ANSWERS: **Distinguishing between organic substances (Level 3)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2017** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  |  | • Recognises that only propanal will react.  • ONE of the following:  EITHER correct colour change  OR  reaction type  OR  equation. | • Only propanal reacts, plus any TWO of:  correct reaction type,  correct colour change,  correct equation. | • Explanation for both aldehyde and ketone, with  correct equation. |
|  | Adding blue Benedict’s solution to a **warmed / heated** sample of propanal will cause a (brick) red colour to form. This happens because the propanal has been oxidised to propanoic acid / carboxylic acid (red colour is copper(I) oxide).    No change will occur when blue Benedict’s solution is added to propanone, as it cannot be further oxidised / won’t react. |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2016** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | **A**: Propan-1-amine. (1-propanamine)  **B**: Propanal.  **C**: Propanoyl chloride.  **D**: Propan-2-one. (propanone)  **A**: *Propan-1-amine (a primary amine)*  CH3CH2CH2NH2 (propan-1-amine) will turn moist red litmus paper blue as it is basic.  CH3CH2CH2NH2 + H2O → CH3CH2CH2NH3+ + OH–  Water: Dissolves in water.  Benedict’s solution will stay blue as primary amines do not react with Benedict’s reagent.  **B**: *Propanal (An aldehyde)*  Damp Litmus: No colour change.  Water: Dissolves in water.  Propanal will react with Benedict’s reagent, with the blue solution forming a (copper mirror) / brick red precipitate. Propanoic acid is formed.  CH3CH2CHO → CH3CH2COOH  **C**: *Propanoyl chloride (An acyl chloride)*  Damp Litmus: Turn blue litmus red  Water: Propanoyl chloride will react vigorously with water to produce propanoic acid and hydrogen chloride.  CH3CH2COCl + H2O → CH3CH2COOH + HCl  Benedict’s solution will stay blue as the acyl chloride does not react with the Benedict’s, but instead reacts with the water present in the Benedict’s solution. | .   * Correct reagent chosen for two substances with incomplete observations.   OR  ONE substance correctly identified with equation. | * TWO substances from **A, B** and **C** correctly identified with accurate observations. * TWO correct equations.   OR  All FOUR substances are correctly identified, with accurate observations and ONE correct equation. | * All chemicals are correctly identified with accurate observations.   AND  TWO appropriate symbol equations given. |
|  | D: *Propan-2-one (A ketone)*  CH3COCH3 (propan-2-one)  Damp Litmus: No colour change.  Water: Dissolves in water.  Benedict’s solution: No reaction, so stays blue. |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2015** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | Bromine water rapidly decolourised from red or orange to colourless in an addition reaction.  OR  Acidified permanganate rapidly decolourised from purple to colourless in a redox or oxidation or reduction reaction. | Incomplete description | Links the observation to the reaction type. |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2014** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| (i)  (ii)  (iii) | *Damp red* litmus.  Propanamine will change the colour of *red* litmus blue.  Propanamide will not change the colour of *red* litmus.  Tollens’ reagent (Fehling’s or Benedict’s or Cr2O72– / H+or MnO4– / H+).  Propanal will form a silver mirror when warmed with Tollens’ reagent.  Propanone will not react with Tollens’ reagent.  Water.  Propanoyl chloride will react violently with water.  Propyl propanoate with not react with water / it will form layers. | * Two correct reagents. * Correct observation for ONE compound. | * TWO pairs of compounds distinguished with reagents and observations linked to the relevant species. | * ALL pairs of compounds distinguished with reagents, conditions and observations linked to species. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2013** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| 1. (i)  (ii)  (iii) |  | * ONE correct.   OR  THREE compounds with correct functional groups. | THREE correct. |  |
