**ATAR CHEMISTRY 12**





**LEARNING PROGRAM 2018**

| **Semester Week** | **Unit 3 – Equilibrium, acids and bases, and redox reactions** | **Pearson Reference** | **Nelson reference** | **Chemistry for WA 2 (Pearson/ Heinemann)** | **Assessment tasks** | **Exploring Chemistry Year 12 E = Experiment I = Investigation SET = Problems PPT = PowerPoint** |
| --- | --- | --- | --- | --- | --- | --- |
| **1-4** | **Chemical equilibrium systems** |  |  |  |  |  |
| ·         collision theory can be used to explain and predict the effects of concentration, temperature, pressure, the presence of catalysts and surface area of reactants on the rates of chemical reactions | Chapter 1 pp 3-9 Qs P8: q1-6 | Chapter 1 - Equilibrium  1.1 |  |  | Rates and Equilibrium slide show |
| ·         chemical systems include physical changes and chemical reactions and may be open (which allow matter and energy to be exchanged with the surroundings) or closed (which allow energy, but not matter, to be exchanged with the surroundings) | Chapter 2.1 P20 | 1.2 |  |  | Set 4 |
| ·         observable changes in chemical reactions and physical changes can be described and explained at an atomic and molecular level | Chapter 2.1 | 1.2 |  |  | E3  E4 |
| ·         over time, in a closed system, reversible physical and chemical changes may reach a state of dynamic equilibrium, with the relative concentrations of products and reactants defining the position of equilibrium | Chapter 2.2. P21-P30 Qs P24: Q 1-4 Qs P31 : q1-3 | 1.3 Qs p146 |  |  | E2 (optional) |
| ·         the characteristics of a system in dynamic equilibrium can be described and explained in terms of reaction rates and macroscopic properties | Chapter 2.2 | 1.3 |  |  |  |
| ·         equilibrium law expressions can be written for homogeneous and heterogeneous systems; the equilibrium constant (K), at any given temperature, indicates the relationship between product and reactant concentrations at equilibrium | Chapter 2 P33 | 1.3  Qs p154 |  |  | Set 5  Set 6 |
| ·         the relative amounts of reactants and products (equilibrium position) can be predicted qualitatively using equilibrium constants (Kc ) | Chapter 2.4 | 1.4 |  |  | Set 7 |
| ·         the reversibility of chemical reactions can be explained in terms of the activation energies of the forward and reverse reactions | Chapter 2.4 | 1.4 |  |  |  |
| ·         the effects of changes in concentration of solutions and partial pressures of gases on chemical systems initially at equilibrium can be predicted and explained by applying collision theory to the forward and reverse reactions | Chapter 2.4, 2.6 Qs Review P39. Q1-5 | 1.4 |  |  |  |
| ·         the effects of changes in temperature, concentration of species in solution, partial pressures of gases, total volume and the addition of a catalyst on equilibrium systems can be predicted using Le Châtelier’s Principle | Chapter 2.5 | 1.4 Qs p167 |  |  |  |
| ·         the effect of changes of temperature on chemical systems initially at equilibrium can be predicted by considering the enthalpy changes for the forward and reverse reactions; this can be represented on energy profile diagrams and explained by the changes in the rates of the forward and reverse reactions | Chapter 2.5 Qs Chapter Rev P56-59 | 1.4 Review Qs pp169 - 170 |  | **Task 1 Practical Test 1 Equilibrium** |  |
|  | **Science as a Human Endeavour** |  |  |  |  |  |
| **5** | Levels of carbon dioxide in the atmosphere are rising and have a significant impact on global systems, including surface temperatures. The increasing level of carbon dioxide in the atmosphere causes more carbon dioxide to dissolve in the ocean producing carbonic acid and leading to increased ocean acidity. This is predicted to have a range of negative consequences for marine ecosystems such as coral reefs. Calcification is the process which results in the formation of calcium carbonate structures in marine organisms. Acidification shifts the equilibrium of carbonate chemistry in seawater, decreasing the rate and amount of calcification among a wide range of marine organisms. The United Nations Kyoto Protocol and the Intergovernmental Panel on Climate Change aim to secure a global commitment to reducing greenhouse gas emissions over the next few decades. | Chapter 3 Qs 3.1 P66 Qs 3.2 P73 Qs Review P81-83 | Context 5 - Aquatic Chemistry (p111 – 119) |  | **Task 2 Test 1- Rates and Equilibrium (pref Tue27 or Wed 28 Feb)** |  |
