

OCR Gateway Chemistry (J248) from 2016 Topic C1: Particles**C1.1**

- Describe the main features of the particle model in terms of states of matter and change of state
- Explain, in terms of the particle model, the distinction between physical changes and chemical changes
- HT ONLY: Discuss the limitations of the particle model in relation to changes of state when particles are represented by inelastic spheres

C1.2

- Describe how and why the atomic model has changed over time
- Describe the structure of and name the sub atomic particles
- State the approximate size of atoms and the relative size of the nucleus and recall where most of the atom's mass is located
- State the relative charge of protons, neutrons and electrons and describe the overall charge of an atom
- State the relative mass of protons, neutrons and electrons and describe the distribution of mass in an atom
- Calculate the number of protons, neutrons and electrons in an atom when given its atomic number and mass number
- Define atomic number and mass number
- Define an ion and an isotope and use the standard notation to represent these

OCR Gateway Chemistry (J248) from 2016 Topic C2: Elements, compounds and mixtures**C2.1**

- Explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term 'pure'
- Recall how to use melting point data to distinguish pure from impure substances
- Describe what the relative formula mass (M_r) of a compound is and calculate the relative formula mass of a compound, give its formula
- Deduce the empirical formula of a compound
- Explain that many useful materials are formulations of mixtures
- Describe, explain and exemplify the processes of filtration, crystallisation, simple distillation, and fractional distillation
- Describe the techniques of paper and thin layer chromatography
- Recall that chromatography involves a stationary and a mobile phase
- Recall how to interpret chromatograms, including measuring R_f values
- Suggest suitable separation and purification techniques for different mixtures
- Suggest chromatographic methods for distinguishing pure from impure substances

C2.2

- Describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties
- Explain how the atomic structure of metals and non-metals relates to their position in the periodic table
- Explain how the position of an element in the periodic table is related to the arrangement of electrons in its atoms
- Describe how elements are placed in groups and periods and how the electrons link to a group number
- Describe and compare the nature and arrangement of chemical bonds in: ionic compounds, simple molecules, giant covalent structures, polymers and metals
- Explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons
- Represent ionic compounds and simple covalent molecules using dot and cross diagrams

- Discuss the limitations of particular representations and models, including dot and cross diagrams, ball and stick models and two-and-three-dimensional representations
- Explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number
- Explain in terms of atomic number how Mendeleev's arrangement was refined into the modern periodic table

C2.3

- Recall that carbon can form four covalent bonds
- Explains that the vast array of natural and synthetic organic compounds occurs due to the ability of carbon to form families of similar compounds, chains and rings
- Explain the properties of graphite, diamond, fullerenes and graphene in terms of their structure and bonding
- Explain the different temperatures at which changes of state occur, using ideas about energy transfers and the relative strength of chemical bonds and intermolecular forces
- Use data to predict states of substances under given conditions
- Explain how the bulk properties of materials are related to the different types of bonds they contain, their bond strengths and the ways in which their bonds are arranged
- CHEM ONLY: Compare the dimensions of nanoparticles to other particles and explain the effect of their high surface area to volume ratio on their properties
- CHEM ONLY: Describe the surface area to volume relationship for different-sized particles and describe how this affects properties
- CHEM ONLY: Describe how the properties of Nano particulate materials are related to their uses
- CHEM ONLY: Explain the possible risks associated with some Nano particulate materials

OCR Gateway Chemistry (J248) from 2016 Topic C3: Chemical reactions

C3.1

- Recall how to use chemical symbols to write the formulae of elements and simple covalent and ionic compounds
- Write word equations and balanced symbol equations for chemical reactions, including using appropriate state symbols
- Use the names and symbols of common elements and compounds and the principle of conservation of mass to write formulae and balanced chemical equations where appropriate
- Use for formula of common ions to deduce the formula of a compound
- HT ONLY: Write balanced half equations and ionic equations
- HT ONLY: Recall and use the definitions of the Avogadro constant and of the mole, and carry out calculations in standard form using the Avogadro constant
- HT ONLY: Explain how the mass of a given substance is related to the amount of that substance in moles and vice versa
- Recall and use the law of conservation of mass
- Explain any observed changes in mass in non-enclosed systems during a chemical reaction, using the particle model
- HT ONLY: Deduce the stoichiometry of an equation from the masses of reactants and products
- HT ONLY: Explain the effect of limiting the quantity of a reactant
- HT ONLY: Calculate the masses of reactants and products when given a balanced symbol equation

