ANSWERS: Level 3 Organic practical procedures

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| **2017** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | Aldehyde (propanal) is obtained by distillation of propan-1-ol with acidified (potassium) dichromate (Cr2O72– / H+). The orange colour of the Cr2O72– / H+ changes to (blue) green (Cr3+ ions). The reaction is an oxidation reaction.  Distillation is a way to separate the aldehyde (propanal) from the reactant alcohol (propan-1-ol) which has a higher boiling point. The aldehyde (propanal) can react further to form a carboxylic acid (propanoic acid). This reaction is prevented if the **aldehyde is removed as it is formed** – distillation achieves this by evaporating the aldehyde and then allowing it to condense for collection. | • Distillation identified.  • Identifies oxidation reaction.  • Correct colour change. | • Correct colour change, reaction type and recognises the need for distillation related to different boiling points /preventing further reaction.  OR  Correct answer, with one omission, e.g. oxidation or colour change. | Full explanation of how only propanal is produced in the laboratory. |

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| **2015** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | Increases the rate of reaction;  (Condensing) prevents volatile chemicals from being lost to the environment,  (The mixture refluxed to increase reaction rate without loss of product through evaporation). | Partial explanation. | Full explanation given. |  |

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| **2014** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (i)  (ii)  (iii)  (iv) | Gas = Carbon dioxide / CO2  NaHCO3 *is* used to remove any remaining acid *mixed with the liquid product.*  Na2SO4 is added to remove any remaining water *mixed with the liquid product.*  *Fractional* Distillation.  Equipment 1.  The purpose of the process is to **purify** the chemical / **remove impurities** / **separate product**   * This is achieved by separating liquids according to their **boiling points**. * Chemicals are boiled then condensed / liquid-gas then gas-liquid.   The fraction at the desired boiling point is kept / other fractions are discarded. | * (i) OR (ii) correct. * (iii) is correct. * Correct purpose.   OR  Partial explanation. | * All correct from (i) – (iii). * Correct purpose.   AND  Partially explained. | Comprehensive discussion. |

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| **2013** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | Aldehyde (Butanal) is obtained by distillation of butan-1-ol with acidified (potassium) dichromate / (acidified potassium) permanganate solution.  (Distillation) is used because the aldehyde has a lower boiling point (than butan-1-ol and the carboxylic acid formed) / to prevent it from being oxidised further.  (Both) reactions are oxidation–reduction because butan-1-ol has lost electrons/lost hydrogen/gained oxygen/oxidation number (of C) has increased.  Carboxylic acid (butanoic acid) is obtained by reacting a mixture of butan-1-ol with acidified potassium dichromate solution (under reflux conditions) until all of the reactant has been converted to butanoic acid.  Observations: orange Cr2O72– to green /, purple MnO4– to colourless / aldehyde condensed in the condenser. | * One process identified. * Identifies oxidation (or reduction) reaction. * Reagent identified. OR One observation. | * A correct explanation of distillation. * Type of reaction justified. * One observation linked. | * Full discussion. |

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| **2011** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (i)  (ii) | D  Refluxing allows the solution to be heated, which increases the rate of the chemical reaction. The reflux apparatus prevents the loss of volatile organic reactants or products. | Correct apparatus identified. | Correct apparatus identified and recognises that refluxing prevents loss of products or reactants.  OR  Correct apparatus identified and recognises that refluxing increases rate of reaction / recognise need for heat  (Eg going to completion with example.) | Correct apparatus identified and recognises that refluxing prevents loss of reactants or products.  AND  Increases the rate of reaction without losing reactants or products / recognise need for heat. |