|  |  |  |  |  |  |  |
|  | **Acids and bases** |  |  |  |  |  |
| **5-6** | ·         acids are substances that can act as proton (hydrogen ion) donors and can be classified as monoprotic or polyprotic, depending on the number of protons available for donation | Chapter 4.1 P86-87, P91 | Chapter 2 - Acid Base Equilibrium Systems  2.1 |  |  | PPT: Acids and Bases (Ta) |
| ·         the relationship between acids and bases in equilibrium systems can be explained using the Brønsted-Lowry model and represented using chemical equations that illustrate the transfer of protons between conjugate acid-base pairs | Chapter 4.2 P89-91 | Qs p179 |  |  | Set 8 |
| ·         the strength of acids is explained by the degree of ionisation at equilibrium in aqueous solution which can be represented by chemical equations and acidity constants (Ka) | Chapter 4.3 P93-97 | 2.4 - 2.5  Qs p194 |  |  | Set 9 |
| ·         water is a weak electrolyte; the self-ionisation of water is represented by Kw = [**H+**][**OH-**] where Kw = 1.0 x 10-14 at 25 oC | Chapter 4.3 P98 | 2.3 |  |  | Set 11 |
| ·         Kw can be used to calculate the concentration of hydrogen ions or hydroxide ions in solutions of strong acids or bases | Chapter 4.3 P99 |  |  |  |  |
| ·         the pH scale is a logarithmic scale and the pH of a solution can be calculated from the concentration of hydrogen ions using the relationship ooooooooopH = - log10 [H+] | Chapter 4.3 P98-105 Qs 4.3 P105 | 2.2  Qs pp187 - 188 |  |  | Set 13 |
|  |  |  |  |  |  |
| ·         acid-base indicators are weak acids, or weak bases, in which the acidic form is a different colour from the basic form | Chapter 6 P138-148 Chapt Rev qs P148 | 2.6 |  |  | Sets 12, 14 PPT Indicators E7, E8 |
| ·         buffer solutions are conjugate in nature and resist changes in pH when small amounts of strong acid or base are added to the solution; buffering capacity can be explained qualitatively; Le Châtelier’s Principle can be applied to predict how buffers respond to the addition of hydrogen ions and hydroxide ions | Chapter 5 P138-148 Qs 5.2 P129 Qs 5.3 P133 Chapt Rev P134 | Context 5 - Aquatic Chemistry (Expt. 5.2: Buffers  p120 – 121) |  |  | PPT: Buffers STAWA P34 Swimming Pools and Oceans Set 14 E10 (optional) |
| ·         the hydrolysis of salts of weak acids and weak bases can be represented using equations; the **Brønsted-Lowry model can be applied to explain the acidic, basic and neutral nature of salts derived from bases and monoprotic and polyprotic acids** | Chapt 4.5 P113-117 Qs Rev 4.5 P118 | p186   Review Qs  p203 - 204 |  |  | Set 10 E9 |
| **7-9** | ·         volumetric analysis methods involving acid-base reactions rely on the identification of an equivalence point by measuring the associated change in pH, using appropriate acid-base indicators or pH meters, to reveal an observable end point | Chapt 4.4 P106 Qs 4.4 Rev P112 Chapter 7 P150-167 Qs Rev 7.2 P157 Qs Rev 7.3 P161 Qs Rev 7.4 P167 | Chapter 4 - Volumetric Analysis  4.1- 4.4  (not redox)   Qs p233, p238 | Chapter 8 (8.2-8.3) |  | Sets 15,16,17 E12 E13 E14 E15 E17 (optional) E18 (optional) |
| ·         data obtained from acid-base titrations can be used to calculate the masses of substances and concentrations and volumes of solutions involved | Chapter 7.5 P168 Qs Rev 7.5 P176 Chapt Rev 177-178 | 4.1  (titration curves)  Review Qs  p251- 252 | Chemical Reactions and Volumetric Analysis (no redox titrations) |  |  |
|  | **Science as a Human Endeavour** |  |  |  |  |  |
