour (60 marks)	You answer a written paper about practical work. There are usually 6 questions, which test the same skill areas as Paper 5.

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

(i) Paper 4 (coursework)
You will carry out several experiments throughout your Chemistry course, which will be marked by your teacher. Your teacher will mark you on **four** different skill areas. What you have to do to get a basic (B), medium (M) or high (H) mark is shown below. You could use a highlighter pen or underlining to note the differences between basic, medium and higher.

Skill C1: Using apparatus
You follow written instructions to set up and use apparatus correctly. You carry out your work safely.

B: •You follow instructions correctly to do a single practical operation, e.g. set up a burette, with hydrochloric acid in it, correctly.
•You use familiar apparatus, with a little help on points of safety.

M: •You follow instructions correctly to do a series of step-by-step practical operations, e.g. set up a burette and carry out a titration.
•You use familiar apparatus fairly well, with no help on points of safety.

H: •You follow instructions correctly to do a series of step-by-step practical operations, but may need to change one step if things don't work out as you thought, e.g. you lower the concentration of acid if the reaction of marble chips with acid goes too fast.
• You use familiar apparatus very well, with no help on points of safety.

Skill C2: Observing
You make observations and measurements and write them down clearly.

B: •You make suitable observations when given some detailed instructions.
•You record results correctly when given a detailed table or some help.

M: •You make suitable observations when given minimal instructions.
•You record results correctly when given an outline table or minimal help.

H: •You make suitable observations without help and record results as accurately as the apparatus allows.
•You record results correctly without help.

Skill C3: Handling results
You draw graphs and/ or perform calculations from your results. You draw conclusions from your results and recognize any results, which do not fit into the pattern.

B: •You draw graphs or charts (or do some calculations) from your results when given detailed suggestions.
•You draw simple conclusions from your results.

M: •You draw graphs or charts (or do some calculations) from your results when given only a little help.
•You draw simple conclusions from your results and comment on the patterns shown by the data, e.g. a high concentration of acid causes a faster rate of reaction than a low concentration.
•You comment on results, which do not fit the pattern.

H: •You draw graphs or charts (or do some calculations) from your results when given no help.
•You draw more general conclusions from your results and comment on the patterns, e.g. the greater the concentration of acid, the faster the reaction.
• You comment on results, which do not fit the pattern and suggest how to deal with them, e.g. ignore them.
•You suggest what errors there are in your experiment.

Skill C4: Planning and evaluating
You plan your experiment given some basic information from your teacher. You suggest how well your plan worked and modify it, if necessary.

B: •You write a simple plan for your experiment.
• You modify your plan after doing several experiments to see which works the best.

M: •You write a plan for your experiment, which has a series of logical steps in it.
•You modify your plan after doing trial experiments and give reasons why you need to alter your original plan.
•If there are two variables (things which can change e.g. concentration of acid, size of marble chips), you recognise that one variable needs to be changed, while the other is kept the same, e.g. keep the size of marble chips the same but vary the concentration of acid.

H: •You write a plan for your experiment which has a series of logical and clearly reasoned steps.
•You modify your plan after doing trial experiments. You give reasons why you need to alter your original plan and suggest to what extent your plan works and why. You suggest how to deal with unexpected results.
• If there are more than two variables, you recognise which needs to be controlled (kept constant) and which needs to be changed.

(ii) Paper 5 (Practical test)

You do a practical exam, which is supervised by a teacher. You are given an instruction sheet which enables you carry out the experiments, handle the data and draw appropriate conclusions. You may be asked to use the following techniques:
- measuring the volumes of liquids and gases, including the use of burettes and

pipettes (You will not be required to weigh materials.)
(You should be able to take burette reading to the nearest 0.1 cm^3 and measure volumes in measuring cylinders to the nearest scale unit.)

- measuring speeds of reaction
- measuring temperature (You should be able to measure the temperature to the nearest scale division on the thermometer.)
- paper chromatography
- filtering
- identifying ions and gases using a table of tests to help you (see Appendices)

(iii) Paper 6 (alternative to practical test)

This is a written Paper, testing the same four skill areas as Paper 5. 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 and gases - <u>you will be expected to learn and remember these tests</u>
- plot and interpret information from graphs
- identify sources of error and suggest improvements in the experiment
- suggest suitable apparatus for investigations

Section 2: What will be tested?

