There are 8 practical experiments are highlighted in pink. These can be on the exam paper so you should understand them and be able to explain the method.

1 Principles of chemistry

The following sub-topics are covered in this section.

(a) States of matter

(b) Elements, compounds and mixtures

(c) Atomic structure

(d) The Periodic Table

(e) Chemical formulae, equations and calculations

(f) Ionic bonding

(g) Covalent bonding

(a)	**States of matter** Taught in Year 7-9
Students should:	
1.1	understand the three states of matter in terms of the arrangement, movement and energy of the particles
1.2	understand the interconversions between the three states of matter in terms of: • the names of the interconversions • how they are achieved • the changes in arrangement, movement and energy of the particles.
1.3	understand how the results of experiments involving the dilution of coloured solutions and diffusion of gases can be explained
1.4	know what is meant by the terms: • solvent • solute • solution • saturated solution.

Specification points 1.5, 1.6 and 1.7 are in the Pearson Edexcel International GCSE in Chemistry only.

(b)	**Elements, compounds and mixtures** Taught in Year 7-9
Students should:	
1.8	understand how to classify a substance as an element, compound or mixture
1.9	understand that a pure substance has a fixed melting and boiling point, but that a mixture may melt or boil over a range of temperatures
1.10	describe these experimental techniques for the separation of mixtures: • simple distillation • fractional distillation • filtration • crystallisation • paper chromatography.
1.11	understand how a chromatogram provides information about the composition of a mixture
1.12	understand how to use the calculation of R_f values to identify the components of a mixture
1.13	*practical: investigate paper chromatography using inks/food colourings*

(c)	**Atomic structure** Taught in Year 9
Students should:	
1.14	know what is meant by the terms atom and molecule
1.15	know the structure of an atom in terms of the positions, relative masses and relative charges of sub-atomic particles
1.16	know what is meant by the terms atomic number, mass number, isotopes and relative atomic mass (A_r)
1.17	be able to calculate the relative atomic mass of an element (A_r) from isotopic abundances

(d)	**The Periodic Table** Taught in Year 10
Students should:	
1.18	understand how elements are arranged in the Periodic Table: • in order of atomic number • in groups and periods.
1.19	understand how to deduce the electronic configurations of the first 20 elements from their positions in the Periodic Table
1.20	understand how to use electrical conductivity and the acid-base character of oxides to classify elements as metals or non-metals
1.21	identify an element as a metal or a non-metal according to its position in the Periodic Table
1.22	understand how the electronic configuration of a main group element is related to its position in the Periodic Table
1.23	understand why elements in the same group of the Periodic Table have similar chemical properties
1.24	understand why the noble gases (Group 0) do not readily react

(e)	**Chemical formulae, equations and calculations** Taught in Year 10
Students should:	
1.25	write word equations and balanced chemical equations (including state symbols): • for reactions studied in this specification • for unfamiliar reactions where suitable information is provided
1.26	calculate relative formula masses (including relative molecular masses) (M_r) from relative atomic masses (A_r)
1.27	know that the mole (mol) is the unit for the amount of a substance
1.28	understand how to carry out calculations involving amount of substance, relative atomic mass (A_r) and relative formula mass (M_r)
1.29	calculate reacting masses using experimental data and chemical equations
1.30	calculate percentage yield
1.31	understand how the formulae of simple compounds can be obtained experimentally, including metal oxides, water and salts containing water of crystallisation
1.32	know what is meant by the terms empirical formula and molecular formula
1.33	calculate empirical and molecular formulae from experimental data
1.36	*practical: know how to determine the formula of a metal oxide by combustion (e.g. magnesium oxide) or by reduction (e.g. copper(II) oxide)*

Specification points 1.34 and 1.35 are in the Pearson Edexcel International GCSE in Chemistry only.

(f)	**Ionic bonding** Taught in Year 10
Students should:	
1.37	understand how ions are formed by electron loss or gain
1.38	know the charges of these ions: • metals in Groups 1, 2 and 3 • non-metals in Groups 5, 6 and 7 • Ag^{+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Pb^{2+}, Zn^{2+} • hydrogen (H^{+}), hydroxide (OH^{-}), ammonium (NH_4^{+}), carbonate (CO_3^{2-}), nitrate (NO_3^{-}), sulfate (SO_4^{2-}).
1.39	write formulae for compounds formed between the ions listed above
1.40	draw dot-and-cross diagrams to show the formation of ionic compounds by electron transfer, limited to combinations of elements from Groups 1, 2, 3 and 5, 6, 7 *only outer electrons need be shown*
1.41	understand ionic bonding in terms of electrostatic attractions
1.42	understand why compounds with giant ionic lattices have high melting and boiling points
1.43	know that ionic compounds do not conduct electricity when solid, but do conduct electricity when molten and in aqueous solution