| **10** | Models and theories are contested and refined or replaced when new evidence challenges them, or when a new model or theory has greater explanatory scope. Davy initially proposed that acids were substances that contained replaceable hydrogen (hydrogen that could be partly or totally replaced by metals) and bases were substances that reacted with acids to form salts and water. The Arrhenius model, which includes only soluble acids and bases, identified acids as substances which produce hydrogen ions in solution and bases as substances which produce hydroxide ions in solution. Subsequently, the Brønsted-Lowry model describes acid-base behaviour in terms of proton donors and proton acceptors. This approach includes a wider range of substances and can be more broadly applied. | Some information in 4.1 P87-88 | (some information in Chapter 2) |  | **Task 3 Test 2 Acids, bases and volumetric analysis 3rd April** |  |
| **11** | ionic and half equations review from Y11 |  |  |  | **Task 4 Practical Test 2 - volumetric Analysis** |  |
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|  | **Oxidation and reduction** |  |  |  |  |  |
|  | **Science Understanding** |  |  |  |  |  |
| **10-12** | ·         oxidation-reduction (redox) reactions involve the transfer of one or more electrons from one species to another | Chapter 8.1  P180-181 qs 8.1 P187 | Chapter 3 – Introduction to Redox Chemistry  3.1  3.2 |  |  | SET 18 ppt: HTa Redox |
| ·         the species being oxidised and reduced in a redox reaction can be identified using oxidation numbers | Chapter 8.2 P188 qs 8.2 Rev P194 |  |  |  | Set 18 |
| ·         oxidation involves the loss of electrons from a chemical species, and reduction involves the gain of electrons by a chemical species; these processes can be represented using half-equations and redox equations (**acidic** conditions only) | Chapter 8.1  P180-182 P195-199 8.3 Rev Qs P200 | 3.3 (optional?)   3.5 – 3.6 |  |  | Set 19 Set 20 |
| ·         a range of reactions involve the oxidation of one species and reduction of another species, including metal and halogen displacement reactions, combustion and corrosion | Combustion: P180 Halogen displ. P181 qs 8.1 P186, Rev P187 Metal displacement P203 9.5 Corrosion  qs: P243 Q1-5 | Qs p211, p217, p222 |  |  | E19  E20  E24  E21 |
|  | Term 2 |  |  |  |  |  |
| **12-14** | ·         Basic Stoichiometry  Moles/mass/gas volume  (To set the foundation for Semester 2 calcs) PV = nRT using Haber as context Multi-step equation calcs using Contact as concept |  |  |  |  |  |
| **14** | ·         Semester 1 Exam Preparation |  |  |  |  |  |
| **15-16** | **TASK 5 Exam –Semester One** |  |  |  | **TASK 5 Exam –Semester One** |  |
| **17** | Exam review |  |  |  |  |  |
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| **16-20** |  |  |  |  |  |  |
| ·         electrochemical cells, including galvanic and electrolytic cells, consist of oxidation and reduction half-reactions connected via an external circuit through which electrons move from the anode (oxidation reaction) to the cathode (reduction reaction) | 9.1 Galvanic Cells. Review P218 Q1-4 | 5.3  Qs p264 |  |  |  |
| ·         galvanic cells produce an electric current from a spontaneous redox reaction | 9.1 Galvanic Cells. Review P218 Q1-4 | 5.4 |  |  |  |
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| ·         the relative strength of oxidising and reducing agents can be determined by comparing standard electrode potentials, and can be used to predict reaction tendency | 9.2 Rev P225: Q1-4 | Chapter 5 - Electro-chemical Cells  5.1 – 5.2  Qs p257 | Chapter 10 (10.1-10.2)  Application of Redox Chemistry to Modern Lifestyles | **TASK 6A Comprehension 1 Research –primary, secondary and fuel cells  (hand out task)** | Set 21 |
| ·         the electric potential difference of a cell under standard conditions can be calculated from standard electrode potentials; these values can be used to compare the voltages generated by cells constructed from different materials | 9.3 Predicting direct redox reactions Qs: 9.3 P228 Q1-5 |  |  |  |  |
| ·         electrochemical cells can be described in terms of the reactions occurring at the anode and cathode, the role of the electrolyte, salt bridge (galvanic cell), ion migration, and electron flow in the external circuit |  |  |  |  |  |
| ·           cell diagrams can be used to represent electrochemical cells |  | 5.6 |  |  |  |