The Examiners take account of 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	1. use scientific ideas, facts and laws 2. know scientific definitions e.g. what is reduction? 3. know about chemical apparatus and how it works 4. know about chemical symbols, quantities (e.g. mass) and units (e.g. dm^3) 5. 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	1. select and organize information from graphs tables and written text 2. change information from one form to another, e.g. draw graphs, construct symbol equations from word equations 3. arrange data and carry out calculations 4. identify patterns from information given and draw conclusions 5. explain scientific relationships, e.g. use the moving (kinetic) particle theory, to explain ideas about rate of reaction 6. make predictions and develop scientific ideas 7. solve problems
C: experimental skills	planning and carrying out experiments and recording and analysing information	1. set up and use apparatus safely 2. make observations and measurements and record them 3. analyse experimental results and suggest how valid they are 4. plan and carry out your own experiment and describe to what extent your plan worked

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 14 topic areas. If you are studying only the Core syllabus (Paper 2), you will need only to refer to the column headed Core material. If you are studying the Extended syllabus (Paper 3) you will need to refer to both the Core and Extended material columns. If you are unsure about which material to use, you should ask your teacher for advice.

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 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/ things which you need to ask your teacher about

Topic	***Core material***			***Extended material***		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
1. Particle theory	Describe the states of matter and how they are changed into each other: • the difference between solids liquids and gases • how the movement and closeness of the particles differs in solids, liquids and gases	☐				
	Describe and explain diffusion: • as the spreading out and intermingling of liquids and gases • caused by the random movement of particles	☐				
	Describe the evidence for the movement of particles in liquids and gases: • in terms of diffusion	☐		Describe what affects the rate of diffusion : • the larger the molecular mass the greater the rate of diffusion	☐	

Topic	***Core material***			***Extended material***		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
2. Experimental techniques	Name apparatus: • stop clock • thermometer • (weighing) balance • burette • pipette • measuring cylinder Understand the idea of purity: • describe paper chromatography • interpret simple chromatograms • substance can be identified from their specific melting and boiling points • know that impurities alter melting and boiling points • purity is important in everyday life e.g. food and drugs Describe methods of purification: • using a suitable solvent e.g. water for dissolving water-soluble substances • filtration • crystallisation • simple distillation (including distillation of alcohol from fermentation) • fractionation (as in oil refining) • suggesting how to purify a substance when given suitable information	☐ ☐ ☐		Outline the use of locating agents to show the position of colourless substances on chromatograms	☐	Details of particular locating agents are not needed

Topic	Core material			Extended material		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
3. Atoms, elements and compounds	Describe atomic structure: • a proton has a positive charge, an electron has a negative charge and a neutron is uncharged • protons and neutrons have approximately the same mass • electrons have a mass about 1/2000 that of a proton • define proton number and nucleon number • elements are ordered in the Periodic Table in order of increasing proton number • the number of electrons in the outer shell of an element is the same as the group number • define isotopes • isotopes can be radioactive or non-radioactive • describe how electrons are built up in shells • understand that a 'full' outer shell of electrons makes a structure stable • understand the term valency electrons Understand the main types of structure: • the differences between elements, compounds and mixtures • how the properties of metals	☐ ☐	a copy of the Periodic Table is available in the exam to help you you do not need to know about s,p and d electrons			

	differ from those of non-metals • an alloy (e.g. brass, steel) is a mixture of a metal with other elements Understand ions and ionic bonding: • ions are formed by the gain or loss of electrons • ionic compounds are formed when group I and group VII elements combine Describe molecules and covalent bonding: • the difference between ions, atoms and molecules • describe the electronic structure and formation of covalent bonds in H_2, Cl_2, H_2O, CH_4 and HCl • describe how the sharing of pairs of electrons in these molecules leads to the noble gas structure round each atom • ionic substances have high melting and boiling points and simple molecular substances have low boiling points • ionic substances are soluble in water whereas covalent compounds may or may not be soluble in water • the electrical conductivity of ionic and covalent compounds	☐ ☐		• describe the formation of ionic bonds which can be formed between metallic and non-metallic elements • ionic compounds have a regular 3-dimensional structure (lattice) of alternating positive and negative ions • describe the electron arrangement in more complex molecules e.g. N_2, C_2H_4, CH_3OH, and CO_2	☐ ☐ ☐	

