NATIONAL 5 CHEMISTRY – UNIT 1 – CHEMICAL CHANGES AND STRUCTURE

**Mandatory key areas of knowledge:** **Chemical Changes and Structure**

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| **Mandatory Course**  **Key areas** | **Exemplification of key areas** |
| **Rates of reaction** | Calculations of the average rate of a chemical reaction from a graph of the change in mass or volume against time.  Learners should be familiar with the factors affecting rates of reaction for this Course. |
| **Atomic structure**  **and bonding related**  **to properties of materials** | Learners should have knowledge of: sub-atomic particles, their charge, mass and position within the atom, the structure of the periodic table, groups, periods and atomic number. They should also be familiar with the seven diatomic elements.  When there is an imbalance in the number of positive protons and electrons the particle is known as an ion.  Chemists use nuclide notation to show the numbers of sub-atomic particles in an atom or ion.  Isotopes are atoms of the same element with different mass numbers. Relative atomic mass is the average mass of the isotopes present taking into account their relative proportions.  In a covalent bond, the shared pair of electrons is attracted to the nuclei of the two bonded atoms.  More than one bond can be formed between atoms leading to double and triple covalent bonds.  Covalent substances can form either discrete molecular or giant network structures.  Diagrams show how outer electrons are shared to form the covalent bond(s) in a molecule and the shape of simple two-element compounds.  Covalent molecular substances have low melting and boiling points due to only weak forces of attraction between molecules being broken.  Giant covalent network structures have very high melting and boiling points because the network of strong covalent bonds must be broken.  Ionic bonds are the electrostatic attraction between positive and negative ions.  Ionic compounds form lattice structures of oppositely charged ions. Ionic compound have high melting and boiling points because strong ionic bonds must be broken in order to break down the lattice.  Dissolving also breaks down the lattice structure. Ionic compounds conduct electricity, only when molten or in solution due to the breakdown of the lattice resulting in the ions being free to move.  Experimental procedures are required to confirm the type of bonding present in a substance. |
| **Formulae and reaction quantities** | Chemical and, ionic formulae including compounds containing group ions are used.  The chemical formula of a covalent molecular substance gives the number of atoms present in the molecule. The formula of a covalent network or ionic compound gives the simplest ratio of atoms/ions in the substance.  **Moles**  The gram formula mass is defined as the mass of one mole of a substance. Using the chemical formula of any substance the gram formula mass can be calculated using relative formula masses of its constituent elements.  The concentration of solutions in moles per litre. Calculations to determine the concentration and volume and the mass of a substance through the number of moles present. |
| **Acids and bases** | Learners should have knowledge of pH and acids and bases including neutralisation reactions and salt formation.  A very small proportion of water molecules will dissociate into an equal number of hydrogen and hydroxide ions.  The pH is a measure of the hydrogen ion concentration. A neutral solution has an equal concentration of hydrogen and hydroxide ions.  A solution with a greater concentration of hydrogen ions than hydroxide ions is an acid. When the reverse is true the solution is known as an alkali. The effect of dilution of an acid or alkali with water is related to the concentrations of hydrogen and hydroxide ions.  When added to water, soluble metal oxides produce metal hydroxide solutions, increasing the hydroxide ion concentration. Soluble non-metal oxides increase the hydrogen ion concentration.  **Neutralisation reactions**  For the neutralisation reactions of acids with alkalis or metal carbonates, the reacting species is determined by omission of spectator ions.  Titration is an analytical technique used to determine the accurate volumes involved in chemical reactions such as neutralisation. An indicator is used to show the end-point of the reaction. |

NATIONAL 5 CHEMISTRY – UNIT 2 – NATURE’S CHEMISTRY

**Mandatory key areas of knowledge:** **Nature’s Chemistry**

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| **Mandatory Course Key areas** | **Exemplification of key areas** |
| **Homologous series** | Alkenes are described as unsaturated hydrocarbons and can undergo addition reactions that convert them into alkanes.    The cycloalkane family is a homologous series of hydrocarbons and is identified from the name and the general formula.    Cycloalkanes, with no more than eight carbon atoms in their longest chain, are named from their full structural formulae, shortened structural formulae and molecular formulae.    Structural formulae can be drawn and molecular formulae written from systematic names.  Isomers including alkanes, branched alkanes, alkenes, branched alkenes and cycloalkanes. Isomers have different properties. |
| **Everyday consumer products** | Alcohols    An alcohol is identified from the –OH group and the ending ‘-ol’.    Straight chain alcohols are named from the structure formulae. Given the names of straight-chain alcohols structural and molecular formulae can be written.  Alcohols are effective solvents, highly flammable, and burn with very clean flames  resulting in their use as a fuel.  Carboxylic acids    Carboxylic acids can be identified by the carboxyl ending, the COOH functional group and the ‘-oic’ name ending.    Straight-chained carboxylic acids can be identified and named from the structural formulae. Given the name of straight chained carboxylic acid the structural formulae can be drawn.    Vinegar is a solution of ethanoic acid. Vinegar is used in household cleaning products designed to remove limescale (a build up of insoluble carbonates on plumbing fixtures) and as a preservative in the food industry.  Esters    An ester can be made by reacting a carboxylic acid and an alcohol.  Some uses of esters are in food flavouring, industrial solvents, fragrances and materials. |
| **Energy from fuels** | Alkanes and alcohols can be used as fuels.    Combustion reactions are exothermic reactions. The opposite of this is an endothermic reaction.    When a substance is combusted the reaction can be represented using a balanced formulae equation. The quantities of reactants and products in these reactions can be calculated.    Different fuels provide different quantities of energy and this can be measured experimentally and calculated using Eh = cm∆T. |

NATIONAL 5 CHEMISTRY – UNIT 3 – CHEMISTRY IN SOCIETY

**Mandatory key areas of knowledge:** **Chemistry in Society**

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| **Mandatory key areas** | **exemplification of key areas** |
| **Metals** | Metallic bonding can explain the conductivity of metals.    Balanced ionic equations can be written to show the reaction of metals with water, oxygen, acids  Ion-electron equations can be written for electrochemical cells including those involving non-metals. Combinations of these reactions form redox equations    Fuel cells and rechargeable batteries are two examples of technologies which utilise redox reactions.    The percentage of a particular metal in an ore can be calculated. From the balanced equations for the extraction of metals the reducing agent can be identified. |
| **Properties of plastics** | Plastics can be made by the processes of addition and condensation polymerisation.    The structure of a polymer can be drawn from the structure of its monomers and vice versa.    The type of polymer can be identified from its structure. |
| **Fertilisers** | The Haber process is one of the most important reactions in the production of fertilisers and is an example of a reversible reaction.  Ammonia is the starting material for the commercial production of nitric acid (Ostwald process), which is used to produce ammonium nitrate. |
| **Nuclear chemistry** | Radioactive elements can become more stable by giving out alpha, beta or gamma radiation.  These types of radiation have specific properties such as their mass, charge and ability to penetrate different materials.  The time for half of the nuclei of a particular isotope to decay is fixed and is called the half-life.  Half-life for a particular isotope is a constant so radioactive isotopes can be used to date materials.  Nuclear equations can be written to describe nuclear reactions. Radioactive isotopes are used in medicine and industry. |
| **Chemical analysis** | **﻿**Chemists play an important role in society by monitoring our environment to ensure that it remains healthy and safe and that pollution is tackled as it arises.    A variety of methods exist which enable chemists to monitor the environment both qualitatively and quantitatively, such as acid/base titration, precipitation, flame testing. |