| **week** | **Lesson 1** | **Lesson 2** | **Lesson 3** | **Lesson 4** |
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| **1** | Lessons lost:   * return to school * assemblies, etc. | | **Subtopic 1.3 Volumetric Analysis**  Revise:   * concentration units and conversions * stoichiometry problems. | Exercises  Revise volumetric glassware and titration procedure. |
| **2** | **Practical:**   1. Prepare standard solution of Iron(II) ammonium sulfate 2. Dilute commercial H2O2 solution. | Standardise KMnO4 solution.  Use standardised solution to determine concentration of H2O2 in commercial product. | Analyse results - calculations  Evaluate procedure:   * systematic and random errors * accuracy and precision. | **Subtopic 1.4 Chromatography**  View Interactive Lab Primer  Discuss concepts of chromatography |
| **3** | TLC and Rf  Interpret chromatograms. | **Practical:**  Identification of the analgesic component of an over-the-counter medication. | **Investigation (1) - Volumetric Analysis**:  Demonstrate that tartaric acid is diprotic. |  |
| **4** | GLC and HPLC  Interpret chromatograms. | **[Subtopic 2.2: Equilibrium]**  Revise reversible reactions.  Introduce concept of equilibrium and Le Châtelier’s Principle (changes in concentration). | Ion exchange chromatography.  **[Subtopics 4.3, 4.2]**  Aluminosilicates and zeolites.  Use of zeolites in water softeners.  Cation exchange in soils.  Availability of nutrient cations to plants.  Effect of acidic/saline conditions on soil fertility.  Release of toxic cations into soil water by acidic conditions. |  |
| **5** | **Subtopic 1.5: AAS**  View VEA Chemical Analysis I.  Discuss concepts.  Importance in assessment of metal ores in mining. | Using AAS to identity elements in a sample.  Using AAS to determine concentration of element in a sample:   * construct calibration graphs (revise volumetric glassware, dilution calculations) * use calibration graphs (interpolation, concentration conversions, systematic and random errors). | Exercises:  Analyse AAS data  Calculations. | **[Subtopic 4.1]**  Photosynthesis  Respiration  Carbon cycle  Fossil fuels  Combustion of carbon-based fuels. |
| **6** | **Subtopic 1.1: Global Warming and Climate Change**  Action of greenhouse gases in maintaining steady atmospheric temperatures.  Anthropogenic sources of GH gases.  Exercise: Plot data for trends in global concentration of CO2. Discuss trend. | View (sections of) **An Inconvenient Truth**  Discuss causes and consequences of global warming.  Discuss thawing of permafrost and impact. | Role of oceans in maintaining steady concentrations of CO2 in the atmosphere (revise equilibrium).  Ocean acidification and effects on ocean calcifying organisms: coral reefs.  Revise pH and calculations from Stage 1. |  |
| **7** | **Subtopic 1.2: Photochemical Smog**  Formation of nitrogen oxides:   * natural processes **[Subtopic 4.3]** * combustion in air.   Formation of ozone from NOx. | Interpret graphs showing concentrations of NOx, ozone, hydrocarbons in air over a city.  Harmful effects of photochemical smog. | Use of catalytic converters to reduce NOx from motor vehicles.  **[Subtopic 2.1]**   * Energy profile diagrams * Effect of catalyst on reaction rate. | Review exercises. |
| **8** | **SAT 1: Test** | **Subtopic 3.1: Introduction**  Revise structural formulae, systematic naming of hydrocarbons from Stage 1. | Physical properties of organic compounds:   * revise secondary interactions from Stage 1 * consider the polarities of various functional groups. | Exercises: Predict/explain physical properties of compounds given their structural formulae. |
| **9** | **Subtopic 3.2: Alcohols**  Occurrence  Systematic nomenclature  Classification as primary, secondary, tertiary. | Oxidation products of alcohols.  **Practical:**  Test a range of primary, secondary, tertiary alcohols with acidified potassium dichromate solution. | Alcohols as fuels:   * combustion products * complete and incomplete combustion   **[Subtopic 4.1]**  Advantages/disadvantages of using ethanol as a fuel in place of fossil fuels.  Renewable fuels. | **[Subtopic 4.1]**  Revise enthalpy and calculations from Stage 1.  Calculate quantities of heat evolved per mole, per gram, and per litre for complete combustion of alcohols.  Use of calorimetry to determine enthalpy of combustion. |
| **10** | **Practical:**  Compare the enthalpies of combustion of the first six alcohols. |  | **Subtopic 3.6: Amines**  Occurrence.  Role of amines in the nervous system  Systematic nomenclature. | Classification as primary, secondary, tertiary.  Amines as bases.  Consider lignocaine and use in protonated form. |