	Understand the structure and properties of giant molecules (macromolecules) • graphite and diamond are giant covalent structures • relate the structures of graphite and diamond to their use as a lubricant (graphite) and in cutting tools (diamond)	☐		• describe the structure of silicon(IV) oxide (silicon dioxide) • the similarity between the structures of silicon(IV) oxide and diamond Describe metallic bonding: • as a lattice of positive ions in a sea of electrons • use this model to explain the electrical conductivity and malleability of metals	☐ ☐ ☐	

Topic	Core material			Extended material		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
4. Quantities and equations	• use the symbols of the elements • write formulas of simple compounds • work out the formula of a compound by comparing the number of different atoms • work out the formula of a compound from a diagram • write word equations • write simple balanced chemical equations • define relative atomic mass, A_r • relative molecular mass, M_r is the sum of the relative atomic masses • the symbol M_r also used for the relative formula mass of ionic compounds • do basic calculations involving simple proportion in order to work out the amounts of substances which react on grams	☐	The mole concept is not needed for the core material	• work out the formula of an ionic compound form the charges on the ions • write more complex balanced equations and include state symbols • write ionic equations • work out a balanced equation given relevant information Use the mole concept: • define the mole • define the Avogadro constant • do calculations using the	☐	The molar gas volume is $24dm^3$ at room temperature and pressure Questions on Gas Laws will not be set

				molar gas volume • from a given equation, calculate reacting masses, and volumes of gases and solutions • the units of solution concentration are either g/dm^3 or mol/dm^3 • calculate amounts of products/ reactants when one reactant in the equation is limiting (not in excess) • calculate empirical formula • calculate molecular formula • calculate % yield and % purity		

Topic	Core material			Extended material		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
5. Electricity and chemistry	Describe some general ideas used in electrolysis: • the cathode is the negative electrode • the anode is the positive electrode • inert electrodes such as platinum or carbon are used in electrolysis	☐				
	Describe the products formed at the electrodes in the electrolysis: • molten lead(II) bromide • concentrated hydrochloric acid • concentrated aqueous sodium chloride • metals or hydrogen are formed at the negative electrode • non-metals (other than hydrogen) are formed at the positive electrode) • predict the products when a molten simple salt (e.g. sodium bromide, lead iodide) is electrolysed	☐		Describe the products formed at the electrodes: • when the electrolyte is molten • when the electrolyte is a solution in water • when the electrolyte is a dilute or concentrated solution of a halide in water • when a solution of copper sulphate in water is electrolysed using carbon electrodes • when a solution of copper sulphate in water is electrolysed using copper electrodes	☐	
	Describe in outline: • the manufacture of aluminium from aluminium oxide in molten cryolite • the manufacture of chlorine and sodium hydroxide from a concentrated solution of sodium chloride	☐	You need to know starting materials and essential conditions but not technical details or diagrams	(For the examples given in this section), describe electrolysis in terms of: • the ions present	☐	

	• the electroplating of metals • the uses of electroplating • why copper is used in electrical cables • why aluminium with a steel core is used in electrical cables • why plastics and ceramics are used as insulators			• the reactions at the electrodes		

Topic	Core material			Extended material		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
6. Energy and chemistry	Understand that: • exothermic reactions are those releasing energy • endothermic reactions are those requiring energy • heat is released when fuels are burnt • hydrogen can be used as a fuel • radioactive isotopes such as ^{235}U are a source of energy	☐		Understand that: • energy is released when bonds are formed (exothermic) • energy is absorbed when bonds are broken • batteries are a source of convenient, portable energy • a cell consists of 2 electrodes in an electrolyte • in a cell, the further the electrodes are apart in the reactivity series, the greater the voltage (and energy). • redox reactions occur at the electrodes in a cell	☐	

