Government of **Western Australia**
School Curriculum and Standards Authority

SAMPLE COURSE OUTLINE

CHEMISTRY
ATAR YEAR 12

Sample course outline

Chemistry – ATAR Year 12

Unit 3 and Unit 4

Science Inquiry Skills
Science Inquiry Skills align with the Science Understanding and Science as a Human Endeavour content of the unit and are integrated into the learning experiences.

Semester 1 – Equilibrium, acids and bases, and redox reactions

Unit 3 Science Inquiry Skills

- identify, research, construct and refine questions for investigation; propose hypotheses; and predict possible outcomes
- design and conduct investigations; and consider research ethics
- represent data in meaningful and useful ways; identify trends, patterns and relationships; identify and distinguish between random and systematic errors and estimate their effect on measured results; synthesise and use evidence to make and justify conclusions
- interpret a range of scientific texts, and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments
- communicate to specific audiences and for specific purposes

Week	Syllabus content
1–2	**Structure of the syllabus** • course outline • assessment outline **Chemical equilibrium systems** • collision theory • chemical systems include physical changes and chemical reactions and may be open or closed • the characteristics of a system in dynamic equilibrium • chemical and physical changes can be explained at an atomic and molecular level • the reversibility of chemical reactions explained in terms of activation energies
3–4	**Chemical equilibrium systems** • 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 • applying collision theory to predict and explain effects of changes in solution concentrations and gas partial pressures on chemical equilibria • using Le Châtelier's Principle to predict effects of changes in temperature, solution concentration, partial pressures of gases, total volume and addition of catalyst on equilibrium systems • conduct investigations on effects of changes to equilibrium systems (SIS) • equilibrium law expressions for homogeneous and heterogeneous systems • predicting the equilibrium position using the equilibrium constant • rising carbon dioxide levels in the atmosphere, ocean acidification and effects on marine ecosystems (SHE) **Task 1:** Investigation – Reaction rates and catalysis **Task 2:** Chemical equilibrium systems topic test

Week	Syllabus content
5–9	**Acids and bases** • acids as proton donors • acid strength and acidity constants • acids and bases in equilibrium systems and the Brønsted-Lowry model • conduct investigations on acid-base properties (SIS) • the hydrolysis of salts of weak acids and weak bases • buffer solutions • water as a weak electrolyte • Kw can be used to calculate the $[H^+]$ or $[OH^-]$ in solutions of strong acids or bases • the pH scale and the relationship $pH = - \log_{10} [H^+]$ • acid-base indicators • volumetric analysis • conduct investigations using acid-base volumetric analysis techniques (SIS) • acid-base titrations and stoichiometric calculations • models and theories are contested and refined or replaced when new evidence challenges them (SHE) **Task 3:** Practical test – Acid-base titration **Task 4:** Acids and bases topic test
10–14	**Oxidation and reduction** • oxidation-reduction (redox) reactions as electrons transfer processes • oxidation involves the loss of electrons and reduction involves the gain of electrons • redox reactions can be represented using half-equations and redox equations • redox reactions, including metal and halogen displacement reactions, and combustion • oxidation numbers • standard electrode potentials • electrochemical cells, including galvanic and electrolytic cells • corrosion of iron as an electrochemical process • corrosion prevention, including by exclusion of oxygen and/or water and through cathodic protection and sacrificial anodes • cell electric potential difference from standard electrode potentials • electrolytic cells, including their use for electrolytic refining (including the purification of copper), and electroplating (including for silver) • construct electrochemical cells (SIS) • spontaneous redox reactions can be used as a source of electrical energy, including primary, secondary and fuel cells (SHE) **Task 5:** Extended response – Electrochemical cells/fuel cells in cars **Task 6:** Oxidation and reduction topic test
15	Examination revision
16	**Task 7:** Semester 1 examination

Semester 2 – Organic chemistry and chemical synthesis

Unit 4 Science Inquiry Skills

- identify, research, construct and refine questions for investigation; propose hypotheses; and predict possible outcomes
- design and conduct investigations; and consider research ethics
- represent data in meaningful and useful ways; identify trends, patterns and relationships; identify and distinguish between random and systematic errors and estimate their effect on measured results; synthesise and use evidence to make and justify conclusions
- interpret a range of scientific texts, and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments
- communicate to specific audiences and for specific purposes

Week	Syllabus content
1–3	**Properties and structure of organic materials** • organic molecules have a hydrocarbon skeleton and can contain functional groups, including alkenes, alcohols, aldehydes, ketones, carboxylic acids, esters, amines and amides • structural formulae for organic molecules • IUPAC nomenclature for parent chains of 8 carbon atoms and for functional groups • functional groups and a molecule's characteristic chemical properties • functional group chemical properties and reactions, including addition reactions, redox reactions of alcohols, and acid-base reactions of carboxylic acids • isomerism, including chain and position structural isomerism and cis-trans isomerism • reactions of alcohols, including combustion, oxidisation with oxidising agents, including acidified MnO_4^- or $Cr_2O_7^{2-}$, and with carboxylic acids to produce esters • conduct investigations on properties of organic compounds containing different functional groups (SIS) • the Protein Data Bank (PDB) is an international repository of structural data of proteins with information contributed by and available to scientists worldwide. The function of a protein is closely linked to its structure (SHE) **Task 8:** Investigation – Degree of saturation of fats **Task 9:** Analytical Investigation – Identification of functional groups in unknown organic compounds
4–6	**Properties and structure of organic materials** • physical properties of organic compounds, including boiling point and solubility in water and organic solvents, can be explained in terms of intermolecular forces which are influenced by the nature of the functional groups • calculations of empirical and molecular formulae of organic compounds and structure determination • addition polymerisation, including for polyethene and polytetrafluoroethene • condensation polymerisation, including for polyamides and polyesters • predicting and drawing polymer structure from its monomers, and predicting and drawing monomers from polymer structure • the properties and uses of addition polymers and condensation polymers produced by industry • the varied structures of different plastics due to characteristics, including cross-linking, chain length, and intermolecular forces leads to a range of distinct properties and consequent uses • α-amino acids – structure, properties and condensation reactions • protein primary, secondary (α-helix and β-pleated sheets) and tertiary structures **Task 10:** Properties and structure of organic materials topic test

Week	Syllabus content
7–9	**Chemical synthesis** • scientific knowledge is used to design chemical synthesis pathways, taking into account sustainability, local resources, economics and environmental impacts (green chemistry) (SHE) • chemical synthesis to form products with specific properties may require 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 • selection of reagents and reaction conditions to optimise the rate and yield of a product, including in the production of ammonia, sulfuric acid and biodiesel • enzymes as biological catalysts for industrial scale synthesis including fermentation to produce ethanol
10–12	**Chemical synthesis** • stoichiometric calculations in chemical synthesis reactions including role of the limiting reagent • percentage yield of chemical synthesis reactions • conduct investigations using chemical synthesis processes (SIS) **Task 11:** Extended response – Ammonia production by the steam reforming/Haber processes and from chicken feathers
13–14	**Chemical synthesis** • saponification • the structures of soaps and detergents and their cleaning action • the properties of soaps and detergents in hard water **Task 12:** Chemical synthesis topic test
15	Examination revision
16	**Task 13:** Semester 2 examination