| **11** | **Subtopic 3.3: Aldehydes and Ketones**  Occurrence  Systematic nomenclature  Formation from appropriate alcohols. | Oxidation products of aldehydes in acidic and alkaline conditions.  Use of acidified dichromate solution and Tollens’ to distinguish between aldehydes and ketones. | **Practical:**  Prepare propanal and test product with Tollens’reagent. |  |
| **12** | **Subtopic 3.4: Carbohydrates**  Occurrence  Definition  Classification as mono, di, polysaccharides.  Functions of carbohydrates in nature. | Solubility of mono and disaccharides in water.  Condensation of monosaccharides to form di and polysaccharides.  Hydrolysis of di and polysaccharides. | Equilibrium in solution between ring and chain forms of glucose.  **Demonstration:**  Tollens’ test on a solution of glucose.  Discuss results in terms of equilibrium and Le Châtelier’s Principle. | **[Subtopic 4.1]**  **Practical:**  Fermentation of a carbohydrate to produce ethanol. |
| **13** | **Subtopic 3.5: Carboxylic Acids**  Occurrence  Systematic nomenclature  Formation from appropriate alcohols. | **Practical:**  Investigate odours of a range of carboxylic acids.  RCOOH as weak acids:   * ionisation in water * reaction with bases. | **Practical:**   * Reaction of hydrochloric and ethanoic acids with magnesium, metal oxides and hydroxides, metal carbonates and hydrogencarbonates. * Explain differences in reactivities. | Consider drugs with carboxyl groups (Aspirin, penicillin). Desirability of using the drug in the form of the carboxylate salt. |
| **14** | **Subtopic 2.1: Rates of Reaction**  Measuring rate by change in concentration, change in mass of system, volume of gas evolved etc.  **Demonstration:**  Follow the reaction of marble chips with HCl solution over time.   * Graph results. * Interpret graph. | Collision theory used to explain the effect on rate of reaction of changes in:   * concentration of reactant * pressure (gaseous systems) * temperature * surface area * presence of catalyst.   Revise energy profile diagrams and catalytic converters.  Discuss photocatalysis (UV light on nanoparticles of TiO2 on surfaces) to remove undesirable solvent vapours from the air. | **Practical:**  Effect of changing temperature OR reactant concentration on the rate of reaction of sodium thiosulfate and HCl. | Analyse results.  Evaluate procedure.  **Introduce Investigation (2): Practical Design**  Effect of changing a reaction condition on the rate of fermentation of a carbohydrate. |
| **15** | **SAT 2: Test** | **Investigation (2): Practical Design**  **Planning lesson (in pairs)** | **Subtopic 2.2: Equilibrium and Yield**  Revise concepts already introduced:   * reversible reactions * dynamic nature   Graphs representing changes in concentrations of reactants and products as a system reaches equilibrium. | Introduce *Kc*.  Calculations involving *Kc* fo homogeneous systems. |
| **16** | Revise Le Châtelier’s Principle introduced earlier.  Consider effect of changes in:   * concentration * pressure (gaseous systems) * temperature.   **Practical:**  Effect of changes in concentration on the equilibrium concentration of Fe (SCN)2+ in solution. | View film clips of effects of pressure and concentration changes on equilibrium systems.  Interpret graphs representing the effect of changes in equilibrium system with concentration, pressure, temperature changes. | **[Subtopic 4.2]**  Use of chlorine, hypochlorous acid and hypochlorites in water treatment – effect of pH on the equilibrium.  **Revise:**  **[Subtopics 1.4, 4.2, 4.3]**  Cation exchange  Availability of nutrients in soil.  Ion chromatography.  Use of zeolites in water softeners.  **[Subtopic 1.1]**  Role of oceans in removing CO2 from the atmosphere/ocean acidification. | **Subtopic 2.3: Optimising Production**  Interpret flow charts.  Desirable features: high rate, high yield, safe processes, minimum impact on the environment, minimum costs.  Discuss compromises to achieve maximum yield in minimum time.  Advantages/disadvantages of using catalysts. |
| **17** | Examples:  Choose from production of ammonia, sulfuric acid, nitric acid. | **Investigation (2): Practical Design** |  | **Subtopic 3.7: Esters**  Occurrence  Systematic nomenclature  Formation from appropriate alcohol and acid – Condensation. |
| **18** | Formation of polyesters  Hydrolysis of esters under acidic and alkaline conditions. | **Practical:**  Preparation of an ester. |  | **Subtopic 3.9: Triglycerides**  Formation from 1,2,3-propanetriol and fatty acid.  Saturated/unsaturated triglycerides:   * sources * physical state. |
