0652 IGCSE Physical Science for 2017: chemistry content mapped to 0620 IGCSE Chemistry f
(February 2015)

NB Note that the Chemistry section of 0652 makes specific refere ics Sections 4.1 and 4.2 being required for the Chemistry as common m

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C1.1	describe the states of matter and explain their interconversion in terms of kinetic particle theory			State the distinguishing properties of solids, liquids and gases Describe the structure of solids, liquids and gases in terms of particle separation, arrangement and types of motion	Relate the properties of solids, liquids and gases to the forces and distances between molecules and to the motion of the molecules.
C1.2	describe diffusion and Brownian motion in terms of kinetic theory			Describe and explain diffusion	
C2.1	name appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes and measuring cylinders			name appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes and measuring cylinders	
C2.2	describe paper chromatography (including the use of locating agents) and interpret simple chromatograms			Demonstrate knowledge and understanding of paper chromatography. Interpret simple chromatograms	
C2.3	recognise that mixtures melt and boil over a range of temperatures			Identify substances and assess their purity from melting point and boiling point information	
C2.4	describe methods of purification by the use of a suitable solvent, filtration, crystallisation and distillation (including use of fractionating column) Please see the fractional distillation of crude oil (petroleum – section 11.2) and fermented liquor (section 11.6)			Describe methods of separation and purification: filtration, crystallisation, distillation, fractional distillation. (including use of fractionating column). (Refer to the fractional distillation of petroleum in section 14.2 and products of fermentation in section 14.6.)	
C3.1.1	state the relative charge and			State the relative charges and	

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	approximate relative mass of a proton, a neutron and an electron			approximate relative masses of protons, neutrons and electrons	
C3.1.2	define *atomic (proton) number* and *mass (nucleon) number*			Define *proton number* (atomic number) as the number of protons in the nucleus of an atom Define *nucleon number* (mass number) as the total number of protons and neutrons in the nucleus of an atom	
C3.1.3	Use atomic (proton) number and the simple structure of atoms to explain the basis of the Periodic Table (see section C7.1 to 7.4), with special reference to the elements with atomic (proton) numbers 1 to 20.			Use proton number and the simple structure of atoms to explain the basis of the Periodic Table (see section 9), with special reference to the elements of proton number 1 to 20	
C3.1.4	use the notation ${}^{A}_{Z}X$ for an atom				
C3.1.5	describe the build-up of electrons in 'shells' and understand the significance of the noble gas electronic structures and of outer electrons. (The ideas of the distribution of electrons in s- and p-orbitals and in d-block elements are not required.) (A copy of the Periodic Table will be provided in Papers 1 and 3.)	(A copy of the Periodic Table will be provided in Papers 2 and 4.)		Describe the build-up of electrons in 'shells' and understand the significance of the noble gas electronic structures and of the outer shell electrons (The ideas of the distribution of electrons in s and p orbitals and in d block elements are **not** required.)	
C3.1.6	define *isotope*			Define *isotopes* as atoms of the same element which have the same proton number but a different nucleon number	
C3.2.1	describe the differences between *elements*, *mixtures* and *compounds*, and between *metals* and *non-metals* (section 7.1)			Identify physical and chemical changes, and understand the differences between them List the general physical properties of metals Describe the general chemical	