(g)	**Covalent bonding** Taught in Year 10
Students should:	
1.44	know that a covalent bond is formed between atoms by the sharing of a pair of electrons
1.45	understand covalent bonds in terms of electrostatic attractions
1.46	understand how to use dot-and-cross diagrams to represent covalent bonds in: • diatomic molecules, including hydrogen, oxygen, nitrogen, halogens and hydrogen halides • inorganic molecules including water, ammonia and carbon dioxide • organic molecules containing up to two carbon atoms, including methane, ethane, ethene and those containing halogen atoms.
1.47	explain why substances with a simple molecular structures are gases or liquids, or solids with low melting and boiling points *the term intermolecular forces of attraction can be used to represent all forces between molecules*
1.48	explain why the melting and boiling points of substances with simple molecular structures increase, in general, with increasing relative molecular mass
1.49	explain why substances with giant covalent structures are solids with high melting and boiling points
1.50	explain how the structures of diamond, graphite and C_{60} fullerene influence their physical properties, including electrical conductivity and hardness
1.51	know that covalent compounds do not usually conduct electricity

Specification points 1.52, 1.53, 1.54, 1.55, 1.56, 1.57, 1.58, 1.59 and 1.60 are in the Pearson Edexcel International GCSE in Chemistry only.

2 Inorganic chemistry

The following sub-topics are covered in this section.

(a) Group 1 (alkali metals) – lithium, sodium and potassium

(b) Group 7 (halogens) – chlorine, bromine and iodine

(c) Gases in the atmosphere

(d) Reactivity series

(e) Acids, alkalis and titrations

(f) Acids, bases and salt preparations

(g) Chemical tests

(a)	**Group 1 (alkali metals) – lithium, sodium and potassium** Taught in Year 10
Students should:	
2.1	understand how the similarities in the reactions of these elements with water provide evidence for their recognition as a family of elements
2.2	understand how the differences between the reactions of these elements with air and water provide evidence for the trend in reactivity in Group 1
2.3	use knowledge of trends in Group 1 to predict the properties of other alkali metals

(b)	**Group 7 (halogens) – chlorine, bromine and iodine** Taught in Year 10
Students should:	
2.5	know the colours, physical states (at room temperature) and trends in physical properties of these elements
2.6	use knowledge of trends in Group 7 to predict the properties of other halogens
2.7	understand how displacement reactions involving halogens and halides provide evidence for the trend in reactivity in Group 7

Specification points 2.4 and 2.8 are in the Pearson Edexcel International GCSE in Chemistry only.

(c)	**Gases in the atmosphere** Taught in Year 9 & Year 10
Students should:	
2.9	know the approximate percentages by volume of the four most abundant gases in dry air
2.10	understand how to determine the percentage by volume of oxygen in air using experiments involving the reactions of metals (e.g. iron) and non-metals (e.g. phosphorus) with air
2.11	describe the combustion of elements in oxygen, including magnesium, hydrogen and sulfur
2.12	describe the formation of carbon dioxide from the thermal decomposition of metal carbonates, including copper(II) carbonate
2.13	know that carbon dioxide is a greenhouse gas and that increasing amounts in the atmosphere may contribute to climate change
2.14	*practical: determine the approximate percentage by volume of oxygen in air using a metal or a non-metal*

(d)	**Reactivity series** Taught in Year 10
Students should:	
2.15	understand how metals can be arranged in a reactivity series based on their reactions with: • water • dilute hydrochloric or sulfuric acid.
2.16	understand how metals can be arranged in a reactivity series based on their displacement reactions between: • metals and metal oxides • metals and aqueous solutions of metal salts.
2.17	know the order of reactivity of these metals: potassium, sodium, lithium, calcium, magnesium, aluminium, zinc, iron, copper, silver, gold
2.18	know the conditions under which iron rusts
2.19	understand how the rusting of iron may be prevented by: • barrier methods • galvanising • sacrificial protection.
2.20	understand the terms: • oxidation • reduction • redox • oxidising agent • reducing agent in terms of gain or loss of oxygen and loss or gain of electrons.

