**AECHE Teaching & Learning Program 2021**

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| **Weeks** | **Science Understanding** | **PEARSON Chemistry 11** | **STAWA** | **Assessment Tasks** |
| **Properties and structure of materials**  Matter at the nanoscale can be manipulated to create new materials, composites and devices; the different characteristics of nanomaterials can be used to provide commercially available products. As products are designed on the basis of properties which are different from the bulk material, their use can be associated with potential risks to health, safety and the environment and this has led to regulations being developed to address new and existing nanoform materials. | | | | |
| T1 W1 | * materials are pure substances with distinct measurable properties, including melting and boiling points, reactivity, hardness and density; or mixtures with properties dependent on the identity and relative amounts of the substances that make up the mixture * pure substances may be elements or compounds which consist of atoms of two or more elements chemically combined; the formulae of compounds indicate the relative numbers of atoms of each element in the compound * differences in the physical properties of substances in a mixture, including particle size, solubility, density, and boiling point, can be used to separate them * nanomaterials are substances that contain particles in the size range 1–100 nm and have specific properties relating to the size of these particles which may differ from those of the bulk material | **Chapter 1.3:**  *Materials in our world*  (pg13-20)  **Chapter 1.2:**  *Materials in our world* (pg8-13) | **SET 4** |  |
| **Properties and structure of atoms**  Findings from a range of scientific experiments contributed to the understanding of the atom, enabling scientists, including Dalton, Thomson, Rutherford, Bohr and Chadwick to develop models of atomic structure and make reliable predictions about the mass, charge and location of the sub-atomic particles. | | | | |
| T1 W2 | * elements are represented by symbols * atoms can be modelled as a nucleus, surrounded by electrons in distinct energy levels, held together by electrostatic forces of attraction between the nucleus and electrons; the location of electrons within atoms can be represented using electron configurations * the ability of atoms to form chemical bonds can be explained by the arrangement of electrons in the atom and in particular by the stability of the valence electron shell * the structure of the periodic table is based on the atomic number and the properties of the elements | **Chapter 3.1-3.2:** *Electrons & the periodic table*  (pg43-52) | **SET 7**  **SET 8**  **SET 9** |  |
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| T1 W2 | * isotopes are atoms of an element with the same number of protons but different numbers of neutrons and are represented in the form A X (IUPAC) or X-A * isotopes of an element have the same electron configuration and possess similar chemical properties but have different physical properties | **Chapter 2.1-2.4:** *Atoms: Structure & Mass*  (pg21-41) | **SET 12** |  |
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| **Weeks** | **Science Understanding** | **PEARSON Chemistry 11** | **STAWA** | **Assessment Tasks** |
| T1 W3 | * the type of bonding within ionic, metallic and covalent substances explains their physical properties, including melting and boiling points, conductivity of both electricity and heat and hardness * chemical bonds are caused by electrostatic attractions that arise because of the sharing or transfer of electrons between participating atoms; the valency is a measure of the bonding capacity of an atom * ions are atoms or groups of atoms that are electrically charged due to a loss or gain of electrons; ions are represented by formulae which include the number of constituent atoms and the charge of the ion  (for example, O2–, SO42–) * ionic bonding can be modelled as a regular arrangement of positively and negatively charged ions in a crystalline lattice with electrostatic forces of attraction between oppositely charged ions * the ionic bonding model can be used to explain the properties of ionic compounds, including high melting point, brittleness and non-conductivity in the solid state; the ability of ionic compounds to conduct electricity when molten or in aqueous solution can be explained by the breaking of the bonds in the lattice to give mobile ions * the formulae of ionic compounds can be determined from the charges on the relevant ions (Appendix 2) | **Chapter 5.1-5.5:** *Ionic bonding*  (pg99-124) | **SET 13**  **SET 14** |  |
