# MARINA INTERNATIONAL SCHOOL

## CHEMISTRY SCHEME OF WORK

### FORM 4 - TERM 1

| WEEK | TOPIC | TOPIC DETAILS |
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| 1.1 | THE PARTICULATE NATURE OF MATTER | 1. State the distinguishing properties of solids, liquids and gases<br>2. Describe the structure of solids, liquids and gases in terms of particle separation, arrangement and types of motion<br>3. Describe changes of state in terms of melting, boiling, evaporation, freezing, condensation and sublimation |
| 1.2 | kinetic theory | 4. Explain changes of state in terms of the kinetic theory<br>5. Describe qualitatively the pressure and temperature of a gas in terms of the motion of its particles |
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| 2.1 | Diffusion and Brownian motion | 6. Describe and explain Brownian motion in terms of random molecular bombardment<br>7. State evidence for Brownian motion<br>8. Show an understanding of the random motion of particles in a suspension (sometimes known as Brownian motion) as evidence for the kinetic particle (atoms, molecules or ions) model of matter |
| 2.2 | Diffusion and Brownian motion | 9. Describe and explain diffusion<br>10. Describe and explain dependence of rate of diffusion on molecular mass |
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| 3.1 | Measurement & Criteria of purity | 1. Name appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes and measuring cylinders |
| 3.2 | Criteria of purity | 2. Demonstrate knowledge and understanding of paper chromatography<br>3. Interpret simple chromatograms<br>4. Identify substances and assess their purity from melting point and boiling point information<br>5. Understand the importance of purity in substances in everyday life, e.g. foodstuffs and drugs<br>6. Interpret simple chromatograms, including the use of Rf values |
| 3.3 | Criteria of purity | |
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| WEEK | TOPIC | TOPIC DETAILS |
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| 4.1 | Methods of purification | 1. Describe and explain methods of purification by the use of a suitable solvent, filtration, crystallisation and distillation (including use of a fractionating column). (Refer to the fractional distillation of petroleum in section 14.2 and products of fermentation in section 14.6.)<br>2. Suggest suitable purification techniques, given information about the substances involved |
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| 5.1 | ATOM, MOLECULES AND IONS | 1. State the relative charges and approximate relative masses of protons, neutrons and electrons<br>2. Define proton number (atomic number) as the number of protons in the nucleus of an atom<br>3. Define nucleon number (mass number) as the total number of protons and neutrons in the nucleus of an atom<br>4. Use proton number and the simple structure of atoms to explain the basis of the Periodic Table with special reference to the elements of proton number 1 to 20 |
| 5.2 | ATOM, MOLECULES AND IONS continue | 5. Define isotopes as atoms of the same element which have the same proton number but a different nucleon number<br>6. State the two types of isotopes as being radioactive and non radioactive<br>7. Understand that isotopes have the same properties because they have the same number of electrons in their outer shell<br>8. State one medical and one industrial use of radioactive isotopes |
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| 6.1 | MOLECULES , IONS AND ELECTRON ARRANGEMENT | 1. Describe the formation of ions by electron loss or gain<br>2. State that cations are positive and anions are negative<br>3. Give examples of polyatomic and monoatomic ion<br>4. Define molecule<br>5. Explain what polyatomic and diatomic molecules are given examples |
| 6.2 | MOLECULES , IONS AND ELECTRON ARRANGEMENT continue | 6. 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.)<br>7. Define element, compound and mixtures |
| 6.3 | MOLECULES , IONS AND ELECTRON ARRANGEMENT continue | 8. Describe the differences between elements, mixtures and compounds, and between metals and non-metals<br>9. Describe an alloy, such as brass, as a mixture of a metal with other elements |
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| WEEK | TOPIC | TOPIC DETAILS |
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| 7.1 | THE PERIODIC TABLE | 1. Describe the Periodic Table as a method of classifying elements and its use to predict properties of elements<br>2. Describe the change from metallic to nonmetallic character across a period<br>3. Describe and explain the relationship between Group number, number of outer shell electrons and metallic/non-metallic character<br>4. Describe lithium, sodium and potassium in Group I as a collection of relatively soft metals showing a trend in melting point, density andreaction with water<br>5. Predict the properties of other elements in Group I, given data, where appropriate |
| 7.2 | THE PERIODIC TABLE | 6. 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<br>7. Predict the properties of other elements in Group VII, given data where appropriate<br>8. Identify trends in Groups, given information about the elements concerned |
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| 8.1 | THE PERIODIC TABLE continue | 9. 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<br>10. Know that transition elements have variable oxidation states |
| 8.2 | THE PERIODIC TABLE continue | 11. Describe the noble gases, in Group VIII or 0, as being unreactive, monoatomic gases and explain this in terms of electronic structure<br><br>12. State the uses of the noble gases in providing an inert atmosphere, i.e. argon in lamps, helium for filling balloons |
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| 9.1 | Ionic bonding | 1. Describe the formation of ionic bonds between element<br>2. Describe the formation of ionic bonds between metallic and non-metallic elements<br>3. Describe the lattice structure of ionic compounds as a regular arrangement of alternating positive and negative ionss from Groups I and VII |
| 9.2 | Covalent molecules | 4. Describe the formation of single covalent bonds in H2, Cl2, H2O, CH4, NH3 and HCl as the sharing of pairs of electrons leading to the noble gas configuration<br>5. Describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds<br>6. Describe the electron arrangement in more complex covalent molecules such as N2, C2H4, CH3OH and CO2<br>7. Explain the differences in melting point and boiling point of ionic and covalent compounds in terms of attractive forces |
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| WEEK | TOPIC | TOPIC DETAILS |
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| 10.1 | Macromolecules | 8. Describe the giant covalent structures of graphite and diamond<br>9. Relate their structures to their uses, e.g. graphite as a lubricant and a conductor, and diamond in cutting tools<br>10. Describe the macromolecular structure of silicon(IV) oxide (silicon dioxide)<br>11. Describe the similarity in properties between diamond and silicon(IV) oxide, related to their structures |
| 10.2 | Metallic bonding | 12. Describe metallic bonding as a lattice of positive ions in a 'sea of electrons' and use this to describe the electrical conductivity and malleability of metals |
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| 11.1 | STOICHIOMETRY | 1. Use the symbols of the elements and write the formulae of simple compounds<br>2. Deduce the formula of a simple compound from the relative numbers of atoms present<br>3. Deduce the formula of a simple compound from a model or a diagrammatic representation |
| 11.2 | STOICHIOMETRY | 4. Determine the formula of an ionic compound from the charges on the ions present<br>5. Construct word equations and simple balanced chemical equations<br>6. Construct equations with state symbols, including ionic equations<br>7. Deduce the balanced equation for a chemical reaction, given relevant information |
| 11.3 | STOICHIOMETRY | 8. Define relative atomic mass, Ar, 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<br>9. Define relative molecular mass, Mr, as the sum of the relative atomic masses. (Relative formula mass or Mr will be used for ionic compounds.) (Calculations involving reacting masses in simple proportions may be set. Calculations will not involve the mole concept.) |