Students should:	
2.21	*practical: investigate reactions between dilute hydrochloric and sulfuric acids and metals (e.g. magnesium, zinc and iron)*

(e)	**Acids, alkalis and titrations** Taught in Year 10
Students should:	
2.28	describe the use of litmus, phenolphthalein and methyl orange to distinguish between acidic and alkaline solutions
2.29	understand how to use the pH scale, from 0–14, can be used to classify solutions as strongly acidic (0–3), weakly acidic (4–6), neutral (7), weakly alkaline (8–10) and strongly alkaline (11–14)
2.30	describe the use of universal indicator to measure the approximate pH value of an aqueous solution
2.31	know that acids in aqueous solution are a source of hydrogen ions and alkalis in a aqueous solution are a source of hydroxide ions
2.32	know that alkalis can neutralise acids

f)	**Acids, bases and salt preparations** Taught in Year 10
Students should:	
2.34	know the general rules for predicting the solubility of ionic compounds in water: • common sodium, potassium and ammonium compounds are soluble • all nitrates are soluble • common chlorides are soluble, except those of silver and lead(II) • common sulfates are soluble, except for those of barium, calcium and lead(II) • common carbonates are insoluble, except for those of sodium, potassium and ammonium • common hydroxides are insoluble except for those of sodium, potassium and calcium (calcium hydroxide is slightly soluble).
2.35	understand acids and bases in terms of proton transfer
2.36	understand that an acid is a proton donor and a base is a proton acceptor
2.37	describe the reactions of hydrochloric acid, sulfuric acid and nitric acid with metals, bases and metal carbonates (excluding the reactions between nitric acid and metals) to form salts
2.38	know that metal oxides, metal hydroxides and ammonia can act as bases, and that alkalis are bases that are soluble in water
2.39	describe an experiment to prepare a pure, dry sample of a soluble salt, starting from an insoluble reactant
2.42	*practical: prepare a sample of pure, dry hydrated copper(II) sulfate crystals starting from copper(II) oxide*

Specification points 2.22, 2.23, 2.24, 2.25, 2.26, 2.27, 2.33, 2.40, 2.41 and 2.43 are in the Pearson Edexcel International GCSE in Chemistry only.

(g)	**Chemical tests** Taught in Year 9 & Year 10
Students should:	
2.44	describe tests for these gases: • hydrogen • oxygen • carbon dioxide • ammonia • chlorine.
2.45	describe how to carry out a flame test
2.46	know the colours formed in flame tests for these cations: • Li^+ is red • Na^+ is yellow • K^+ is lilac • Ca^{2+} is orange-red • Cu^{2+} is blue-green.
2.47	describe tests for these cations: • NH_4^+ using sodium hydroxide solution and identifying the gas evolved • Cu^{2+}, Fe^{2+} and Fe^{3+} using sodium hydroxide solution.
2.48	describe tests for these anions: • Cl^-, Br^- and I^- using acidified silver nitrate solution • SO_4^{2-} using acidified barium chloride solution • CO_3^{2-} using hydrochloric acid and identifying the gas evolved.
2.49	describe a test for the presence of water using anhydrous copper(II) sulfate
2.50	describe a physical test to show whether a sample of water is pure

3 Physical chemistry

The following sub-topics are covered in this section.

(a) Energetics

(b) Rates of reaction

(c) Reversible reactions and equilibria

(a)	**Energetics** Taught in Year 11
Students should:	
3.1	know that chemical reactions in which heat energy is given out are described as exothermic, and those in which heat energy is taken in are described as endothermic
3.2	describe simple calorimetry experiments for reactions such as combustion, displacement, dissolving and neutralisation
3.3	calculate the heat energy change from a measured temperature change using the expression $Q = mc\Delta T$
3.4	calculate the molar enthalpy change (ΔH) from the heat energy change, Q
3.8	*practical: investigate temperature changes accompanying some of the following types of change:* • *salts dissolving in water* • *neutralisation reactions* • *displacement reactions* • *combustion reactions.*

Specification points 3.5, 3.6 and 3.7 are in the Pearson Edexcel International GCSE in Chemistry only.

(b)	**Rates of reaction** Taught in Year 11	
Students should:		
3.9	describe experiments to investigate the effects of changes in surface area of a solid, concentration of a solution, temperature and the use of a catalyst on the rate of a reaction	
3.10	describe the effects of changes in surface area of a solid, concentration of a solution, pressure of a gas, temperature and the use of a catalyst on the rate of a reaction	
3.11	explain the effects of changes in surface area of a solid, concentration of a solution, pressure of a gas and temperature on the rate of a reaction in terms of particle collision theory	
3.12	know that a catalyst is a substance that increases the rate of a reaction, but is chemically unchanged at the end of the reaction	
3.13	know that a catalyst works by providing an alternative pathway with lower activation energy	
3.15	*practical: investigate the effect of changing the surface area of marble chips and of changing the concentration of hydrochloric acid on the rate of reaction between marble chips and dilute hydrochloric acid*	
3.16	*practical: investigate the effect of different solids on the catalytic decomposition of hydrogen peroxide solution*	

(c)	**Reversible reactions and equilibria** Taught in Year 11	
Students should:		
3.17	know that some reactions are reversible and this is indicated by the symbol ⇌ in equations	
3.18	describe reversible reactions such as the dehydration of hydrated copper(II) sulfate and the effect of heat on ammonium chloride	

Specification points 3.14, 3.19, 3.20, 3.21 and 3.22 are in the Pearson Edexcel International GCSE in Chemistry only.