C3.2

- Distinguish between endothermic and exothermic reactions on the basis of the temperature change of the surroundings
- Draw and label a reaction profile for an exothermic and an endothermic reaction
- Explain activation energy as the energy needed for a reaction to occur
- HT ONLY: Calculate energy changes in a chemical reaction by considering bond making and bond breaking energies

C3.3

- Explain reduction and oxidation in terms of loss or gain of oxygen, identifying which species are oxidised and which are reduced
- HT ONLY: Explain reduction and oxidation in terms of gain or loss of electrons
- Recall that acids form hydrogen ions when they dissolve in water and solutions of alkalis contain hydroxide ions

- Describe neutralisation as acid reacting with alkali or a base to form a salt plus water
- Recall that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water
- Recall that carbonates and some metals react with acids and write balanced equations predicting products from given reactants
- HT ONLY: Use and explain the terms dilute and concentrated and weak and strong, in relation to acids
- Recall that relative acidity and alkalinity are measured by pH
- HT ONLY: Describe neutrality and relative acidity and alkalinity in terms of the effect of the concentration of hydrogen ions on the numerical value of pH
- HT ONLY: Recall that as hydrogen ion concentration increases by a factor of ten, the pH value of a solution decreases by a factor of one
- Describe techniques and apparatus used to measure pH

C3.4

- Recall at which inert electrode (cathode or anode) that metals, hydrogen and non-metals are formed at
- Predict the products of electrolysis of binary ionic compounds (e.g. NaCl) in the molten state
- Describe competing reactions in the electrolysis of aqueous solutions of ionic compounds e.g. NaCl and CuSO₄
- Describe electrolysis in terms of the ions present and reactions at the electrodes
- Describe the technique of electrolysis using inert and non-inert electrodes

OCR Gateway Chemistry (J248) from 2016 Topic C4: Community level systems

C4.1

- Recall the physical and chemical properties of Groups 1, 7 and 0
- Explain how observed simple properties of Groups 1, 7 and 0 depend on the outer shell of electrons of the atoms and predict properties from given trends down the groups
- Recall the general properties of transition metals and their compounds and exemplify these by reference to a small number of transition metals
- Recall how to predict possible reactions and probable reactivity of elements from their positions in the periodic table
- Explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion
- Deduce the order of reactivity of metals based on experimental data

C4.2

- Describe how to test for the presence of hydrogen, oxygen, carbon dioxide and chlorine
- CHEM ONLY: Describe tests to identify aqueous cations and aqueous anions
- CHEM ONLY: Describe how to perform a flame test
- CHEM ONLY: Recall how to identify species from test results
- CHEM ONLY: Interpret flame tests to identify metal ions
- CHEM ONLY: Describe the advantages of instrumental methods of analysis
- CHEM ONLY: Recall how to interpret an instrumental result when given appropriate data in chart or tabular form

OCR Gateway Chemistry (J248) from 2016 Topic C5: Monitoring and controlling chemical reactions

C5.1

- CHEM & HT ONLY: Explain how the concentration of a solution in mol/dm³ is related to the mass of the solute and the volume of the solution
- CHEM ONLY: Describe the technique of titration
- CHEM & HT ONLY: Explain the relationship between the volume of a solution of known concentration of a substance and the volume or concentration of another substance that react completely together
- CHEM & HT ONLY: Describe the relationship between molar amounts of gases and their volumes and vice versa
- CHEM & HT ONLY: Calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass
- CHEM & HT ONLY: Calculate the volumes of gases involved in reactions using the molar gas volume at room temperature and pressure

- HT ONLY: Explain how the mass of a solute and the volume of the solution is related to the concentration of the solution
- CHEM ONLY: Calculate the theoretical amount of a product from a given amount of reactant
- CHEM ONLY: Calculate the percentage yield of a reaction product from the actual yield of a reaction
- CHEM ONLY: Define the atom economy of a reaction
- CHEM ONLY: Calculate the atom economy of a reaction to form a desired product from the balanced equation
- CHEM & HT ONLY: Explain why a particular reaction pathway is chosen to produce a specified product given appropriate data

C5.2

- Suggest practical methods for determining the rate of reaction
- Recall how to interpret rate of reaction graphs
- Describe the effect of changes in temperature, concentration, pressure, and surface area on rate of reaction
- Explain the effects on rates of reaction of changes in temperature, concentration and pressure in terms of frequency and energy of collision between particles
- Explain the effects on rates of reaction of changes in the size of the pieces of a reacting solid in terms of surface area to volume ratio
- Describe the characteristics of catalysts and their effect on rates of reaction
- Recall how to identify catalysts in reactions
- Explain catalytic action in terms of activation energy
- Recall that enzymes act as catalysts in biological systems