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				properties of metals e.g. reaction with dilute acids and reaction with oxygen.	
C3.2.2	describe *alloys*, such as brass, as mixtures of a metal with other elements			.	
C3.2.3		explain how alloying affects the properties of metals (see 3.2(d))		Explain in terms of their properties why alloys are used instead of pure metals	
C3.2(a).1	describe the formation of *ions* by electron loss or gain and describe the formation of ionic bonds between the alkali metals and the halogens			Describe the formation of ions by electron loss or gain Describe the formation of ionic bonds between metals and non-metals as exemplified by elements from Groups I and VII.	
C3.2(a).2		describe the formation of ionic bonds between metallic and non-metallic elements			describe the formation of ionic bonds between metallic and non-metallic elements
C3.2(b).1	describe the formation of single covalent bonds in H_2, C*l*$_2$, H_2O, CH_4 and HC*l* as the sharing of pairs of electrons leading to the noble gas configuration			Describe the formation of single covalent bonds in H_2, C*l*$_2$, H_2O, CH_4, NH_3 and HC*l* as the sharing of pairs of electrons leading to the noble gas configuration	
C3.2(b).2		describe the electron arrangement in more complex covalent molecules such as N_2, C_2H_4, CH_3OH and CO_2			Draw dot-and-cross diagrams to represent the multiple bonding in N_2, C_2H_4, CH_3OH and CO_2.
C3.2(b).3	describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds			Describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds	
C3.2(c).1	describe the structure of graphite and of diamond			Describe the giant covalent structures of graphite and diamond	
C3.2(c).2		relate these structures to melting point, conductivity and hardness		Relate their structures to the use of. graphite as a lubricant and a conductor, and of diamond in	

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				cutting tools	
C3.2.(d).1		describe metallic bonding as a lattice of positive ions in a 'sea of electrons' and use this to explain the electrical conductivity and malleability of metals			describe metallic b[illegible] lattice of positive ions[illegible] electrons' and use this t[illegible] the electrical conductivity a[illegible] malleability of metals
C4.1	use the symbols of the elements and write the formulae of simple compounds			Use the symbols of the elements to write the formulae of simple compounds	
C4.2		determine the formula of an ionic compound from the charges on the ions present			Determine the formula of an ionic compound from the charges on the ions present
C4.3	deduce the formula of a simple compound from the relative numbers of atoms present			Determine the formula of a simple compound from the relative numbers of atoms present	
C4.4		deduce the balanced equation of a chemical reaction, given relevant information			Deduce the balanced equation for a chemical reaction, given relevant information
C4.5	construct word equations and simple balanced chemical equations			Construct word equations and simple balanced chemical equations	
C4.6	define *relative atomic mass*, A_r			Define *relative atomic mass*, *A*r , as the average mass of naturally occurring atoms of an element on a scale where the 12C atom has a mass of exactly 12 units	
C4.7	define *relative molecular mass*, M_r , and calculate it as the sum of the relative atomic masses (the term *relative formula mass* or M_r will be used for ionic compounds)			Define *relative molecular mass*, *M*r , as the sum of the relative atomic masses (*Relative formula mass* or *M*r will be used for ionic compounds)	
C4.8		calculate stoichiometric reacting masses and volumes of gases and solutions, solution concentrations expressed in g / dm^3 and mol / dm^3.		Calculate stoichiometric reacting masses, volumes of gases and solutions, and concentrations of solutions expressed in g / dm^3 and mol / dm^3 (Calculations	

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		(Calculations based on limiting reactants may be set; questions on the gas laws and the conversion of gaseous volumes to different temperatures and pressures will **not** be set.)		involving the idea of limiting reactants may be set Questions on the gas laws and the conversion of gaseous volumes to different temperatures and pressures will **not** be set.)	
C5.1.1	describe the production of heat energy by burning fuels			Describe the release of heat energy by burning fuels	
C5.1.2	describe hydrogen as a fuel			State the use of hydrogen as a fuel	
C5.1.3	describe radioactive isotopes, such as ^{235}U, as a source of energy			Describe radioactive isotopes, such as ^{235}U, as a source of energy	
C5.2.1	describe the meaning of *exothermic* and *endothermic* reactions			Describe the meaning of *exothermic* and *endothermic* reactions	
C5.2.2	describe bond breaking as endothermic and bond forming as exothermic				Describe bond breaking as an endothermic process and bond forming as an exothermic process
C5.3.1	describe the effects of concentration, particle size, catalysts (including enzymes) and temperature on the rates of reactions			Describe and explain the effect of concentration, particle size, catalysts (including enzymes) and temperature on the rates of reactions	
C5.3.2		show awareness that light can provide the energy needed for a chemical reaction to occur			Describe and explain the role of light in photochemical reactions and the effect of light on the rate of these reactions (This should be linked to section 14.4.)
C5.3.3	state that organic compounds that catalyse organic reactions are called enzymes				
C5.3.4		state that photosynthesis leads to the production of glucose from carbon dioxide and water in the			(Describe) photosynthesis as the reaction between carbon dioxide and water in the presence of