| 2. | Add to water then test with blue litmus paper  The butan-1-ol will not react with water nor change the colour of the moistened litmus paper.  The butanoic acid will change the moistened blue litmus paper to red.  The butanoyl chloride will react violently with the water.  Carboxylic acids react with water to form hydronium ions / equation  Acyl chlorides react with water to form carboxylic acids and hydrogen chloride / equation | * ONE chemical identified. * ONE chemical (word or symbol) equation. | * Devises a correct method with observations identifying all THREE substances. | * Correct method referenced to the structure of the organic compounds. |
| 3. | * Butan-1-ol is oxidised using permanganate / acidified dichromate,  EITHER forming an aldehyde which can be identified using Tollens’, silver mirror forms / Benedict’s or Fehling’s solution.  OR forms brick red precipitate / forming a carboxylic acid, which can be identified turning (moist) blue litmus paper red. * Butan-2-ol is oxidised to a ketone with permanganate / acidified dichromate, but this does not give a positive test using Tollens’ or Benedict’s. * Methyl propan-2-ol does not react with oxidising agents, permanganate remains purple / dichromate remains orange.   *Lucas test may be accepted with correct explanation.*  *(anhydrous) ZnCl2 and conc HCl*  *Solution goes cloudy / layers form*  *Tertiary in seconds*  *Secondary in minutes*  *Primary in hours / no reaction.* | * Identifies ONE alcohol with partial explanation. * Correctly links observations to species involved in one reaction. | Identifies TWO alcohols with minor omission (eg acidified or ‘conc’ missing). | Identifies all three alcohols. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2012** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
|  | H3C – CH2 – CH2 – NH2 is propanamine / 1-aminopropane  Propanamine will turn **damp** (red) litmus blue.  H3CCH2CH2NH2 + H2O H3CCH2CH2NH3  + + OH–  H3C – CH2 – CHO is propanal.  Propanal will react with Tollens’ reagent, forming a silver mirror /  precipitate.  Reaction: CH3CH2CHO + Ag+ CH3COOH + Ag  (OR half equations)  H3C – COCl is ethanoyl chloride.  Ethanoyl chloride will react vigorously with water  OR  Ethanoyl chloride will turn **damp** (blue) litmus paper red.  Reaction: CH3COCl + H2O →CH3COOH + HCl  is propanone.  Propanone will not react with any of the reagents. | THREE correct names given to  their appropriate formula  OR  TWO substances positively  identified. | THREE substances correctly  named.  AND  THREE substances positively  identified.  OR  TWO substances positively  identified, with corresponding  reasoning / equation. | All chemicals correctly  identified and named, with TWO  appropriate equations. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2011** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
|  | **Compound A**  90698assq1a  **Compound B** = alkene with two OH groups anywhere.  90698assq1a2  accept –OHs anywhere  **Compound C** = aldehyde = butanal – with one –OH group coming off any C atom.  90698assq1b1  **Compound D** = ester  90698assq1b3  **Justification**  **B**: rapid decolourisation of bromine water indicates an alkene/double bond /unsaturated compound  **C**: Reaction with Cr2O72– / H+ indicates alcohol or aldehyde, but Fehlings indicates aldehyde.  **D**: Hydrolysis of an ester can produce the alcohol and acid. As methanol forms, the ester must be methyl propanoate. (link presence of the methyl group in the ester to the formation of methanol)  90698assq1b2b  This isomer contains an asymmetric C atom.  Four different groups are attached to the chiral carbon. (substituents)  (Not four different functional groups/species.)  (Accept list of groups.) | TWO of   * One correct structural formula. * Justification for a functional group for one compound. | TWO of   * Correct structural formulae for A to D. * Justification for two functional groups. * Correct structural formula **and** justification for one compound. | Correct structural formula for compounds A to D that are linked to correct justifications.  AND |
| 2. | Damp red litmus will turn blue in the presence of the amine but no change with the amide (or clearly indicate solution / add water / aqueous).  OR  Universal indicator.  OR  Add Cu2+(aq) the amine will form a deep blue solution and no reaction with the amide. | * Correct laboratory procedure to distinguish amine / amide provided.   (ONE outcome.) | * Correct laboratory procedure to distinguish amine / amide provided and the different outcomes identified. |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2010** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| (a)  (b) | Compound B has an aldehyde group. To test for aldehyde group add Tollens’ reagent or Fehlings or Benedicts and heat.  