

**M1.** (a) **M1**  $\text{AgNO}_3$  OR silver nitrate OR any soluble silver salt

**M2** remains colourless or no reaction or no (observed) change or no precipitate

**M3** white precipitate or white solid/white suspension

*An insoluble silver salt OR Tollens' OR ammoniacal silver nitrate or  $\text{HCl}/\text{AgNO}_3$  is CE = 0 for the clip*

*For M1*

*Credit acidified (or  $\text{HNO}_3$ ) silver nitrate for M1 and mark on  
If silver ions or incorrect formula for silver nitrate, penalise M1 but mark M2 and M3*

*If no reagent or incorrect reagent in M1, then no marks for M2 or M3*

*For M2*

*Ignore "nothing"*

*Ignore "no observation"*

*Ignore "clear"*

*Ignore "dissolves"*

*For M3*

*Ignore "cloudy solution" OR "suspension"*

3

(b) **M1** any soluble sulfate by name or formula e.g. sodium sulfate or sulfuric acid.

**M2** white precipitate or white solid/white suspension

**M3** remains colourless or no reaction or no (observed) change or no precipitate

**OR** as an alternative

**M1**  $\text{NaOH}/\text{KOH}$

**M2** remains colourless or no reaction or no (observed) change

**M3** white precipitate or white solid/white suspension

*An insoluble sulfate OR conc  $\text{H}_2\text{SO}_4$  is CE = 0 for the clip*

*If no reagent or incorrect reagent in M1, then no marks for M2 or M3*

*For the M1 soluble sulfate*

*If sulfate ions or incorrect formula for the chosen sulfate,  
penalise M1 but mark M2 and M3*

*For the M1 NaOH/KOH*

*If ammonia, then CE = 0*

*If hydroxide ions or incorrect formula for the chosen  
hydroxide, penalise M1 but mark M2 and M3*

*For no (observed) change in both alternatives*

*Ignore "nothing"*

*Ignore "no observation"*

*Ignore "clear"*

*Ignore "dissolves"*

*For the white precipitate in both alternatives*

*Ignore "cloudy solution" OR "suspension"*

3

- (c) **M1** ammonia (can be dilute or concentrated)
- M2** dissolves OR soluble OR (forms a) colourless  
solution OR goes colourless
- M3** does not dissolve OR not soluble OR remains as a solid  
OR no (observed) change OR no reaction OR yellow solid remains

OR if concentrated ammonia has been used, accept yellow  
solid turns white.

OR as an alternative using conc sulfuric acid

**M1** concentrated sulfuric acid OR c(onc) H<sub>2</sub>SO<sub>4</sub>

**M2** misty/white fumes/gas

OR remains white

OR no change (in colour)

**M3** turns black (solid)

OR purple fumes/gas

OR correct reference to H<sub>2</sub>S observation (e.g. bad egg smell)

*For M1*

*If incorrect formula or "ammonium", penalise M1 but mark*

*M2 and M3*

*If no reagent or incorrect reagent in M1, then no marks for M2 or M3*

*For M3*

*Ignore “nothing”*

*Ignore “no observation”*

*For the alternative using sulfuric acid*

*If dilute sulfuric acid or “aq” (alone) or the idea of concentrated not included CE = 0*

*If incorrect formula, penalise M1 but mark M2 and M3*

*If no reagent or incorrect reagent in M1, then no marks for M2 or M3*

3

(d) **M1** acidified potassium dichromate or  $K_2Cr_2O_7/H_2SO_4$

OR  $K_2Cr_2O_7/H^+$  OR acidified  $K_2Cr_2O_7$

**M2** (orange to) green solution OR goes green

**M3** (solution) remains orange or no reaction or no (observed) change

Alternative using  $KMnO_4/H_2SO_4$

**M1** acidified potassium manganate(VII) or  $KMnO_4/H_2SO_4$

OR  $KMnO_4/H^+$  OR acidified  $KMnO_4$

**M2** colourless solution OR goes colourless

**M3** (solution) remains purple or no reaction or no (observed) change

*If no reagent or incorrect reagent in M1, then no marks for M2 or M3*

*For M1*

*If “dichromate” or “dichromate(IV)” or incorrect formula or no acid, penalise M1 but mark M2 and M3*

*For M2 ignore dichromate described as “yellow” or “red”*

*For M3*

*Ignore “nothing”*

*Ignore “no observation”*

*For M1*

*If “manganate” or “manganate(IV)” or incorrect formula or no acid, penalise M1 but mark M2 and M3*