Topic	Core material			Extended material		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
7.1 Chemical reactions	Understand that speed of a reaction: • is also called rate of reaction • can be calculated by measuring the volume of gas in a gas syringe over a period of time • can be calculated by measuring the volume of gas in an upturned measuring cylinder full of water over a period of time	☐		Understand speed of reaction in more detail: •devise a way to measure the speed of a reaction when given information about the experiment e.g. mass loss of a reactant • interpret data obtained from speed of reaction experiments	☐	
	Understand that various factors affect the speed of a chemical reaction: • increasing the temperature increases the speed • increasing the concentration of one or more of the reactants increases the speed • decreasing the particle size of a solid reactant increases the speed • a catalyst is a substance that speeds up a chemical reaction (and is not chemically changed at the end) • enzymes are biological catalysts	☐		understand that: • light affects the speed of a few reactions e.g. the darkening of silver halides • increasing the temperature increases the speed of a reaction because of increased rate of collision of the particles • increasing the concentration of a reactant increases the speed of a reaction because of the increased rate of collision of the particles	☐	
	Describe some effects related to the speed of reaction include: • explosions in flour mills due to fine particles of readily combustible flour in the air	☐		Describe more effects related to speed of reaction: • silver salts are used in photography	☐	

	• explosions in mines due to explosive combinations of gases Understand that reversible reactions: • can be reversed by changing the reaction conditions • water is removed when a hydrated salt is gently heated • a hydrated salt is formed when water is added back to a dehydrated salt Understand redox reactions: • oxidation is gain of oxygen • reduction is loss of oxygen • the oxidation state of an ion in a compound is given by roman numbers e.g. iron(II), manganate(VII)	 	hydrated means that it has water in its crystals	• in the presence of light, some silver salts are reduced to silver • photosynthesis is the reaction between carbon dioxide and water to produce glucose • light energy is needed for photosynthesis • chlorophyll absorbs the light energy photosynthesis Understand more about reversible reactions: • the concept of equilibrium • increase in pressure on a reversible reaction pushes the equilibrium in favour of the side of the equation with the lower volume of gas • for an endothermic reaction, increase in temperature increases the products • for an exothermic reaction, increase in temperature increases the reactants Understand redox reactions: • oxidation is loss of electrons • reduction is gain of electrons • oxidation is increase in oxidation number • reduction is decrease in oxidation number • when potassium manganate (VII) oxidises a substance, it	 	

				changes in colour from deep pink to colourless • when (acidified) potassium iodide reduces a substance, it changes in colour from colourless to brown		

Topic	Core material			Extended material		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
8. Acids, bases and salts	Describe the properties of acids and bases: • acids react with metals to form a salt and hydrogen • acids react with hydroxides and basic oxides to form a salt and water • acids react with carbonates to form a salt, carbon dioxide and water • pH can be measured using universal indicator • how the numbers on the pH scale describe the degree of acidity or alkalinity. • pH 7 is neutral (neither acid nor alkaline) • the importance of controlling soil acidity	☐		Describe the properties of acids and bases: • an acid gives off protons (to water) when it reacts • a base accepts protons • when dissolved in water, strong acids are completely ionised • when dissolved in water, weak acids are only slightly ionised	☐	
	Describe oxides: • oxides of many non-metals are acidic • oxides of many metals are basic	☐		Describe oxides: • as amphoteric if they react with both acids and bases • neutral if they do not react with acids or bases	☐	
	Describe the preparation of salts: • by reaction of acids with metals, metal oxides, hydroxides and carbonates • filtration and crystallization are used to separate and purify salts	☐		Describe the preparation of salts: • by precipitation • suggest a way of making a salt when given suitable information	☐	
	Describe tests to identify the following cations (positive ions) in	☐	see table of tests in Section 4.2			

	aqueous solution using sodium hydroxide or ammonia: • aluminium • ammonium • calcium • copper(II) • iron (II) and iron(III) • zinc					
	Describe tests to identify the following anions (negative ions) in aqueous solution: • carbonate (by reaction with dilute acid then testing the gas given off with limewater) • chloride (by reaction with silver nitrate solution under acid conditions) • iodide (by reaction with lead(II) nitrate solution under acid conditions) • nitrate (by reduction with aluminium under alkaline conditions) • sulphate (by reaction with a solution of barium ions under acid conditions)	☐	See table of tests in section 4.2			
	Describe tests to identify the following gases: • ammonia (with damp red litmus) • carbon dioxide (with limewater) • chlorine (with damp litmus) • hydrogen (with a lighted splint) • oxygen (with a glowing splint)	☐	see table of tests in Section 4.2			

