4th Year Chemistry

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes** *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop Scientific Communication skills** | **Opportunities to develop and apply practical and enquiry skills** | **Self/peer assessment opportunities and resources** *Reference to past questions that indicate success* | Key pieces of assessed work |
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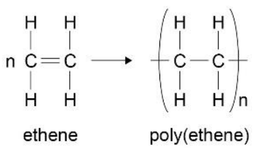
| 4.7.3.1 | Alkenes can be used to make polymers such as poly(ethene) and poly(propene) by addition polymerisation.<br><br>In addition polymerisation reactions many small molecules (monomers) join together to form very large molecules (polymers).<br><br>For example:<br><br><br><br>In addition polymers the repeating unit has the same atoms as the monomer because no other molecule is formed in the reaction. | Recognise addition polymers and monomers from diagrams in the forms shown and from the presence of the functional group -C=C- in the monomers.<br><br>Draw diagrams to represent the formation of a polymer from a given alkene monomer.<br><br>Relate the repeating unit to the monomer.<br><br>WS 1.2 | 1 | Define:<br>• monomer<br>• polymer<br>• polymerisation<br>• repeating unit.<br><br>Describe the process of polymerisation. | Model polymerisation using molecular model kits.<br><br>Research uses of simple polymers.<br><br>Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects. | Video clip<br>YouTube:<br>Polymerisation of propene and chloroethene | |

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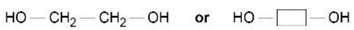
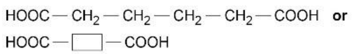
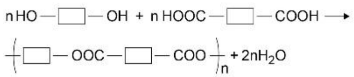
| | | MS 5b | | | | | |
| 4.7.3.2<br>(HT<br>only) | Condensation polymerisation involves monomers with two functional groups. When these types of monomers react they join together, usually losing small molecules such as water, and so the reactions are called condensation reactions.<br><br>The simplest polymers are produced from two different monomers with two of the same functional groups on each monomer.<br><br>For example:<br>ethane diol<br><br>and<br>hexanedioic acid<br><br>polymerise to produce a polyester:<br> | Explain the basic principles of condensation polymerisation by reference to the functional groups in the monomers and the repeating units in the polymers.<br><br>WS 1.2<br><br>MS 5b | 1 | Describe what takes place during condensation polymerisation.<br>Identify monomers, polymers and repeating units.<br><br>Describe the polymerisation of ethane-1,2-diol and hexanedioic acid. | Use models to represent condensation polymerisation.<br><br>Research common polyesters and their uses.<br><br>Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects. | Video clip<br>YouTube:<br>Condensation Polymerisation | |
| 4.7.3.3<br>(HT<br>only) | Amino acids have two different functional groups in a molecule. Amino acids react by | | 0.5 | Describe the polymerisation of amino acids to | Research common amino acids and | | Past paper question 6 specimen paper 2 set 1 |

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| | condensation polymerisation to produce polypeptides.<br><br>For example: glycine is $H_2NCH_2COOH$ and polymerises to produce the polypeptide $(-HNCH_2COO-)_n$ and n $H_2O$<br><br>Different amino acids can be combined in the same chain to produce proteins. | | | produce polypeptides. | polypeptides, and polypeptide uses. | | Past paper question 6 specimen paper 2 set 2<br><br>Question booklets organic chemistry 1,2 and 3<br><br>Extension; Question booklets organic chemistry 4,5,6,7 and 8 |
| 4.7.3.4 | DNA (deoxyribonucleic acid) is a large molecule essential for life. DNA encodes genetic instructions for the development and functioning of living organisms and viruses. Most DNA molecules are two polymer chains, made from four different monomers called nucleotides, in the form of a double helix. Other naturally occurring polymers important for life include proteins, starch and cellulose. | Be able to name the types of monomers from which these naturally occurring polymers are made. | 1 | Describe the structure of DNA in terms of two polymer chains and nucleotides.<br><br>Research and present the discovery of the structure of DNA including the contributions of Francis Crick, James Watson, Maurice Wilkins and Rosalind Franklyn. | Research the history of the discovery of DNA as a polymer chain.<br><br>Research naturally occurring polymers and their uses. | Video clip YouTube: DNA and genes<br><br>The story of DNA is presented in the BBC Horizon Programme 'Life Story'. | TEST |
| 4.4.3.1 | When an ionic compound is melted or dissolved in water, the ions are free to move about within the liquid or solution. These liquids and solutions are able to conduct electricity and are called electrolytes. | **(**HT only) **Throughout 4.4.3:** Higher Tier students should be able to write half equations for the reactions occurring at the electrodes during | 1 | Explain why solid ionic compounds cannot conduct electricity but ionic compounds can conduct electricity when melted or dissolved in water. | Carry out the electrolysis of solutions following the RSC method: RSC Electrolysis of solutions | Video clips: BBC Bitesize Electrolysis and electroplating<br><br>YouTube: GCSE Science Revision Electrolysis of a Solution | |