*Credit alkaline  $KMnO_4$  for possible full marks but M2 gives brown precipitate or solution goes green*

3

[12]

**M2.** Add Tollens / Fehling's / Benedict's reagent / ir spectra

*Accept any other chemically correct reagent and observation*

1

Silver mirror / blue to red **OR** red precipitate (with ethanal) / peak at  $1700\text{ cm}^{-1}$  (in ethanal)

*Must have correct test to access second mark*

*Accept 'silver'. Do not accept 'silver solution'*

*Give one mark for 'silver mirror test' and 'silver mirror'*

*Accept correct answer based on n.m.r. spectra*

1

[2]

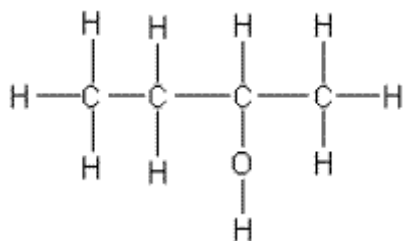
**M3.** (a) (i) Hexan-1-ol  
*ONLY*

1

(ii) Homologous (series)  
*ONLY*

1

(iii) Displayed formula for butan-2-ol



*All bonds must be drawn out including the O-H bond*

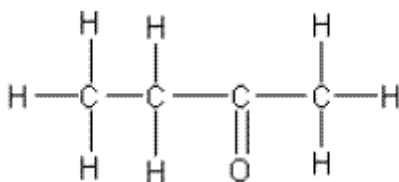
*Ignore bond angles*

1

- (iv)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} + [\text{O}] \longrightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CHO} + \text{H}_2\text{O}$   
 Require this whole equation as written or formulae drawn out  
 Penalise “sticks”

1

- (v) Displayed formula for butanone  
 (credit possible enols, ethers and cyclic structures for  $\text{C}_4\text{H}_8\text{O}$ )



All bonds must be drawn out  
 Ignore bond angles

1

- (b) **M1**  $q = m c \Delta T$  OR calculation  $175 \times 4.18 \times 8$   
**M2** = **5852** (J) OR 5.85 (kJ) OR 5.9 (kJ) (This also scores M1)  
**M3** 0.005 mol, therefore  $\Delta H = \underline{-1170}$  (kJ mol<sup>-1</sup>)

OR  $\Delta H = \underline{-1170.4}$  (kJ mol<sup>-1</sup>)

OR  $\Delta H = \underline{-1200}$  (kJ mol<sup>-1</sup>)

*Award full marks for correct answer*

*In M1, do not penalise incorrect cases in the formula*

*Ignore incorrect units in M2*

*Penalise M3 ONLY if correct answer but sign is incorrect OR value is in J mol<sup>-1</sup>*

*If  $m = 5 \times 10^{-3}$  OR if  $\Delta T = 281$ , CE and only allow one mark for correct mathematical formula for M1*

*If  $c = 4.81$  (leads to 6734) penalise M2 ONLY and mark on for M3 = -1350 (-1347)*

3

- (c) (i) **M1** The enthalpy change (or heat change at constant pressure) when 1 mol of a compound/substance/alcohol  
**M2** is burned completely in oxygen  
 OR burned in excess oxygen

**M3** with all reactants and products/all substances in standard states

OR

all reactants and products/all substances in normal states under standard conditions OR 100 kPa/1 bar and a specified T/298 K

*For M3*

*Ignore reference to 1 atmosphere*

3

(ii) **M1 (could be scored by a correct mathematical expression)**

**M1**  $\Delta H = \Sigma \Delta H_f(\text{products}) - \Sigma \Delta H_f(\text{reactants})$

OR a correct cycle of balanced equations

**M2** =  $4(-394) + 5(-286) - (-327)$

(This also scores M1)

**M3** = -2679 (kJ mol<sup>-1</sup>) OR -2680 (kJ mol<sup>-1</sup>)

**Award 1 mark ONLY for (+) 2679 OR (+) 2680**

*Correct answer to calculation gains full credit*

*Credit 1 mark if + 2679 (kJ mol<sup>-1</sup>)*

*For other incorrect or incomplete answers, proceed as follows*

- *check for an arithmetic error (AE), which is either a transposition error or an incorrect multiplication; this would score 2 marks (M1 and M2)*
- *If no AE, check for correct method; this requires either a correct cycle with 4CO<sub>2</sub> and 5H<sub>2</sub>O OR a clear statement of M1 which could be in words and scores only M1*

