ANSWERS: Types of organic reactions

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| **2019** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (a)  (b)  **2.** | Potassium permanganate will turn from purple to colourless / pale pink / brown when mixed with compound **A**, whereas there would be no observable change with compound **B**. This is an oxidation reaction.  Compound **B** reacting with bromine water will be a slow reaction requiring  UV light as a catalyst. It will form 1-bromobutane / 2-bromobutane and HBr. The bromine water will decolourise from a red-brown / orange / brown / yellow colour. This is a substitution reaction where the H on one carbon is substituted by a Br atom. The H atom that is removed bonds with the remaining Br atom to form hydrogen bromide.  Compound **A** reacting with bromine water is a fast reaction, forming  2,3-dibromobutane. The bromine water decolourises from a red-brown colour. This is an addition reaction, where the double bond is broken and two Br atoms are added.  The reaction that forms compound **B** is an addition reaction where the double bond is broken to add OH and H to saturate the molecule and form an alcohol. The reverse reaction is the removal of the H and OH to form a double bond in an elimination reaction, forming an unsaturated molecule with a double bond. The elimination reaction uses concentrated sulfuric acid to remove the water whereas the addition reaction uses dilute sulfuric acid to add the water. The reactions are opposite in that one breaks the double bond to increase saturation and one forms a double bond to decrease saturation. | • Identifies the type of reaction.  OR  States the colour change.  • Identifies the two types of reaction occurring.  OR  States the colour change.  • States reaction to form **B** is addition.  • Reverse reaction is elimination. | • Links the observation to the reaction type.  • Explains the type of reaction linked to observations for **A** or **B**.  • Explains the addition reaction*.*  • Explains the elimination reaction. | • Compares and contrasts all aspects of the reactions for **A** and **B**.  • Contrasts the two reactions related to propene and propanol. |

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| **2018** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | A reaction with dilute aqueous KOH will produce an alcohol, propan-2-ol.    This is a substitution reaction. The Cl atom is substituted by an OH group.  If concentrated KOH(*alc*) is used, an elimination reaction occurs, and the 2-chloropropane forms propene because a H and a Cl atom will be removed, whilst a double bond is formed. | • Identifies one product (name or structure)  • Identifies one type of reaction with correct  reagent and product (can be in a structural formula). | • Explains ONE type of reaction linked to correct reagent condition and organic product. | • Elaborates on both  reactions of 2-chloropropane,  referring to reaction  type, conditions, and  products. |

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| **2017** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | Alkanes will slowly react with bromine water in the presence of a UV catalyst. The orange Br2(*aq*) will decolourise slowly. This is a substitution reaction where one H atom is replaced with a Br atom.  **A picture containing object  Description automatically generated**  Whereas, alkenes react immediately with orange Br2(*aq*), decolouring it to yellow /colourless quickly. Unlike alkanes, alkenes do not require a catalyst for the reaction to proceed. This is an addition reaction, where the double bond is broken, and two atoms of Br are added to the organic structure.  A picture containing object  Description automatically generated | Identifies alkenes react faster than alkanes.  OR  Alkanes need a catalyst to react (UV / sunlight).  OR  Identifies both types of reaction correctly. | Explains what happens in the reaction of either an alkene or an alkane with bromine water,  Br2(*aq*).  OR  Has an explanation for alkene and alkane but did not contrast with a minor omission. | Contrasts the conditions  and the types of reactions of an alkane and an alkene with bromine water, Br2(*aq*). |

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| **2015** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | Ethene reacts with aqueous KMnO4 to form a diol, ethan-1,2-diol.  ass91165Q3b2  This is an oxidation or addition reaction in which the double bond is broken and two –OH groups attach to each C atom of the double bond. The purple KMnO4 turns brown (or colourless)  Ethene reacts with dilute acid, H2O / H+, to form ethanol.  ass91165Q3b3  This is an addition reaction as once again the double bond is broken. However, in this reaction one –OH group and one –H atom attach to each C atom of the double bond. No colour changes are observed in this reaction.  When ethene reacts with hydrogen bromide, bromoethane is formed. Again there is no colour change observed.  ass91165Q3b4  This reaction is an addition reaction, as the double bond is broken and two atoms are added to each C atom of the double bond. In this reaction one H and one Br atom are added.  All three reactions involve the breaking of the double bond.  All three reactions involve addition.  Two of these reactions are addition reactions and one is an oxidation reaction.  Only one of the reactions gives a colour change that is easily observed. | Identifies colour change  with KMnO4.  Writes equations for TWO  of the reactions showing  structural formulae.  Identifies the reaction type for TWO of the reactions. | Explains the reaction  type for each of the  reactions.  Links reaction type to the correct equation for each of the reactions. | Compares and contrasts ALL THREE reactions. |