| T1 W4 | * metallic bonding can be modelled as a regular arrangement of atoms with electrostatic forces of attraction between the nuclei of these atoms and their delocalised electrons that are able to move within the three dimensional lattice * the metallic bonding model can be used to explain the properties of metals, including malleability, thermal conductivity, generally high melting point and electrical conductivity; covalent bonding can be modelled as the sharing of pairs of electrons resulting in electrostatic forces of attraction between the shared electrons and the nuclei of adjacent atoms * the properties of covalent molecular substances, including low melting point, can be explained by their structure and the weak intermolecular forces between molecules; their non-conductivity in the solid and liquid/molten states can be explained by the absence of mobile charged particles in their molecular structure * molecular formulae represent the number and type of atoms present in the molecules (Appendix 2) * the properties of covalent network substances, including high melting point, hardness and electrical conductivity, are explained by modelling covalent networks as three-dimensional structures that comprise covalently bonded atoms * elemental carbon exists as a range of allotropes, including graphite, diamond and fullerenes, with significantly different structures and physical properties | **Chapter 4.1-4.4** *Metals*  (pg73-96)  **Chapter 6.1-6.2:** *Materials made of molecules*  (pg127-139)  **Chapter 7.1:** *Carbon*  (pg141-150) | **SET 15**  **SET 17**  **SET 16** |  |
| **Weeks** | **Science Understanding** | **PEARSON Chemistry 11** | **STAWA** | **Assessment Tasks** |
| T1 W5 | * the elements of the periodic table show trends across periods and down main groups, including in atomic radii, valencies, 1st ionisation energy and electronegativity as exemplified by groups 1, 2, 13–18 and period 3 | **Chapter 3.3-3.5:** *Electrons & the periodic table*  (pg53-70) | **SET 10** |  |
| T1 W6 | **TEST 1: Atomic Structure, Bonding & Periodic Trends** |  |  | **Test 1:** Atomic Structure, Bonding & Periodic Trends  (3%) |
| T1 W7 | * flame tests and atomic absorption spectroscopy (AAS) are analytical techniques that can be used to identify elements; these methods rely on electron transfer between atomic energy levels and are shown by line spectra * the relative atomic mass (atomic weight), Ar is the ratio of the average mass of the atom to 1/12 the mass of an atom of 12C; relative atomic masses of the elements are calculated from their isotopic composition * mass spectrometry involves the ionisation of substances and the separation and detection of the resulting ions; the spectra which are generated can be analysed to determine the isotopic composition of elements and interpreted to determine relative atomic mass |  | **SET 11**  **SET 21** |  |
| T1 W7 | Stoichiometry   * chemical reactions can be represented by chemical equations; balanced chemical equations indicate the relative numbers of particles (atoms, molecules or ions) that are involved in the reaction * the mole is a precisely defined quantity of matter equal to Avogadro’s number of particles. | **Chapter 9.1-9.4:**  *The mole*  (pg189-204) | **SET 23**  **SET 24** |  |
| T1 W8 | * the mole concept relates mass, moles and molar mass and, with the Law of Conservation of Mass; can be used to calculate the masses of reactants and products in a chemical reaction |  | **SET 25** |  |
| T1 W9 | percentage composition of a compound can be calculated from the relative atomic masses of the elements in the compound and the formula of the compound |  | **SET 29** |  |
| T1 W9 | **TEST 2: Stoichiometry** |  |  | **Test 2:**  Stoichiometry  (3%) |
| **SCHOOL HOLIDAYS** | | | | |
| **Weeks** | **Science Understanding** | **PEARSON Chemistry 11** | **STAWA** | **Assessment Tasks** |
| T2 W1 | * hydrocarbons, including alkanes, alkenes and benzene, have different chemical properties that are determined by the nature of the bonding within the molecules * molecular structural formulae (condensed or showing bonds) can be used to show the arrangement of atoms and bonding in covalent molecular substances * IUPAC nomenclature is used to name straight and simple branched alkanes and alkenes from C1- C8 | **Chapter 7.2:**  *Carbon*  (pg151-157)  **Chapter 8.1-8.4:**  *Organic compounds*  (pg159-187) | **SET 40** |  |
| T2 W2 | * chemical reactions and phase changes involve enthalpy changes, commonly observable as changes in the temperature of the surroundings and/or the emission of light * endothermic and exothermic reactions can be explained in terms of the Law of Conservation of Energy and the breaking of existing bonds and forming of new bonds; heat energy released or absorbed by the system to or from the surroundings, can be represented in thermochemical equations   **Investigation 1: Hot & Cold Packs** | **Chapter 10.1-10.2:**  *Energy changes in chemical reactions*  (pg207-220) | **SET 38** | **Investigation 1:** Hot & Cold Packs  (12.5%) |