| ·           electrolytic cells use an external electrical potential difference to provide the energy to allow a non-spontaneous redox reaction to occur; electrolytic cells are used in a range of industrial situations, including metal plating and the purification of copper |  | Context 2 - Chemical industry a) Copper   refining (p43) b) Electroplating   (Expt. 5.3 p272) |  |  |  |
| **Science as a Human Endeavour** |  |  |  |  |  |
| Spontaneous redox reactions can be used as a source of electrical energy, including primary, secondary and fuel cells. Fuel cells are a potential lower-emission alternative to the internal combustion engine and are already being used to power various modes of transport. Organisations, including the International Partnership for Hydrogen and Fuel Cells in the Economy, have been created to foster global cooperation on research and development, common codes and standards, and information sharing on infrastructure development. | 9.4 Everyday sources of power. Rev Qs P238: 1-5 | 5.5  Qs p266  Context 3 –  Alternative sources of energy a) Batteries   (p64 – 74) b) Fuel cells   (p74 – 76)  Review Qs  p277 - 278 |  |  |  |
| **20** |  |  |  |  | **TASK 7 Tuesday 26th June Test 3 - Redox reactions & Electro-chemistry &  TASK 6B (concurrently** |  |
|  | TERM 3 |  |  |  |  |  |
|  | **Unit 4 – Organic chemistry and chemical synthesis** | |  |  |  |  |
|  |  |  |  |  |  |  |
|  | **Science Understanding** |  |  |  |  |  |
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| **21-25** | • organic molecules have a hydrocarbon skeleton and can contain functional groups, including alkenes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines and amides; functional groups are groups of atoms or bonds within molecules which are responsible for the molecule’s characteristic chemical properties |  | Chapter 6 - Classes of Organic Compounds   6.1 - 6.2  (no alkynes)  Qs p291, p294, p296, p297 – 298 | Chapter 11 11.1 - 11.3 Organic Chemistry 1 - Hydrocarbons  Chapter 12 12.1-12.4 Organic Chemistry 2 - Organic Functional Groups |  | PPT: Organic Chemistry |
| ·         isomers are compounds with the same molecular formulae but different structures; different types of isomerism include chain and position structural isomerism and cis-trans isomerism | 13.1 Diversity of carbon compounds 13.1 Review P319 Q1-8 13.3 Properties of organic compounds 13.3 Review P347 Q1-3 13.4 Isomers 13.4 Review P352 Q1-3 | 6.3  6.4 |  |  |  |
| • organic compounds display characteristic physical properties, including boiling point and solubility in water and organic solvents; these properties can be explained in terms of intermolecular forces (dispersion forces, dipole-dipole interactions and hydrogen bonds) which are influenced by the nature of the functional groups | 13.3 Properties of organic compounds 13.3 Review P347 Q1-3 | Review Qs  p323 - 326 |  |  | Set 24 |
| • IUPAC nomenclature is used to name organic species, including those with a parent chain of up to 8 carbon atoms | 13.2 Functional groups 13.2 Review P334 Q1-5 | 6.5 |  |  |  |
| ·         IUPAC nomenclature is used to name organic species, including those with one of the following functional groups: alkenes, alcohols, aldehydes, ketones, carboxylic acids , esters, amines and amides | Amines and Amides, P328-329 | Qs p304, p306, p310, p315 |  |  |  |
| ·         structural formulae (condensed or showing bonds) can be used to show the arrangement of atoms and bonding in organic molecules that contain the following functional groups: alkenes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines and amides | 13.2 Functional groups Amines + amides P328 13.2 Review P334 Q1-5 Chapt 13 rev P366 Q8-11 | 6.10  Qs p319 |  |  | E29, Set 25 |
| functional groups within organic compounds display characteristic chemical properties and undergo specific reactions; these reactions include addition reactions of alkenes, redox reactions of alcohols, and acid-base reactions of carboxylic acids; these reactions can be used to identify the functional group present within the organic compound • all alcohols can undergo complete combustion; with oxidising agents, including acidified MnO4- or Cr2O72- oxidation of primary alcohols produces **aldehydes** and **carboxylic acids**, while the oxidation of secondary alcohols produce ketones; these reactions have characteristic observations and can be represented with equations | 14.2 Chemical properties of alcohols 14.2Review P383 Q1-3 |  |  | **TASK 8A**  **Investigation 1 – Identification of unknowns**  **(planning phase)** | E31 |