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		presence of chlorophyll and sunlight (energy)			chlorophyll and [illegible]rgy) to produce glucose [illegible]
C5.3.5	describe the application of the above factors to the danger of explosive combustion with fine powders (e.g. flour mills) and gases (e.g. mines)			Describe the application of the above factors to the danger of explosive combustion with fine powders (e.g. flour mills) and gases (e.g. methane in mines)	
C5.3.6		describe the use of silver salts in photography (i.e. reduction of silver ions to silver)			Describe the use of silver salts in photography as a process of reduction of silver ions to silver;
C5.4.1	define *oxidation* and *reduction* in terms of oxygen gain / loss			Define *oxidation* and *reduction* in terms of oxygen loss/gain	
C6.1.1	describe the characteristic properties of acids as reactions with metals, bases, carbonates and effect on litmus			Describe the characteristic properties of acids as reactions with metals, bases, carbonates and effect on litmus and methyl orange	
C6.1.2		define *acids* and *bases* in terms of proton transfer, limited to aqueous solutions			Define *acids* and *bases* in terms of proton transfer, limited to aqueous solutions
C6.1.3	describe neutrality, relative acidity and alkalinity in terms of pH (whole numbers only) measured using Universal Indicator paper			Describe neutrality and relative acidity and alkalinity in terms of pH measured using Universal Indicator paper (whole numbers only)	
C6.1.4		use these ideas to explain specified reactions as acid / base			
C6.1.5	describe and explain the importance of the use of lime in controlling acidity in soil			Describe and explain the importance of controlling acidity in soil	
C6.2.1	classify oxides as either acidic or basic, related to the metallic and non-metallic character of the element forming the oxide			Classify oxides as either acidic or basic, related to metallic and non-metallic character	
C6.2.2		classify other oxides as neutral or amphoteric			Further classify other oxides as neutral or amphoteric

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C6.3.1	describe the preparation, separation and purification of salts as examples of some of the techniques specified in section 2 and the reactions specified in section 6.1			Demonstrate knowledge and understanding of preparation, separation and purification of salts as examples of some of the techniques specified in section 2.2.2 and the reactions specified in section 8.1	
C6.3.2		suggest a method of making a given salt from suitable starting materials, given appropriate information, including precipitation			Demonstrating knowledge and understanding of the preparation of insoluble salts by precipitation Suggest a method of making a given salt from suitable starting materials, given appropriate information.
C6.4.1	describe the use of the following tests to identify: – *aqueous cations:* ammonium, copper(II), iron(II), iron(III) and zinc, using aqueous sodium hydroxide and aqueous ammonia as appropriate. (Formulae of complex ions are **not** required.) – *anions:* carbonate (by reaction with dilute acid and then limewater), chloride (by reaction under acidic conditions with aqueous silver nitrate), nitrate (by reduction with aluminium to ammonia) and sulfate (by reaction under acidic conditions with aqueous barium ions)			Describe the following tests to identify: *aqueous cations:* aluminium, ammonium, calcium, chromium(III), copper(II), iron(II), iron(III) and zinc (using aqueous sodium hydroxide and aqueous ammonia as appropriate) (Formulae of complex ions are **not** required.) *cations:* use of the flame test to identify lithium, sodium, potassium and copper(II) *anions:* carbonate (by reaction with dilute acid and then limewater), chloride, bromide and iodide (by reaction under acidic conditions	