| **19** | **Practical:**  Use bromine solution to test various triglycerides for saturation.  Conversion of liquid triglycerides into triglycerides with higher melting point.  Discuss production of margarine. | Alkaline hydrolysis of triglycerides.  Formation of amphiphilic particles.  Explain uses of amphiphilic particles:   * to remove grease (soaps and detergents – include effect of hard water) * to stabilise mayonnaise and ice cream * in Nano sized micelles to deliver hydrophobic drugs. | **Subtopic 3.8: Amides**  Formation by condensation of amine and carboxylic acid.  Formation and properties of polyamides.  Consider nylon. | Hydrolysis of amides under acidic and alkaline conditions. |
| **20** | **Subtopic 3.10: Proteins**  Amino acids   * general formula * acidic and basic properties * self-ionised form. | Condensation to form protein chain.  Protein chains and secondary interactions:   * within the chain * between the chain and water. | Effect of changes in pH and temperature on the spatial arrangement of the protein chain and hence of its function.  Role of enzymes in life processes. |  |
| **21** | **Subtopic 4.1**  Revise material introduced earlier in the year:   * fuels * carbon cycle and reactions * fossil and renewable fuels.   Biofuels:   * production of ethanol (revise) and biodiesel * biofuels/fossil fuels and global warming. | **Practical:**  Prepare a sample of biodiesel. |  | **SAT 3: Test** |
| **22** | Advantages/disadvantages of using carbon-based fuels for energy.  Revise:   * combustion (complete/incomplete) * calorimetry/enthalpy of combustion * thermochemical calculations. | Writing thermochemical equations.  Compare fuels (including calculations of energies released per mole, per gram, per litre). | Revise galvanic cells from Stage 1.  Photovoltaic cells.  Advantages/disadvantages of direct energy generation. | Fuel cells   * structure * half-equations for various fuels * advantages/disadvantages compared with other galvanic cells. |
| **23** | **Subtopic 4.2**  Different methods for treating water.  Use of aluminium ions and polymers to remove suspended clay particles from water. | Revise:   * hard water * use of zeolites in water softeners * use of chlorine and some compounds for disinfection.   Reverse osmosis process.  Desalination by reverse osmosis and thermal distillation. | Discuss issues associated with use of Adelaide desalination plant.  **Introduce Investigation (3) SHE:**  **Industrial wastewater**.  Class time for initial research and discussion with teacher |  |
| **24** | **Subtopic 4.3: Soil**  Why plants need nutrients in soluble form.  Revise:   * natural and anthropogenic nitrogen-fixing processes.   Why fertilisers may be needed to improve the productivity of some soils. | Process and consequences of eutrophication. | Silicon dioxide, silicates and aluminosilicates  Formula of anion from formula of silicate of aluminosilicate. | Revise:   * cation exchange * impact of acidic and saline conditions on the nutrient value of soils. |
| **25** | **Subtopic 4.4**  Revise work on addition polymers from Stage 1, and on condensation polymers from Topic 3.7, 3.8.    View VEA Addition Polymers. | View VEA Condensation Polymers    Advantages/disadvantages of:   * synthetic polymers * producing polymers from fossil source or from renewable materials. | Properties of organic polymers:   * revise secondary interactions from Stage 1 * effect of cross-linking and secondary interactions on rigidity, strength, elasticity, behaviour on heating. | Thermoplastic and thermoset polymers:   * structure * effect of heat * impact on ability to be recycled.   Impact of disposal of plastics on the environment.  Biodegradability. |
| **26** | Occurrence of metals – depends on metal reactivity.  Stages in the production of metals form their ores – energy requirements.  Method of reduction is related to the reactivity of the metal and availability of energy.  Depending on metal reactivity may use:   * electrolysis of molten salt * electrolysis of aqueous solution * heat and a reducing agent. | Revise electrolysis from Stage 1.  Compare reduction methods for the production of:   * Group 1 and 2 metals, and aluminium * zinc * iron or copper. | Compare environmental impacts of producing aluminium from bauxite with zinc from zinc ore.  Discuss phytomining and bioleaching. | Consider production of Zn to revise:   * amphiphilic particles (froth flotation) * reactions of metallic oxides with acids * displacement of a metal from solution by a more reactive metal * electrolysis of aqueous solutions. |
| **27** | Need for the recycling of materials.  Discuss energy requirements for recycling aluminium cans and for producing cans from bauxite. | Difficulties in recycling:   * thermosetting plastics (revise) * composite materials. | **Revision** | **Revision** |
| **28** | **Revision** | Revision | **SAT 4: Test** |  |
| **29** |  |  |  |  |