| functional groups within organic compounds display characteristic chemical properties and undergo specific reactions; these reactions include addition reactions of alkenes, redox reactions of alcohols, and acid-base reactions of carboxylic acids; these reactions can be used to identify the functional group present within the organic compound • alcohols can react with carboxylic acids in a condensation reaction to produce esters and can be represented with equations | 14.3 Chemical properties of carboxylic acids 14.3 Review P399 Q1-6 |  |  | **TASK 8A**  **Investigation 1 – Identification of unknowns**  **Lab** | E32 |
| ·         chemical synthesis processes may involve the construction of reaction sequences with more than one chemical reaction, including the hydrolysis of ethene to form ethanol and the subsequent reaction of ethanol with acetic (ethanoic) acid to produce ethyl ethanoate | 14.4 Creating molecules: an introduction to organic synthesis. Review P394 Q1-4; Chapt 14 Review P395 Q1-20 |  |  | Task 9 Tues week 6 Organic Test | Set 30 |
| • empirical and molecular formulae can be determined by calculation and the structure of an organic compound established from the chemical reactions they undergo, and other analytical data | 13.6 Determining the formulae of organic compounds 13.6 Review P365 Q1-5 Chapter 13 review P366 Q21-26 |  |  | ` | Set 26, 27 |
|  | Organic synthesis |  |  |  |  |  |
| **26-27** | **Introduction to polymers** | 15.1 Polymers: a diverse class of materials 15.1Review P404 Q1-4 |  |  |  |  |
| ·         addition reactions can be used to produce polymers, including polyethene and polytetrafluoroethene •         the structure of an addition polymer can be predicted from its monomer and the structure of an addition polymer can be used to predict the monomer from which it was derived • industry produces a vast range of plastics, including addition polymers (polyethene, polytetrafluoroethene) and condensation polymers (nylon and polyethylene terephthalate [PET]) which have different properties and uses | 15.2 Addition polymerisation 15.2 Review P413 Q1-5 |  |  |  |  |
| ·         condensation reactions can be used to produce polymers, including polyamides and polyesters •          the structure of a condensation polymer can be predicted and drawn from its monomer(s) and the structure of a condensation polymer can be used to predict the monomer(s) from which it was derived • industry produces a vast range of plastics, including addition polymers (polyethene, polytetrafluoroethene) and condensation polymers (nylon and polyethylene terephthalate [PET]) which have different properties and uses | 15.3 Condensation polymerisation. 15.3 Review P420 Q1-6 |  |  |  | E34 (optional) |
| industry produces a vast range of plastic which have different properties and uses | 15.4 Designing polymers for a purpose Review P429 Q1-5 Chapter 15 Review P430 Q1-28 |  |  |  |  |
| • the base hydrolysis (saponification) of fats (triglycerides) produces glycerol and the salt of a long chain fatty acid (soap) • the structure of soaps contains a non-polar hydrocarbon chain and a carboxylate group; the structure of the anionic detergents derived from dodecylbenzene contains a non-polar hydrocarbon chain and a sulfonate group • the cleaning action of soaps and detergents can be explained in terms of their non-polar hydrocarbon chain and charged group; the properties of soaps and detergents in hard water can be explained in terms of the solubilities of their calcium salts | 16.1 Fats and oils  16.1Review P437 Q1-3  16.2 Production of Soaps 16.2 Review P444 Q1-5 16.3 The cleaning action of soaps and detergents 16.3 Review P446 Q1-3 |  |  |  |  |