Observations for Tollens: The (colourless) solution would form a silver mirror (or black precipitate.  Observations for Fehlings or Benedicts: The blue solution changes to **a brick red precipitate**.  No reaction with propanone, which is a ketone.  Acidified dichromate. Colour change orange to green.  Acidified permanganate. Colour change purple to colourless.  Compound X = CH3CH(OH)COOH  (2-hydroxypropanoic acid)  Chiral C and acid group reacts with carbonate. Secondary OH oxidised to ketone – if it was primary, then the diacid would form.  Compound Y = CH3COCOOH – no chiral C. Acid group still reacts. It is the product of the oxidation of the secondary alcohol, (evidence may be drawn from the equation). | Correct functional groups.  OR  Correct reagents for test.  Recognises any TWO functional groups (not Compound A). | Correct functional groups. AND Reagents and observations for tests.  Identifies ONE compound with links to data provided. | Correctly distinguishes between the two compounds (c) (includes observation for aldehyde and ketone) (say or imply ketone does not react).  AND  Identifies BOTH compounds with links to data provided. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2009** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
|  | The liquid is 3-methyl butan-1-ol  No enantiomers – cannot be A or D.  Reaction with acidified dichromate – cannot be a 3° alcohol (B) as tertiary alcohols cannot be oxidised  Reaction with conc. H2SO4 is an elimination reaction – cannot be 2,2,dimethyl propan–1–ol (E) as there is no H on C adjacent to the C with –OH. (no double bond/alkene can form because of the three C-C bonds) | * Correct answer but not justified (c)   **OR**  Correctly interprets one piece of data about the unknown. | Correct answer but not fully explained.  **OR**  Correctly interprets 2 pieces of data about the unknown. | Correct answer with full justification. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2008** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
|  | 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  OR  using chemical tests to positively identify TWO of the organic species and links reactions to observations. | Identifies TWO products of oxidation and correct reagent for oxidation plus correct description of how to obtain two separate products  OR  distinguishes between the products and the original alcohol using chemical tests –linking observations to reactions. | Identifies TWO products of oxidation  AND  correct reagent for oxidation  AND  correctly describes how to obtain two separate products  AND  how to distinguish between the products and the original alcohol, linking observations to reactions. |
|  | Propanoic acid can be identified as it turns damp blue litmus paper red or produces a gas with a metal carbonate or bicarbonate. Neither propan-1-ol nor propanal change the colour of litmus paper or react with the carbonate or bicarbonate.  Propanal will form a brick-red ppt with Benedict’s or Fehling solutions or a silver mirror with Tollens’ reagent, but propan-1-ol will not.  OR use acidified dichromate or acidified permanganate which will not react with the acid but will oxidise both the alcohol and aldehyde and turn the orange Cr2O72- green or purple MnO4- to colourless.  OR In reverse identify aldehyde first (as above) then use litmus or Cr2O72-/H+ or MnO4-/H+ to identify acid or alcohol respectively. |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **2007** | 90698q2diass  Ester group does not have acidic properties. –OH must be on secondary carbon to be oxidised to ketone rather than carboxylic acid  OR  Alternative structure that includes an ester group and a primary alcohol group that is only oxidised to an aldehyde group rather than the carboxylic acid eg:  90698q2dass | Valid structure showing correct number of atoms of each type and no carboxylic acid group  **OR**  Discussion linking lower boiling point to structure and weaker intermolecular attractions **and** lack of acidity due to no carboxylic acid group. | Correct structure.  **OR**  Isomeric structure that does not have a carboxylic acid group eg ester plus **primary** alcohol group and explanation links structure to lack of acidity of cpd Z or link between lower boiling point and expected weaker intermolecular forces. | Correct explanation to justify structure of Z and its oxidation product being non-acidic. |

© 2018 <https://www.chemical-minds.com>

NCEA questions and answers reproduced with permission from NZQA