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| **2010** | **Evidence** | | **Achievement** | | **Merit** | | **Excellence** |
| (i)  (ii) | The acid is **providing the Cl** group for **substitution** with the OH, (indicates a source).  The NaHCO3 solution **neutralises** any remaining HCl.  The **anhydrous sodium sulfate** **absorbs** any **water** left in the sample (is a drying agent).  The separating funnel allows two reactants to be shaken together and for compounds to be separated based on their **solubility** or **polarity**. The haloalkane is not soluble in water and will not mix with the aqueous acid layer. The more dense liquid (aqueous or acid) will be in the lower level, and can be run off by removing the stopper and opening the tap.  Distillation purifies the sample. It separates the sample from liquid impurities with different boiling point. The haloalkane has a different boiling point to any other substances remaining. It will have the lower boiling point. The liquid at the lower boiling point will start to boil at a lower temperature. It will evaporate and move down the condenser, where it is cooled and returned to the liquid state. | | Recognises reason for ONE step.  Refers to solubility (not mixing is  sufficient here).  OR  Refers to boiling point | | Recognises reason for ALL steps.  Explains how ONE process  works.  OR  Incomplete explanation of BOTH processes. | | Recognises reason for TWO steps (in b(i)).  AND  Correctly discusses use of separating funnel and distillation linking properties of compounds to use.  (Refers to layers even if word density is not used.) |
| **2008** | **Evidence** | **Achievement** | | **Merit** | | **Excellence** | | |
| 1. (i) | Aldehyde (propanal) is obtained by heating a mixture of propan-1-ol with acidified (potassium dichromate) solution or (acidified) permanganate solution. Propanal can be removed from the solution as it forms, using distillation, as the aldehyde has a lower boiling point than propan-1-ol and the carboxylic acid.  Carboxylic acid (propanoic acid) is obtained by reacting a mixture of propan-1-ol with acidified potassium dichromate solution (under reflux conditions) until all of the reactant has been converted to propanoic acid. | Identifies TWO products of oxidation (as aldehyde and carboxylic acid or as propanal and propanoic acid) AND  correct reagent for oxidation | | Identifies TWO products of oxidation and correct reagent for oxidation plus correct description of how to obtain two separate products | | Identifies TWO products of oxidation  AND  correct reagent for oxidation  AND  correctly describes how to obtain two separate products | | |
| 2. | (Methanoic acid + 2-methylpropan-1-ol 2-methylpropylmethanoate + water)  HCOOH + HOCH2CH(CH3)2 HCOOCH2CH(CH3)2 + H2O  Sulfuric acid is added as a catalyst and/or a dehydrating agent to push the equilibrium reaction towards the product ester by removing the water molecule.  Potassium carbonate is added after completing the reaction to neutralise the excess acid.  Refluxing is used to heat an organic reaction without losing volatile organic reactants or products.  Distillation is used to separate the product from any remaining reactants. It works because all the organic molecules will have different boiling points. | Describes the use of TWO reagents  OR  limited explanation of refluxing and distillation  OR  writes equation (not words) for reaction that shows the structure of the 2 reactants  OR  explanation of one process and use of one reagent. | | EITHER  Chemical equation showing structures of reactants and the ester AND any two explanations correct in relation to the use of the reagents or the processes (distillation and refluxing)  OR  the two processes (distillation and refluxing) and the correct use of the 2 reagents. | | Appropriate chemical equation including H2O as a product.  Discusses why the two reagents are used and why refluxing and distillation are used. | | |

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| **2006** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (a)(i) | The two clear, colourless solutions would become cloudy on mixing and would then separate out into two layers. | Two correct of:   1. Correct observation which relates to the formation of an insoluble product. 2. Correct structural formula 3. Name. |  |  |
| (ii) | 2-chloro-2-methylpropane  OR 2-chloromethyl propane |
| (b) (i) | Aqueous sodium carbonate is added to neutralise any remaining acid. The anhydrous magnesium sulfate is added to dry the organic product (haloalkane). | Reason for adding either the sodium carbonate or the anhydrous MgSO4 is given. | Answer gives a valid reason for adding both reagents |  |
| (b)(ii) | The alkyl halide is insoluble in water and forms a separate layer, which may be removed using the separating funnel (apparatus C).  Once the acid has been neutralised, the lower aqueous layer once again needs to be removed using the separating funnel (C).  The haloalkane is then placed in the flask and purified by distilling (apparatus D) and only collecting the liquid distilling off close to the BP of the haloalkane. | One correct apparatus identified, with minimal link to the solubility (apparatus C) or boiling point (apparatus D). | Identifies appropriate equipment for one separation and links it to a valid property of the product. | Full answer identifying appropriate equipment for both separation techniques including links to a valid property of the product. |

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