# CHEMISTRY SCHEME OF WORK

## FORM 4 - TERM 2

| WEEK | TOPIC | TOPIC DETAILS |
|---|---|---|
| 1.1 | THE MOLE CONCEPT | 1. Define the mole and the Avogadro constant<br>2. Use the molar gas volume, taken as 24 dm3 at room temperature and pressure<br>3. Calculate stoichiometric reacting masses, volumes of gases and solutions, and concentrations of solutions expressed in g / dm3 and mol / dm3. (Calculations 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.) |
| 1.2 | THE MOLE CONCEPT | 4. Calculate empirical formulae and molecular formulae<br>5. Calculate percentage yield and percentage purity |
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| 2.1 | OXIDATION & REDUCTION | 1. Define oxidation and reduction in terms of oxygen loss/gain. (Oxidation state limited to its use to name ions, e.g. iron(II), iron(III), copper(II), manganate(VII).)<br>2. Define redox in terms of electron transfer<br>3. Identify redox reactions by changes in oxidation state and by the colour changes involved when using acidified potassium manganate(VII), and potassium iodide. (Recall of equations involving KMnO4 is not required.) |
| 2.2 | OXIDATION & REDUCTION | 4. Define oxidising agent as a substance which oxidises another substance during a redox reaction.<br>5. Define reducing agent as a substance which reduces another substance during a redox reaction.<br>6. Identify oxidising agents and reducing agents from simple equations |
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| 3.1 | Electricity and chemistry | 1. Define electrolysis as the breakdown of an ionic compound, molten or in aqueous solution, by the passage of electricity |
| 3.2 | Electricity and chemistry | 2. Describe the electrode products and the observations made during the electrolysis of:<br>☐ molten lead(II) bromide<br>☐ concentrated hydrochloric acid<br>☐ concentrated aqueous sodium chloride<br>☐ dilute sulfuric acid<br>between inert electrodes (platinum or carbon) |