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| **2014** | **Evidence** | **Achievement** | | | | **Merit** | | | | **Excellence** | | |
| **1.** | All three reactions are substitution reactions. In all three reactions an atom or group of atoms is being replaced with another atom or group of atoms.  In **Reaction One;** a Br atom replaces an H atom. UV light is necessary.  In **Reaction Two;** a Cl atom replaces the OH group.  No conditions are required.  In **Reaction Three;** the Cl atom is replaced by NH2.  No conditions are required.  Two layers form in Reaction One as hexane is non-polar and the product (bromohexane) is effectively also non-polar. The water from the bromine water is polar and therefore the non-polar organic reactant and product will not dissolve in the water; because of this, two layers form as this polar and non-polar layer do not mix. | States that all reactions are substitution reactions.  States the condition required for Reaction One.  States that water or Br2 (*aq*) is polar  **OR**  Some organic compounds are non-polar. | | | | Explains substitution reactions in terms of atoms or groups of atoms being replaced.  Explains why two layers form by linking the following:  water is polar and the bromohexane / hexane is non-polar  **OR**  Polar and non-polar compounds do not dissolve in each other. | | | | Compares and contrasts the reactions by fully explaining why all three reactions are substitution reactions with reasons involving the atoms or groups of atoms.  Explains fully why two layers form by linking the following:  water is polar and the bromohexane / hexane is non-polar  **AND**  Polar and non-polar compounds do not dissolve in each other. | | |
| **2.** | When propanoic acid reacts with sodium carbonate, an acid-base reaction occurs in which sodium propanoate, water and carbon dioxide are formed. It is acid-base because the propanoic acid donates a proton, forming the propanoate ion.  When propanamine reacts with HCl or H2SO4, acid-base reactions occur. Amines are bases and as a result, amines accept protons from acids. In these two reactions both sulfuric acid and hydrochloric acid donate protons to the amine to form organic salts.  When propan-1-ol reacts with HCl, a substitution reaction occurs; in this reaction the Cl from HCl replaces the –OH group from propan-1-ol, forming a haloalkane. | | Has one product correct for either reaction (i) or (ii).  States THREE correct types of reaction.  **OR**  States a correct type of reaction with a supporting reason. | | | | Full explains one of the acid-base reactions.  **OR**  Identifies **AND** partially explains TWO different types of reactions. | | | | Compares and contrasts the reactions by:  Fully explaining one of the acid- base reactions.  **AND**  Fully explaining the substitution reaction.  **AND**  Fully explaining the elimination reaction. | |
| **3. i)**  **ii)**  **iii)** | It is an addition reaction because the double bond is breaking and an H and a Cl are being added to each of the carbons that were in the double bond.  It is an elimination reaction because two atoms are being removed from the molecule and a double bond is being formed between the carbon atoms from which the atoms have been removed. | | | | Recognises that atoms are being added across the double bond.  Recognises that atoms are being removed in Reaction 2.  Correctly draws the product for Reaction 4. | | | | Because the double bond is breaking and an H and a Cl are being added to each of the carbons that were in the double bond. | | |  |
| **2013** | **Evidence** | | | **Achievement** | | | | **Merit** | | | | **Excellence** |
|  | Reaction with PCl5 is a substitution reaction. The hydroxyl group (–OH) is replaced by a chloro group (–Cl).  The product is CH3CH2CH2CH2Cl  The functional group in the product is a chloro group / chloroalkane (haloalkane).  Reaction with acidified dichromate is oxidation as the alcohol is oxidised to a carboxylic acid.  The product is CH3CH2CH2COOH  The functional group in the product is carboxylic acid.  Reaction with concentrated H2SO4 is an elimination reaction. A hydrogen atom and the –OH group on (adjacent) carbon atoms are removed forming a (carbon-to-carbon) double bond.  The product is CH3CH2CH=CH2  The functional group in the product is a (carbon-to-carbon) double bond / alkene. | | | TWO different reaction types identified.  ONE functional group correct.  ONE formula of product correct. | | | | For the substitution reaction forming chlorobutane  The type of reaction plus TWO of the following correct: reason, functional group, formula of the organic product.  For the oxidation reaction forming butanoic acid:  The type of reaction plus, the functional group, AND the formula of organic product correct.  For the elimination reaction forming but-1-ene:  The type of reaction plus TWO of the following correct: reason, functional group, formula of the organic product. | | | | In (b) elaborates all THREE reactions fully. |

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