Topic	Core material			Extended material		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
9. Periodic table	Understand the Periodic Table: • as a method of classifying elements • its use in predicting the properties of elements • that there is a change from metallic to non-metallic character across a period. Describe the group I elements: • they include lithium, sodium and potassium • they are fairly soft metals • they have low densities for metals • their melting points decrease down the group • they are more reactive down the group • trends can be used to predict the properties of other elements in the group Describe the group VII elements (halogens): • they include chlorine, bromine and iodine • they contain diatomic molecules (molecules with 2 atoms) • their colour gets darker down the group • at room temperature, chlorine is a gas, bromine a liquid and iodine a solid	☐ ☐ ☐		Understand that: • valency electrons are those in the outer shell • the number of valency electrons is equal to the group number • elements in groups I to III are metals and elements in groups • elements on the right hand side of the Periodic Table tend to be non metals although for groups IV to VI there is a change from metallic to non-metallic character down the group • Describe the trends in any group of the Periodic Table when given information about the elements in the group	☐ ☐	

	• their reaction with halide ions shows a trend, the halogens higher in the group being more reactive • trends can be used to predict the properties of other elements in the group Describe the transition elements: • they are metals with very high densities • they have high melting points • they form coloured compounds • the elements and their compounds are often catalysts Describe the noble gases: • they are unreactive (inert) • they are used where an inert atmosphere is important • argon is used in lamps and helium is used in balloons	 				

Topic	Core material			Extended material		
	You should be able to:	Checklist	Comments	You should be able to:	Checklist	Comments
10. Metals	Describe the general properties of metals: • physical properties e.g. shiny, malleable, ductile etc • some chemical reactions which are common to many metals e.g. many metals react with oxygen to form oxides and many react with acids • alloys (mixtures of metals with other elements) may alter the physical properties of the metal e.g. make the metal stronger, more malleable or more resistant to corrosion • you can tell if a metal is an alloy from a diagram of its structure	☐				
	Describe the reactivity series: • as an order of reactivity of the metals potassium, calcium, sodium, magnesium, zinc, iron (hydrogen) and copper	☐		Describe the reactivity series : • as a list of the ease of formation of positive ions (the metals most easily forming positive ions being at the top)	☐	
	You can get the order of reactivity by observing the reaction of the metals with: • water or steam • dilute hydrochloric acid • reduction of the metal oxide with carbon	☐		You can get this order of reactivity by observing the reaction of the metals with • ionic solutions such as sodium chloride solution (the more reactive metal displaces the less reactive one) • by the reaction of the metals with metal oxides (the more	☐	

	• work out an order of reactivity from experimental results			reactive metal displaces the less reactive one) • aluminium appears to be unreactive because it forms a protective oxide layer on its surface		
				Describe the action of heat (if any) on: • hydroxides of Ca, Cu, Fe, Mg, K, Na and Zn • nitrates of Ca, Cu, Fe, Mg, K, Na and Zn	☐	
	Describe how we get metals from their ores: • metals above carbon in the reactivity series are easily obtained from their ores by reduction with carbon • metals near the top of the reactivity series are usually extracted by electrolysis • the main reactions in the extraction of iron from haematite (reduction with carbon and carbon monoxide) • steel is made from iron by reaction with oxygen and basic oxides	☐		Describe how we get metals from their ores: • the main reactions in the extraction of zinc from zinc blends • the main ore of aluminium is bauxite	☐	
	Describe the uses of metals: • aluminium for aircraft bodies because of its strength and low density • aluminium for food containers	☐		Describe further uses of metals: • zinc for galvanizing and making brass • copper for electrical wires because of its good electrical	☐	

	because it resists corrosion • mild steel for car bodies and machinery • stainless steel for chemical plant and cutlery (knives, forks, spoons) • the properties of iron can be changed by adding small amounts of other elements to make steels with special properties			conductivity • copper for saucepans because it is a good conductor of heat.		

Topic	Core material	Extended material

	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
11. Air and water	Understand the importance of water: • know a chemical test for water • describe how water is purified by filtration and chlorination • name some uses of water in the home • name some uses of water in industry	☐				