| WEEK | TOPIC | TOPIC DETAILS |
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| 3.3 | Electricity and chemistry | |
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| 4.1 | Electricity and chemistry continue | 5. Describe electrolysis in terms of the ions present and reactions at the electrodes in the examples given<br>6. Predict the products of electrolysis of a specified halide in dilute or concentrated aqueous solution<br>7. Construct ionic half-equations for reactions at the cathode |
| 4.2 | Electricity and chemistry continue | 8. Relate the products of electrolysis to the electrolyte and electrodes used, exemplified by the specific examples in the Core together with aqueous copper(II) sulfate using carbon electrodes and using copper electrodes (as used in the refining of copper)<br>9. Describe the electroplating of metals<br>10. Outline the uses of electroplating |
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| 5.1 | Electricity and chemistry continue | 1. Describe the reasons for the use of copper and (steel-cored) aluminium in cables, and why plastics and ceramics are used as insulators<br>2. Describe the transfer of charge during electrolysis<br>to include:<br>☐ the movement of electrons in the metallic conductor<br>☐ the removal or addition of electrons from the external circuit at the electrodes<br>☐ the movement of ions in the electrolyte |
| 5.2 | Electricity and chemistry continue | 3. Describe the production of electrical energy from simple cells, i.e. two electrodes in an electrolyte<br>4. Describe, in outline, the manufacture of:<br>☐ aluminium from pure aluminium oxide in molten cryolite.<br>☐ chlorine, hydrogen and sodium hydroxide from concentrated aqueous sodium chloride (Starting materials and essential conditions should be given but not technical details or diagrams.) |
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| 6.1 | Electricity and chemistry continue | 5. Know that aluminium is extracted from the ore bauxite by electrolysis<br>6. Discuss the advantages and disadvantages of recycling metals, limited to iron/steel and aluminium<br>7. Describe in outline, the extraction of aluminium from bauxite including the role of cryolite and the reactions at the electrodes |
| 6.2 | Electricity and chemistry continue | 8. Name the uses of aluminium:<br>☐ in the manufacture of aircraft because of its strength and low density<br>☐ in food containers because of its resistance to corrosion |
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| WEEK | TOPIC | TOPIC DETAILS |
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| 7.1 | ENERGETICS OF A REACTION | 1. Identify physical and chemical changes, and understand the differences between them<br>2. Describe the meaning of exothermic and endothermic reactions<br>3. Interpret energy level diagrams showing exothermic and endothermic reactions<br>4. Describe bond breaking as an endothermic process and bond forming as an exothermic process<br>5. Draw and label energy level diagrams for exothermic and endothermic reactions using data provided |
| 7.2 | ENERGETICS OF A REACTION | 6. Calculate the energy of a reaction using bond energies |
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| 8.1 | ENERGETICS OF A REACTION continue | 7. Describe the release of heat energy by burning fuels<br>8. State the use of hydrogen as a fuel<br>9. Describe radioactive isotopes, such as 235U, as a source of energy |
| 8.2 | ENERGETICS OF A REACTION continue | 10. Describe the use of hydrogen as a fuel reacting with oxygen to generate electricity in a fuel cell. (Details of the construction and operation of a fuel cell are not required.) |

# CHEMISTRY SCHEME OF WORK

## FORM 4 - TERM 3

| WEEK | TOPIC | TOPIC DETAILS |
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| 1.1 | Acids, bases and salts | 1. Describe the characteristic properties of acids as reactions with metals, bases, carbonates and effect on litmus and methyl orange |
| 1.2 | Acids, bases and salts continue | 2. Describe the characteristic properties of bases as reactions with acids and with ammonium salts and effect on litmus and methyl orange |
| 1.3 | Acids, bases and salts continue | 3. Describe neutrality and relative acidity and alkalinity in terms of pH measured using universal indicator paper (whole numbers only) |
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| 2.1 | Acids, bases and salts continue | 4. Describe and explain the importance of controlling acidity in soil<br>5. Define acids and bases in terms of proton transfer, limited to aqueous solutions<br>6. Describe the meaning of weak and strong acids and bases |
| 2.2 | Acids, bases and salts continue | 7. Classify oxides as either acidic or basic, related to metallic and non-metallic character<br>8. Further classify other oxides as neutral or amphoteric |
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| 3.1 | Preparation of salts | 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 of the syllabus. |
| 3.2 | Preparation of salts continue | 2. Demonstrate knowledge and understanding of the preparation of insoluble salts by precipitation. |
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| 4.1 | preparation of salt continue | 3. Suggest a method of making a given salt from a suitable starting material, given appropriate information |
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| 5.1 | IDENTIFICATION OF IONS AND GASES | 1. Describe the following tests to identify:<br>• aqueous cations:<br>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.) |

| WEEK | TOPIC | TOPIC DETAILS |
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| 5.2 | IDENTIFICATION OF IONS AND GASES | cations:<br>use of the flame test to identify lithium, sodium, potassium and copper(II) |
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| 6.1 | IDENTIFICATION OF IONS AND GASES | • anions:<br>carbonate (by reaction with dilute acid and then limewater), chloride, bromide and iodide (by reaction under acidic conditions 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)) |
| 6.2 | IDENTIFICATION OF IONS AND GASES | • gases:<br>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)) |