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C6.5.1	describe the use of the following tests to identify: ammonia (using damp red litmus paper), carbon dioxide (using limewater), chlorine (using damp litmus paper), hydrogen (using a lighted splint), oxygen (using a glowing splint)			with aqueous silver nitrate), nitrate (by reduction with aluminium), sulfate (by reaction under acidic conditions with aqueous barium ions) and sulfite (by reaction with dilute acids and then aqueous potassium manganate(VII) *gases:* ammonia (using damp red litmus paper), carbon dioxide (using limewater), chlorine (using damp litmus paper), hydrogen (using lighted splint), oxygen (using a glowing splint), and sulfur dioxide (using aqueous potassium manganate(VII)	
C7.1	describe the Periodic Table as a method of classifying elements and describe its use in predicting properties of elements			Describe the Periodic Table as a method of classifying elements and its use to predict properties of elements	
C7.1.1	describe the change from metallic to non-metallic character across a period			Describe the change from metallic to non-metallic character across a period	
C7.1.2		describe the relationship between group number and the number of outer electrons			Describe and explain the relationship between Group number, number of outer shell electrons and metallic/non-metallic character
C7.2.1	describe lithium, sodium and potassium in Group I as a collection of relatively soft metals showing a trend in melting point, density and reaction with water			Describe lithium, sodium and potassium in Group I as a collection of relatively soft metals showing a trend in melting point, density and reaction with water	

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C7.2.2	predict the properties of other elements in the group given data, where appropriate *(Group I)*			Predict the properties of other elements in Group I, given data, where appropriate	
C7.2.3	describe chlorine, bromine and iodine in Group VII as a collection of diatomic non-metals showing a trend in colour, and state their reaction with other halide ions			Describe the halogens, chlorine, bromine and iodine in Group VII, as a collection of diatomic non-metals showing a trend in colour and density and state their reaction with other halide ions	
C7.2.4	predict the properties of other elements in the group, given data where appropriate *(Group VII)*			Predict the properties of other elements in Group VII, given data where appropriate	
C7.2.5		identify trends in other groups, given data about the elements concerned			Identify trends in Groups, given data about the elements concerned
C7.3.1	describe the transition elements as a collection of metals having high densities, high melting points and forming coloured compounds, and which, as elements and compounds, often act as catalysts			Describe the transition elements as a collection of metals having high densities, high melting points and forming coloured compounds, and which, as elements and compounds, often act as catalysts	
C7.4.1	describe the noble gases as being unreactive			Describe the noble gases, in Group VIII or 0, as being unreactive, monoatomic gases and explain this in terms of electronic structure	
C7.4.2	describe the uses of the noble gases in providing an inert atmosphere (e.g. argon in lamps and helium for filling weather balloons)			State the uses of the noble gases in providing an inert atmosphere, i.e. argon in lamps, helium for filling balloons	
C8.1.1	compare the general physical and chemical properties of metals with those of non-metals			List the general physical properties of metals Describe the general chemical properties of metals e.g. reaction with dilute acids and reaction	

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				with oxygen	
C8.2.1	place in order of reactivity: potassium, sodium ,calcium, magnesium, zinc, iron, hydrogen and copper, by reference to the reactions, if any and where relevant, of the metals with: – water or steam – dilute hydrochloric acid (equations not required) – the aqueous ions of other metals			Place in order of reactivity: potassium, sodium, calcium, magnesium, zinc, iron, (hydrogen) and copper, by reference to the reactions, if any, of the metals with: – water or steam – dilute hydrochloric acid (except for alkali metals) and the reduction of their oxides with carbon	
C8.2.2		account for the apparent unreactivity of aluminium in terms of the oxide layer adhering to the metal			
C8.2.3	deduce an order of reactivity from a given set of experimental results			Deduce an order of reactivity from a given set of experimental results	
C8.3(a).1	describe the ease in obtaining metals from their ores by relating the elements to the reactivity series			Describe the ease in obtaining metals from their ores by relating the elements to the reactivity series	
C8.3(a).2		describe the essential reactions in the extraction of iron from haematite		Describe and state the essential reactions in the extraction of iron from haematite	
C8.3(a).3	name metals that occur 'native', including copper and gold				
C8.3(a).4	name the main ores of aluminium, copper and iron				
C8.3(b).1	describe the idea of changing the properties of iron by the controlled use of additives to form steel alloys				Describe the idea of changing the properties of iron by the controlled use of additives to form steel alloys
C8.3(b).2		name the uses, related to their properties, of copper (electrical		Name the uses of aluminium: – in the manufacture of aircraft	