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| | Passing an electric current through electrolytes causes the ions to move to the electrodes. Positively charged ions move to the negative electrode (the cathode), and negatively charged ions move to the positive electrode (the anode). Ions are discharged at the electrodes producing elements. This process is called electrolysis. | electrolysis, and may be required to complete and balance supplied half equations.<br>WS 4.1 | | Define the term electrolyte.<br>Describe how an electric current can pass through an ionic compound.<br><br>Explain what happens to positive and negative ions during electrolysis and how elements form from their ions. | Write balanced symbol equations for these reactions.<br><br>Write half equations for the reactions that occur at each electrode. | | |
| 4.4.3.2 | When a simple ionic compound (eg lead bromide) is electrolysed in the molten state using inert electrodes, the metal (lead) is produced at the cathode and the non-metal (bromine) is produced at the anode. | Students should be able to predict the products of the electrolysis of binary ionic compounds in the molten state. | 0.5 | Calculate the atom economy for simple examples.<br><br>Extended writing: write instructions to another student how to calculate the atom economy giving explained examples. | Demo the electrolysis of lead bromide. A safer alternative for practical work is anhydrous zinc chloride.<br><br>Write balanced half equations for the reactions that occur at both electrodes. | Video clip:<br>YouTube: Electrolysis of Molten Compounds | |
| 4.4.3.3 | Metals can be extracted from molten compounds using electrolysis. Electrolysis is used if the metal is too reactive to be extracted by reduction with carbon or if the metal reacts with carbon. Large amounts of energy are used in the extraction process to melt the compounds and to produce the electrical current. | Explain why a mixture is used as the electrolyte.<br><br>Explain why the positive electrode must be continually replaced. | 1 | Recall the reactivity series.<br><br>Give reasons why some metals have to be extracted by electrolysis.<br><br>Extended writing: describe how aluminium is | Research how aluminium is extracted from its ore.<br>Write balanced half equations for the reactions that occur at both electrodes. | | Past paper question 1 specimen paper 1 set 1 |

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| | Aluminium is manufactured by the electrolysis of a molten mixture of aluminium oxide and cryolite using carbon as the positive electrode (anode). | WS 1.4, 4.1 | | extracted from its ore.<br><br>Write balanced half equations for the reactions that occur at both electrodes.<br><br>Extended writing: describe how reactive metal elements were discovered by electrolysis.<br>Construct a timeline. | | | |
| 4.4.3.4 | The ions discharged when an aqueous solution is electrolysed using inert electrodes depend on the relative reactivity of the elements involved.<br><br>At the negative electrode (cathode), hydrogen is produced if the metal is more reactive than hydrogen.<br><br>At the positive electrode (anode), oxygen is produced unless the solution contains halide ions when the halogen is produced.<br><br>This happens because in the aqueous solution water molecules break down producing hydrogen ions and | Be able to predict the products of the electrolysis of aqueous solutions containing a single ionic compound.<br><br>WS 2.1, 2.2, 2.3, 2.4, 2.6 | 2 | Define the term aqueous.<br><br>Extended writing: describe how an aqueous solution is electrolysed.<br><br>Explain why the following atoms could be produced:<br>• hydrogen<br>• oxygen. | **Required practical 3:**<br><br>Investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis.<br><br>AT skills covered by this practical activity: 3, 7 and 8. | | Past paper question 3 specimen paper 1 set 2 |

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| | hydroxide ions that are discharged. | | | | | | |
| 4.4.3.5 (HT only) | During electrolysis, at the cathode (negative electrode), positively charged ions gain electrons and so the reactions are reductions.<br><br>At the anode (positive electrode), negatively charged ions lose electrons and so the reactions are oxidations.<br><br>Reactions at electrodes can be represented by half equations, for example:<br><br>$2H^+ + 2e^- \rightarrow H_2$<br>and<br>$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$<br>or<br>$4OH^- - 4e^- \rightarrow O_2 + 2H_2O$ | | 1 | Explain thoroughly what happens at the following electrodes using suitable examples and half equations:<br>• cathode<br>• anode. | | | Question booklets Electrolysis 1,2 and 3<br><br>TEST |