C5.3

- Recall that some reactions may be reversed by altering the reaction conditions
- Recall that dynamic equilibrium occurs in a closed system when the rates of forward and reverse reactions are equal
- HT ONLY: Recall how to predict the effect of changing reaction conditions on equilibrium position and suggest appropriate conditions to produce as much of a particular product as possible

OCR Gateway Chemistry (J248) from 2016 Topic C6: Global challenges

C6.1

- Explain, using the position of carbon in the reactivity series, the principles of industrial processes used to extract metals
- Explain why and how electrolysis is used to extract some metals from their ores
- HT ONLY: Evaluate alternative biological methods of metal extraction
- CHEM & HT ONLY: Describe the process of condensation polymerisation
- CHEM & HT ONLY: Explain the trade-off between rate of production of a desired product and position of equilibrium, in some industrial processes
- CHEM & HT ONLY: Recall how to interpret graphs of reaction conditions versus rate
- CHEM & HT ONLY: Explain how the commercially used conditions for an industrial process are related to the availability and cost of raw materials and energy supplies, control of equilibrium position and rate
- CHEM ONLY: Explain the importance of the Haber process in agricultural production
- CHEM ONLY: Compare the industrial production of fertilisers with laboratory syntheses of the same products
- CHEM ONLY: Recall the importance of nitrogen, phosphorus and potassium compounds in agricultural production
- CHEM ONLY: Describe the industrial production of fertilisers as several integrated processes using a variety of raw materials
- Describe the basic principles in carrying out a life-cycle assessment of a material or product
- Recall how to interpret data from a life-cycle assessment of a material or product
- Describe a process where a material or product is recycled for a different use, and explain why this is viable
- Evaluate factors that affect decisions on recycling
- CHEM ONLY: Describe the composition of some important alloys in relation to their properties and uses
- CHEM ONLY: Describe the process of corrosion and the conditions which cause corrosion
- CHEM ONLY: Explain how mitigation of corrosion is achieved by creating a physical barrier to oxygen and water and by sacrificial protection

- CHEM ONLY: Compare quantitatively the physical properties of glass and clay ceramics, polymers, composites and metals
- CHEM ONLY: Explain how the properties of materials are related to their uses and select appropriate materials given details of the usage required

C6.2

- CHEM ONLY: Recognise functional groups and identify members of the same homologous series
- CHEM ONLY: Name and draw the structural formulae, using fully displayed formulae, of the first four members of the straight chain alkanes, alkenes, alcohols and carboxylic acids
- CHEM ONLY: Predict the formulae and structures of products of reactions of the first four and other given members of the homologous series of alkanes, alkenes and alcohols
- CHEM ONLY: Recall the basic principles of addition polymerisation by reference to the functional group in the monomer and the repeating units in the polymer
- CHEM & HT ONLY: Explain the basic principles of condensation polymerisation
- CHEM & HT ONLY: Describe practical techniques to make a polymer by condensation
- CHEM ONLY: Deduce the structure of an addition polymer from a simple alkene monomer and vice versa
- CHEM ONLY: Recall that DNA is a polymer made from four different monomers called nucleotides and that other important naturally-occurring polymers are based on sugars and amino-acids
- CHEM ONLY: Recall that it is the generality of reactions of functional groups that determine the reactions of organic compounds
- Describe and explain the separation of crude oil by fractional distillation
- Describe the fractions as largely a mixture of compounds of formula C_nH_{2n+2} which are members of the alkane homologous series
- Recall that crude oil is a main source of hydrocarbons and is a feedstock for the petrochemical industry
- Explain how modern life is crucially dependent upon hydrocarbons and recognise that crude oil is a finite resource
- Describe the production of materials that are more useful by cracking
- CHEM ONLY: Recall that a chemical cell produces a potential difference until the reactants are used up
- CHEM ONLY: Evaluate the advantages and disadvantages of hydrogen/oxygen and other fuel cells for given uses

C6.3

- Interpret evidence for how it is thought the atmosphere was originally formed
- Explain how, at the beginning of Earth's existence, oxygen was produced by photosynthesis and use the word and chemical equation for photosynthesis
- Describe the greenhouse effect in terms of the interaction of radiation with matter within the atmosphere
- Evaluate arguments for and against the idea that human activities cause a rise in temperature that results in global climate change
- State some potential side effects of global climate change, including discussing scale, risk and environmental implications
- List the major sources of carbon monoxide, sulfur dioxide, oxides of nitrogen and particulates in the atmosphere and explain the problems caused by increased amounts of these substances
- Describe the principal methods for increasing the availability of potable water in terms of the separation techniques used