| **Chemical reactions: reactants, products and energy change** | | | | |
| T2 W3 | **TEST 3: Organic Chemistry & Energy Change** | **Chapter 11.1-11.3:**  *Fuels & introduction to stoichiometry*  (pg221-255) |  | **Test 3:** Organic Chemistry & Energy Change  (3%) |
| T2 W4 | Assessment free week: Revisions of concepts | **UNIT 1 Review:**  (pg257-262) |  |  |
| T2 W5  T2 W6 | **Yr 11 EXAMS WEEKS 1 AND 2** |  |  | **Exam:** Unit 1 (20%) |

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| **Intermolecular forces and gases**  There are differences in the energy output and carbon emissions of fossil fuels (including coal, oil, petroleum and natural gas) and biofuels (including biogas, biodiesel and bioethanol). These differences, together with social, economic, cultural and political values, determine how widely these fuels are used. Chromatographic techniques, including thin layer chromatography (TLC), gas chromatography (GC), and high performance liquid chromatography (HPLC), are used to determine the components of a wide range of mixtures in various settings. The decision to use a particular chromatographic technique depends on a number of factors, including the properties of the substances being separated, the amount of substance available for analysis and the sensitivity of the equipment. Chromatographic techniques have a wide range of analytical and forensic applications, including monitoring air and water pollutants, drug testing of urine and blood samples, and testing for food additives and quality | | | | |
| T2 W7 | * alkanes, alkenes and benzene undergo characteristic reactions such as combustion, addition reactions for alkenes and substitution reactions for alkanes and benzene * fossil fuels (including coal, oil, petroleum and natural gas) and biofuels (including biogas, biodiesel and bioethanol) can be compared in terms of their energy output, suitability for purpose, and the nature of products of combustion |  | **SET 17** |  |
| T2 W8 | * observable properties, including vapour pressure, melting point, boiling point and solubility, can be explained by considering the nature and strength of intermolecular forces within a covalent molecular substance | **Chapter 12.1-12.3:**  *Intermolecular forces*  (pg263-282) | **SET 18**  **SET 19** |  |
| T2 W9 | * the valence shell electron pair repulsion (VSEPR) theory and Lewis structure diagrams can be used to explain, predict and draw the shapes of molecules * the polarity of molecules can be explained and predicted using knowledge of molecular shape, understanding of symmetry, and comparison of the electronegativity of atoms involved in the bond formation   **Extended Response 1: Nano-particles & Hydrocarbons** |  |  | **Extended Response 1:** Nano-particles & Hydrocarbons  (5%) |
| T2 W10 | * the shape and polarity of molecules can be used to explain and predict the nature and strength of intermolecular forces, including dispersion forces, dipole-dipole forces and hydrogen bonding |  | **SET 20** |  |
| T2 W11 | **2nd Hand Data Assessment: IMF & Vapour Pressure**  data from chromatography techniques, including thin layer chromatography (TLC), gas chromatography (GC), and high-performance liquid chromatography (HPLC), can be used to determine the composition and purity of substances; the separation of the components is caused by the variation in strength of the interactions between atoms, molecules or ions in the mobile and stationary phases | **Chapter 13.1-13.2:**  *Chromatography*  (pg283-301) |  | **2nd Hand Data Assessment:** IMF & Vapour Pressure  (12.5%) |
| **SCOOL HOLIDAYS** | | | | |
| **Weeks** | **Science Understanding** | **PEARSON Chemistry 11** | **STAWA** | **Assessment Tasks** |
| **Aqueous solutions and acidity**  The supply of potable drinking water is an extremely important issue for both Australia and countries in the Asian region. Water sourced from groundwater and seawater undergoes a number of purification and treatment processes (such as desalination, chlorination, fluoridation) before it is delivered into the supply system. Chemists regularly monitor drinking water quality to ensure that it meets the regulations for safe levels of solutes. Heavy metal contamination in ground water is monitored to ensure that concentrations are at acceptable levels. Several methods can be used to reduce heavy metal contamination; the method used is influenced by economic and social factors. | | | | |
| T3 W1 | * the unique physical properties of water, including melting point, boiling point, density in solid and liquid phases and surface tension, can be explained by its molecular shape and hydrogen bonding between molecules * solutions can be classified as saturated, unsaturated or supersaturated; the concentration of a solution is defined as the quantity of solute dissolved in a quantity of solution; this can be represented in a variety of ways, including by the number of moles of the solute per litre of solution (mol L-1) and the mass of the solute per litre of solution (g L-1) or parts per million (ppm) | **Chapter 15.1-15.6:**  *Properties & uses of water*  (pg331-379) | **SET 31**  **SET 32** |  |