	Understand the importance of clean air: • clean air is a mixture containing approximately 79% nitrogen and 20% oxygen • oxygen is used in oxygen tents in hospitals and (with the hydrocarbon acetylene) in welding • there are small amounts of noble gases, carbon dioxide and water vapour in the air • carbon dioxide is formed by the complete combustion of carbon compounds • carbon dioxide is a product of respiration • carbon dioxide is given off when an acid reacts with a carbonate • pollutants in the air include carbon monoxide, sulphur dioxide, oxides of nitrogen and lead compounds • the carbon monoxide is formed by incomplete combustion of carbon compounds • carbon monoxide is poisonous • the sulphur dioxide is formed from the combustion of fossil fuels containing sulphur • sulphur dioxide contributes to acid rain which corrodes buildings and damages fish and plants • the lead compounds and nitrogen oxides are found in car exhausts • nitrogen oxides contribute to acid rain and irritate the nose and throat • lead compounds damage the nervous system	☐		• Describe how nitrogen and oxygen are separated from liquid air by fractional distillation Explain: • how nitrogen oxides are formed in the car engine • how nitrogen oxides are removed by a catalytic converter	☐ ☐	

	Describe methods of rust prevention: • paints and other coatings prevent rust by stopping oxygen getting to the iron	☐		Describe further methods of rust prevention: • sacrificial protection (by placing a metal higher in the reactivity series in contact with the iron) • galvanizing iron with a layer of zinc	☐	
	Describe the importance of ammonia and ammonium compounds: • ammonia is released when ammonium salts are heated with sodium hydroxide • fertilizers add nitrogen back to the soil which has been removed by plants • fertilizers often contain nitrogen, phosphorus and potassium	☐		Describe the manufacture of ammonia by the Haber Process: • the hydrogen comes from petroleum hydrocarbons or steam • the nitrogen comes from the air • the essential conditions for the process	☐	

Topic	Core material			Extended material		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
12. Sulphur				Describe some aspects of the chemistry of sulphur: • name some sources of sulphur • sulphur is used to make sulphuric acid • the conditions used in the Contact process for making sulphuric acid (catalyst, temperature and (normal) pressure) • dilute sulphuric acid has the properties of a typical acid • sulphur dioxide is used to bleach wood pulp • sulphur dioxide is a food preservative because it kills bacteria	☐	

Topic	Core material			Extended material		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
13. Carbonates	Describe the reactions and uses of calcium carbonate: • how lime (calcium oxide) is made from calcium carbonate by heating • the chemical reaction involved in making lime is thermal decomposition • lime is used to neutralise acidic soils • slaked lime is used to neutralise acidic industrial waste • calcium carbonate is used in the manufacture of iron and of cement	☐				

Topic	Core material			Extended material		
	You should be able to:	*Checklist*	*Comments*	*You should be able to:*	*Checklist*	*Comments*
14. Organic chemistry	Name and draw the structures of: • methane • ethane • ethanol • ethanoic acid • 1,2-dibromoethane • poly(ethene) Recognise by name, compounds ending in: • -ane are alkanes • -ene are alkenes • -ol are alcohols • -oic acid are carboxylic acids Recognise from diagrams, the structures of: • alkanes • alkenes • alcohols • carboxylic acids Understand about fuels: • that coal, natural gas and petroleum are fuels • that natural gas is largely methane • that petroleum is a mixture of hydrocarbons • how petroleum is separated into useful fractions by fractional	☐ ☐ ☐ ☐		Name and draw further structures: • unbranched alkanes • alkenes • alcohols with up to 4 carbon atoms • carboxylic acids with up to 4 carbon atoms • describe and identify structural isomers	☐	but not cis-trans isomers

	distillation • the names of the petroleum fractions • petrol is used as a fuel in cars • paraffin is used for oil stoves and aircraft fuel • diesel is used for fuel in diesel engines • lubricating oil is used for lubricants and for making waxes and polishes • bitumen is used for making roads					
	Describe an homologous series of compounds as: • having the same functional group • having similar properties	☐		Describe an homologous series in more detail: • e.g. they can be represented by a general formula e.g. alkenes C_nH_{2n}	☐	
	Understand that alkanes: • are saturated hydrocarbons • are generally unreactive • can be burnt in excess air to form carbon dioxide and water	☐		Describe further reactions of alkanes: • they react with chlorine (in the presence of light to substitute one or more hydrogen atoms)	☐	
	Understand about alkenes: • that they are unsaturated hydrocarbons • they decolourise bromine water (or acidified potassium manganate(VII)) : • ethene undergoes addition polymerisation to form poly(ethene) • in addition polymerisation, the	☐		Describe the reaction of alkenes: • with bromine • with steam • with hydrogen	☐	