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		wiring and in cooking utensils) and of aluminium (aircraft parts and food containers)		because of its strength and low density – in food containers because of its resistance to corrosion Name the uses of copper related to its properties (electrical wiring and in cooking utensils)	
C8.3(b).3	name the uses of mild steel (car bodies and machinery) and stainless steel (chemical plant and cutlery)			name the uses of mild steel (car bodies and machinery) and stainless steel (chemical plant and cutlery)	
C8.3(b).4	name the uses of zinc for galvanising and making brass				Explain the use of zinc for galvanising steel, and for making brass.
C9.1	describe a chemical test for water			Describe chemical tests for water using cobalt(II) chloride and copper(II) sulfate	
C9.2	show understanding that hydration may be reversible (e.g. by heating hydrated copper(II) sulfate or hydrated cobalt(II) chloride)				
C9.3	describe, in outline, the purification of the water supply in terms of filtration and chlorination			Describe, in outline, the treatment of the water supply in terms of filtration and chlorination	
C9.4	name some of the uses of water in industry and in the home			Name some of the uses of water in industry and in the home	
C9.5	describe the composition of clean air as being approximately 78% nitrogen, 21% oxygen and the remainder as being a mixture of noble gases, water vapour and carbon dioxide			State the composition of clean air as being a mixture of 78% nitrogen, 21% oxygen and small quantities of noble gases and carbon dioxide.	
C9.6	name the common pollutants in the air as being carbon			name the common air pollutants as being carbon monoxide, sulfur	

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	monoxide, sulfur dioxide, oxides of nitrogen and lead compounds			dioxide, oxides of nitrogen and lead compounds	
C9.7	state the source of each of these pollutants: – carbon monoxide from the incomplete combustion of carbon-containing substances – sulfur dioxide from the combustion of fossil fuels which contain sulfur compounds (leading to 'acid rain') – oxides of nitrogen and lead compounds from car exhausts			State the source of each of these pollutants: – carbon monoxide from the incomplete combustion of carbon-containing substances – sulfur dioxide from the combustion of fossil fuels which contain sulfur compounds (leading to 'acid rain') – oxides of nitrogen from car engines – lead compounds from leaded petrol	
C9.8		explain the catalytic removal of nitrogen oxides from car exhaust gases			Describe and explain the presence of oxides of nitrogen in car engines and their catalytic removal
C9.9	state the adverse effect of common pollutants on buildings and on health			State the adverse effect of these common pollutants on buildings and on health and discuss why these pollutants are of global concern	
C9.10	describe the separation of oxygen and nitrogen from liquid air by fractional distillation				Describe the separation of oxygen and nitrogen from liquid air by fractional distillation
C9.11	name the uses of oxygen in oxygen tents in hospitals, and with acetylene (a hydrocarbon) in welding				
C9.12	describe methods of rust prevention:			Describe and explain methods of rust prevention, specifically paint and other coatings to exclude	