| T3 W2 | * the presence of specific ions in solutions can be identified by observing the colour of the solution, flame tests and observing various chemical reactions, including precipitation and acid-base reactions * the solubility of substances in water, including ionic and polar and non-polar molecular substances, can be explained by the intermolecular forces, including ion-dipole interactions between species in the substances and water molecules, and is affected by changes in temperature | **Chapter 16.1-16.5:**  *Aqueous solutions*  (pg383-407) | **SET 27** |  |
| T3 W3 | * the Arrhenius model can be used to explain the behaviour of strong and weak acids and bases in aqueous solutions * **Extended Response 2: Acids & Solutions** |  | **SET 33** | **Extended Response 2:** Acids & Solutions  (5%) |
| **Weeks** | **Science Understanding** | **PEARSON Chemistry 11** | **STAWA** | **Assessment Tasks** |
| T3 W4 | * indicator colour and the pH scale are used to classify aqueous solutions as acidic, basic or neutral * pH is used as a measure of the acidity of solutions and is dependent on the concentration of hydrogen ions in the solution * patterns of the reactions of acids and bases, including reactions of acids with bases, metals and carbonates and the reactions of bases with acids and ammonium salts, allow products and observations to be predicted from reactants; ionic equations represent the reacting species and products in these reactions | **Chapter 17.1-17.4:**  *Acids & bases*  (pg409-437) | **SET 34**  **SET 35** |  |
| T3 W5 | * the mole concept can be used to calculate the mass of solute, and solution concentrations and volumes involved in a chemical reaction |  | **SET 36**  **SET 37**  **SET 5** |  |
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| T3 W6 | **TEST 4: Acids, Solutions & IMF** |  |  | **Test 4:** Acids, Solutions & IMF  (3%) |
| T3 W7 | * the behaviour of an ideal gas, including the qualitative relationships between pressure, temperature and volume, can be explained using the Kinetic Theory | **Chapter 14.1-14.3:**  *Gases*  (pg305-328) |  |  |
| T3 W8 | * the mole concept can be used to calculate the mass of substances and volume of gases (at standard temperature and pressure) involved in a chemical reaction |  | **SET 26** |  |
| **Weeks** | **Science Understanding** | **PEARSON Chemistry 11** | **STAWA** | **Assessment Tasks** |
| **Rates of chemical reactions**  Catalysts are used in many industrial processes in order to increase the rates of reactions that would otherwise be uneconomically slow. Catalysts are also used to reduce the emission of pollutants produced by car engines. Motor vehicles have catalytic converters which are used to catalyse reactions that reduce the amount of carbon monoxide, unburnt petrol and nitrogen oxides that are emitted. | | | | |
| T3 W9 | * varying the conditions under which chemical reactions occur can affect the rate of the reaction * the rate of chemical reactions can be quantified by measuring the rate of formation of products or the depletion of reactants * collision theory can be used to explain and predict the effects of concentration, temperature, pressure, the presence of catalysts and surface area on the rate of chemical reactions | **Chapter 18.1-18.3:**  *Rates of chemical reactions*  (pg439-454) |  |  |
| T3 W10 | * the activation energy is the minimum energy required for a chemical reaction to occur and is related to the strength and number of the existing chemical bonds; the magnitude of the activation energy influences the rate of a chemical reaction * energy profile diagrams, which can include the transition state and catalysed and uncatalysed pathways, can be used to represent the enthalpy changes and activation energy associated with a chemical reaction |  | **SET 39** |  |
| **SCHOOL HOLIDAYS** | | | | |
| T4 W1 | * catalysts, including enzymes and metal nanoparticles, affect the rate of certain reactions by providing an alternative reaction pathway with a reduced activation energy, hence increasing the proportion of collisions that lead to a chemical change | **Chapter 19.1:**  *Catalysts*  (pg457-466) |  |  |
| T4 W2 | Revision |  |  |  |
| T4 W3 | **TEST 5: Kinetic Theory & Rates of Reaction** |  |  | **Test 5:** Kinetic Theory & Rates  (3%) |
| T4 W4 | Assessment free week: Revisions of course concepts |  |  |  |
| T4 W5 | **Yr 11 EXAMS WEEK 1** |  |  | **Exam:** Unit 2 (30%) |
| T4 W6 | **Yr 11 EXAMS WEEK 2** |  |  |  |

\* Note: this program is subject to change, as required. Any necessary changes will be clearly notified via Connect and Department of Education email.