| • reagents and reaction conditions are chosen to optimise yield and rate for chemical synthesis processes, including in the production of ammonia (Haber process), sulfuric acid (Contact process) and biodiesel (base-catalysed and lipase-catalysed methods) | 16.4 Production of biodiesel. 16.4 Review P453 Q1-5  Chapt 16 Review P454 Q1-18 |  |  | Hand Out 10A Comprehension sheet on Haber |  |
|  | Scientific knowledge can be used to design alternative chemical synthesis pathways, taking into account sustainability, local resources, economics and environmental impacts (green chemistry), including the production of ethanol and biodiesel. | 12.1 Green Chemistry 12.1 Review  page 307 Q1–8 |  |  |  |  |
|  | **Biochemistry: Amino acids and proteins** |  |  |  |  |  |
| **28** | • α-amino acids can be represented using a generalised structure • the characteristic properties of α-amino acids include the formation of zwitterions and the ability to react to form amide (peptide) bonds through condensation reactions • α-amino acids undergo condensation reactions to form polypeptides (proteins) in which the α-amino acid monomers are joined by peptide bonds | 17.1 Amino Acids. 17.1 Review Qs P464 Q1-4   17.2 The formation of proteins  17.2 Review P469 Q1-4 |  |  |  | Set 28 |
| • the sequence of α-amino acids in a protein is called its primary structure • secondary structures of proteins, (a-helix and b-pleated sheets) result from hydrogen bonding between amide and carbonyl functional groups; hydrogen bonding between amide and carbonyl functional groups within a peptide chain leads to a-helix structures while hydrogen bonding between adjacent polypeptide chains leads to b-pleated sheets | 17.3 Primary and secondary structures of proteins 17.3 Review P475 Q1-4 |  |  |  |  |
| • the tertiary structure of a protein (the overall three-dimensional shape) is a result of folding due to interactions between the side chains of the a-amino acid in the polypeptide, including disulfide bridges, hydrogen bonding, dipole-dipole interactions, dispersion forces and ionic interactions | 17.4 Tertiary structures of proteins 17.4 Review P483 Q1-3  Chapt 17 Review P484 Q1-18 |  |  |  | Protein lab (optional), Set 29 E35 |
| • enzymes are protein molecules which are biological catalysts and can be used on an industrial scale to produce chemicals that would otherwise require high pressure or temperature conditions to achieve an economically viable rate, including fermentation to produce ethanol versus hydrolysis of ethene • reagents and reaction conditions are chosen to optimise yield and rate for chemical synthesis processes, including in the production of biodiesel (base-catalysed and lipase-catalysed methods)  The Protein Data Bank (PDB) houses an international repository of structural data of proteins. The information is accessed and contributed to by scientists worldwide. The function of a protein is closely linked to its structure. | 18.1 Investigating proteins  18.1 Review qs P491 Q1-3   18.2 Enzymes 18.2 Review P497 Q1-3  18.3 Enzymes dependence on pH and Temperature  18.3 Review P503 Q1-4  18.4 Enzymes in industry 18.4 Review P508 Q1-3 Chapt 18 Review P509 Q1-18 |  |  | Task 11 Polymers, synthesis and protein test and Task 10B (Week 8) | I36, E38 (optional) |
|  |  |  |  |  |  |  |
| **29-30** | the percentage yield of a chemical synthesis reaction can be calculated by comparing theoretical versus actual product quantities | 11.1 Review  page 277 Q1–4 |  |  |  | Set 31 |
| quantities of products in a chemical synthesis reaction can be calculated by comparing stoichiometric quantities with actual quantities and by determining the limiting reagent | 11.2 Review  page 283 Q1–4 |  |  |  | Set 33 |
| chemical synthesis to form products with specific properties may require the construction of reaction sequences with more than one chemical reaction and involves the selection of particular reagents and reaction conditions in order to optimise the rate and yield of the product | 11.3 Review  page 292 Q1–6  Chapter 11 review |  |  |  | Set 35 |
| 30 | WACE Revision |  |  |  |  |  |
| 32 | Mock WACE Exam |  |  |  | Task 12 Mock Exam |  |
| 34 | Exam Review + WACE Revision |  |  |  |  |  |