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	– paint and other coatings, to exclude oxygen – galvanising			oxygen	
C9.13		explain galvanising in terms of the reactivity of zinc and iron			Describe and explain sacr[illegible] protection in terms of the reactivity series of metals and galvanising as a method of rust prevention
C9.14	describe the need for nitrogen-, phosphorous- and potassium-containing fertilisers			Describe the need for nitrogen-, phosphorus- and potassium-containing fertilisers	
C9.15	describe the formation of carbon dioxide: – as a product of complete combustion of carbon-containing substances – as a product of respiration – as a product of the reaction between an acid and a carbonate			State the formation of carbon dioxide: – as a product of complete combustion of carbon-containing substances – as a product of respiration – as a product of the reaction between an acid and a carbonate – from the thermal decomposition of a carbonate	
C10.1	describe the manufacture of calcium oxide (lime) from calcium carbonate (limestone) in terms of the chemical reactions involved			Describe the manufacture of lime (calcium oxide) from calcium carbonate (limestone) in terms of thermal decomposition	
C10.2	name some uses of lime and calcium hydroxide (slaked lime), such as treating acidic soil and neutralising acidic industrial waste products			Name some uses of lime and slaked lime such as in treating acidic soil and neutralising acidic industrial waste products, e.g. flue gas desulfurisation	
C11.1.1	name, and draw, the structures of methane, ethane, ethene, ethanol, ethanoic acid and the products of the reactions stated in sections 11.4 to 11.6			Name and draw the structures of methane, ethane, ethene, ethanol, ethanoic acid and the products of the reactions stated in sections 14.4–14.6	
C11.1.2	state the type of compound			State the type of compound	

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	present, given a chemical name ending in *-ane*, *-ene*, *-ol*, or *-oic* acid or a molecular structure			present, given a chemical name ending in *-ane, -ene, -ol,* or *-oic acid* or a molecular structure	
C11.2.1	name the fuels coal, natural gas and petroleum			Recall coal, natural gas and petroleum as fossil fuels that produce carbon dioxide on combustion.	
C11.2.2	name methane as the main constituent of natural gas			Name methane as the main constituent of natural gas	
C11.2.3	describe petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation			Describe petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation	
C11.2.4	name the uses of the fractions: – petrol fraction as fuel in cars – paraffin fraction for oil stoves and aircraft fuel – diesel fraction for fuel in diesel engines – lubricating fraction for lubricants and making waxes and polishes – bitumen for making roads			Name the uses of the fractions as: – refinery gas for bottled gas for heating and cooking – gasoline fraction for fuel (petrol) in cars – naphtha fraction for making chemicals – kerosene/paraffin fraction for jet fuel – diesel oil/gas oil for fuel in diesel engines – fuel oil fraction for fuel for ships and home heating systems – lubricating fraction for lubricants, waxes and polishes – bitumen for making roads .	
C11.3.1	describe the concept of homologous series as a 'family' of similar compounds with similar properties due to the presence of the same functional group			describe the concept of homologous series as a 'family' of similar compounds with similar properties due to the presence of the same functional group	
C11.4.1	describe the properties of			Describe the properties of	

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	alkanes (exemplified by methane) as being generally unreactive, except in terms of burning			alkanes (exemplified by methane) as being generally unreactive, except in terms of burning.	
C11.5.1	describe the properties of alkenes in terms of addition reactions with bromine, hydrogen and steam				Describe the addition react[illegible] alkenes, exemplified by ethen[illegible] with bromine, hydrogen and steam.
C11.5.2		describe the manufacture of alkenes and of hydrogen by cracking			Describe the manufacture of alkenes and of hydrogen by cracking.
C11.5.3	distinguish between *saturated* and *unsaturated* hydrocarbons from molecular structures, by simple chemical tests			Recognise saturated and unsaturated hydrocarbons • from molecular structures, • by their reaction with aqueous bromine.	
C11.5.4	describe the formation of poly(ethene) as an example of addition polymerisation of monomer units			Define polymers as large molecules built up from small units (monomers)	
C11.6.1	name the uses of ethanol: as a solvent, as a fuel and as a constituent of wine and beer			Name the uses of ethanol as a solvent and as a fuel	
C11.6.2		describe the formation of ethanol by fermentation and by the catalytic addition of steam to ethane		Describe the manufacture of ethanol by fermentation and by the catalytic addition of steam to ethene	