4 Organic chemistry

The following sub-topics are covered in this section.

(a) Introduction

(b) Crude oil

(c) Alkanes

(d) Alkenes

(e) Synthetic polymers

(a) Introduction Taught in Year 11	
Students should:	
4.1	know that a hydrocarbon is a compound of hydrogen and carbon only
4.2	understand how to represent organic molecules using empirical formulae, molecular formulae, general formulae, structural formulae and displayed formulae
4.3	know what is meant by the terms homologous series, functional group and isomerism
4.4	understand how to name compounds relevant to this specification using the rules of International Union of Pure and Applied Chemistry (IUPAC) nomenclature *students will be expected to name compounds containing up to six carbon atoms*
4.5	understand how to write the possible structural and displayed formulae of an organic molecule given its molecular formula
4.6	understand how to classify reactions of organic compounds as substitution, addition and combustion *knowledge of reaction mechanisms is not required*

(b) Crude oil Taught in Year 11	
Students should:	
4.7	know that crude oil is a mixture of hydrocarbons
4.8	describe how the industrial process of fractional distillation separates crude oil into fractions
4.9	know the names and uses of the main fractions obtained from crude oil: refinery gases, gasoline, kerosene, diesel, fuel oil and bitumen
4.10	know the trend in colour, boiling point and viscosity of the main fractions
4.11	know that a fuel is a substance that, when burned, releases heat energy
4.12	know the possible products of complete and incomplete combustion of hydrocarbons with oxygen in the air
4.13	understand why carbon monoxide is poisonous, in terms of its effect on the capacity of blood to transport oxygen *references to haemoglobin are not required*
4.14	know that, in car engines, the temperature reached is high enough to allow nitrogen and oxygen from air to react, forming oxides of nitrogen
4.15	explain how the combustion of some impurities in hydrocarbon fuels results in the formation of sulfur dioxide

Students should:	
4.16	understand how sulfur dioxide and oxides of nitrogen oxides contribute to acid rain
4.17	describe how long-chain alkanes are converted to alkenes and shorter-chain alkanes by catalytic cracking (using silica or alumina as the catalyst and a temperature in the range of 600–700 ºC)
4.18	explain why cracking is necessary, in terms of the balance between supply and demand for different fractions

(c)	**Alkanes** Taught in Year 11
Students should:	
4.19	know the general formula for alkanes
4.20	explain why alkanes are classified as saturated hydrocarbons
4.21	understand how to draw the structural and displayed formulae for alkanes with up to five carbon atoms in the molecule, and to name the unbranched-chain isomers
4.22	describe the reactions of alkanes with halogens in the presence of ultraviolet radiation, limited to mono-substitution *knowledge of reaction mechanisms is not required*

(d)	**Alkenes** Taught in Year 11
Students should:	
4.23	know that alkenes contain the functional group >C=C<
4.24	know the general formula for alkenes
4.25	explain why alkenes are classified as unsaturated hydrocarbons
4.26	understand how to draw the structural and displayed formulae for alkenes with up to four carbon atoms in the molecule, and name the unbranched-chain isomers *knowledge of cis/trans or E/Z notation is not required*
4.27	describe the reactions of alkenes with bromine to produce dibromoalkanes
4.28	describe how bromine water can be used to distinguish between an alkane and an alkene

Specification points 4.29, 4.30, 4.31, 4.32, 4.33, 4.34, 4.35, 4.36, 4.37, 4.38, 4.39, 4.40, 4.41, 4.42, 4.43 are in the Pearson Edexcel International GCSE in Chemistry only.

(e)	**Synthetic polymers** Taught in Year 11
Students should:	
4.44	know that an addition polymer is formed by joining up many small molecules called monomers
4.45	understand how to draw the repeat unit of an addition polymer, including poly(ethene), poly(propene), poly(chloroethene) and (poly)tetrafluoroethene
4.46	understand how to deduce the structure of a monomer from the repeat unit of an addition polymer and vice versa
4.47	explain problems in the disposal of addition polymers, including: • their inertness and inability to biodegrade • the production of toxic gases when they are burned.

Specification points 4.48, 4.49 and 4.50 are in the Pearson Edexcel International GCSE in Chemistry only.

THE END