	simple units (ethene) which join together are called monomers • that unsaturated hydrocarbons differ from saturated hydrocarbons in structure and reaction with bromine water Understand that ethanol: • forms carbon dioxide and water on complete combustion • can be made by fermentation • can be made by addition of steam to ethene in the presence of a catalyst • is used as a solvent • is used as a fuel	☐				
				Understand that ethanoic acid: • it is formed when ethanol is oxidised by oxygen from the air • it can be made by oxidising ethanol with acidified potassium dichromate (VI). • it is a weak acid • it reacts with ethanol to make the ester, ethyl ethanoate	☐	
				Understand some aspects of the chemistry of macromolecules: • they are large molecules built up from small units called monomers • different macromolecules have different units and/ or different linkages between the units	☐	

				Understand some of the chemistry of synthetic polymers: • plastics and man made fibres have particular uses • the pollution problems that are caused by non-biodegradable plastics • know how to work out the structure of a polymer from a given alkene • know how to work out the structure of an alkene monomer when given the structure of the polymer • the structure of nylon (a polyamide) can be represented as: *(copy as p 12 in syllabus – 2nd diagram from bottom)* • nylon is formed by a condensation polymerisation. • the structure of terylene (a polyester) can be represented as: *(copy as p12 in syllabus bottom diagram)* • terylene is formed by a condensation reaction Understand some of the chemistry of natural macromolecules: • proteins, carbohydrates and fats form the main part of our food • proteins have the same linkages (amide) as in nylon • proteins have different monomer	☐ ☐	*Details of manufacture of polymers is not needed*

				units to nylon • proteins are hydrolysed to amino acids • fats have the same linkage (ester) as terylene • fats have different units to terylene • fats are hydrolysed to make soap • complex carbohydrates contain a large number of (polymerised) sugar units • the structure of the sugar units can be represented as: HO — □ — OH • the structure of a sugar polymer can be represented as: — O — □ — O — □ — O — • in a sugar units are joined by condensation polymerisation when a sugar polymer is formed • complex carbohydrates such as starch can be hydrolysed to simple sugars • ethanol and carbon dioxide are formed when simple sugars are fermented • amino acids (from the hydrolysis of proteins) and simple sugars (from the hydrolysis of complex carbohydrates) can be separated and identified using chromatography		

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 and the information about proton number and relative atomic masses. You must remember that the mass number (number of protons + neutrons) is not the same as the relative atomic mass. You also need to realise that:

- groups are the columns down the table
- periods are the rows across the table
- the first period only contains two elements, hydrogen and helium.

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

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 Sulphur 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 †															

*58-71 Lanthanoid series

†90-103 Actinoid series

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	163 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

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 3) and for Paper 6 (Alternative to Practical). However, if you are entered for Paper 5 (Practical Test), you will be given a copy of this table in the examination.

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 solution'

Tests for anions

anion	*test*	*test result*
carbonate (CO^{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
sulphate (SO_4^{2-}) [in solution]	acidify, 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 (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess,
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 lime water milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	‘pops' with a lighted splint
oxygen (O_2)	relights a glowing splint

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.

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 iodine 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. reduction is gain of electrons; 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 • observations *e.g. describe what you see when sodium reacts with water* • how to do particular experiments *e.g. describe how you can 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) BUT, 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	See 'Understand'

(what is meant by the term…)	
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 compound X 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:	checklist	comments
• add, subtract, multiply and divide	☐	
Use: • averages • decimals • fractions • percentages • ratios • reciprocals	 ☐ ☐ ☐ ☐ ☐ ☐	
• recognise standard notation (notation is putting symbols for numbers e.g. x = 2, y = 5, atomic mass, Z = 12) • use standard notation	☐ ☐	
• use direct proportion (stepwise increases) • use inverse proportion (inverse means turned up side down)	☐ ☐	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? 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 • graphs with line of best fit	☐ ☐	You will be given the data
interpret: • bar graphs • pie charts • 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 100oC
use the formulas: • area = length x width • volume = length x breadth x height • use and convert metric units into one another	☐ ☐ ☐	e.g. 100cm = 1 m 1000g = 1 kg
• use a ruler (compasses, protractor and set square)	☐	It is unlikely that you will have to use the instruments in brackets in chemistry exams)
understand the meaning of : • angle • curve • circle • radius • diameter • square • rectangle • diagonal	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐	
• 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