3

(d) (i) **M1 This is about the change in formula up the series**

Each alcohol in the series (compared with the previous one)

increases by/has an extra CH<sub>2</sub>

OR

has one more C-C and two more C-H

**M2 This is about the reaction and bond breaking/making**

Combustion of each alcohol in the series breaks one more C-C and two more C-H compared with the previous one AND forms one more mol CO<sub>2</sub> and one more mol H<sub>2</sub>O

OR

A statement in which there is the idea that the extra OR additional OR difference in number of bonds broken and formed (as the series increases) is the same OR has the same difference in energy

*N.B. If the first statement here for M2 is given, both marks score*

2

(ii) **For the two marks M1 and M2**

heat loss or heat absorbed by the apparatus

OR

incomplete combustion/not completely burned

OR

The idea that the water may end up in the gaseous state (rather than liquid) OR reactants and/or products may not be in standard states.

2

[18]

**M4.** (a) to neutralise stomach acidity

**OR**

as an antacid

OR

eases indigestion/heartburn

*Ignore milk of magnesia*  
*Credit suitable reference to indigestion/laxative/relief of constipation*

1

- (b) (i) an electron acceptor

**OR**

(readily) gains/accepts/receives electron(s)

*NOT an electron pair acceptor*

*Ignore removes/takes away/attracts electrons*

1

- (ii) Br<sub>2</sub> ONLY

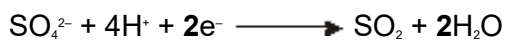
*Ignore "bromine"*

*Apply the list principle*

1

- (iii)  $\text{H}_2\text{SO}_4 + 2\text{H}^+ + 2\text{e}^- \longrightarrow \text{SO}_2 + 2\text{H}_2\text{O}$

**OR**



*Ignore state symbols*

*Ignore absence of negative charge on electron*

*Or multiples of equations*

1

- (c) (i) (acid) catalyst

**OR**

catalyses (the reaction)

**OR**

to speed up the reaction/increase the rate (of reaction)

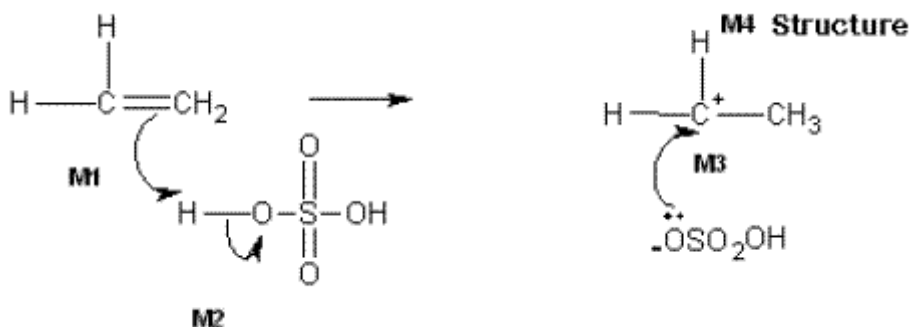
*Ignore "provides H<sup>+</sup> ions"*

*Accept phonetic spelling*

1



(ii)



**M1** must show an arrow from the double bond towards the H atom of the H – O bond OR HO on a compound with molecular formula for H<sub>2</sub>SO<sub>4</sub> (or accept H<sub>2</sub>SO<sub>3</sub> here) M1 could be to an H<sup>+</sup> ion and M2 an independent O – H bond break on a compound with molecular formula for H<sub>2</sub>SO<sub>4</sub> or H<sub>2</sub>SO<sub>3</sub>

**M2** must show the breaking of the O – H bond.

**M3** must show an arrow from the lone pair of electrons on the correct oxygen of the negatively charged ion towards the positively charged carbon atom.

**M4** is for the structure of the carbocation.

**NB The arrows here are double-headed**

*M2 Ignore partial charges unless wrong*

*M3 NOT HSO<sub>4</sub><sup>-</sup>*

*For M3, credit as shown or <sup>-</sup>OSO<sub>3</sub>H ONLY with the negative charge anywhere on this ion*

*OR correctly drawn out with the negative charge placed correctly on oxygen*

*Max 3 marks for wrong reactant*

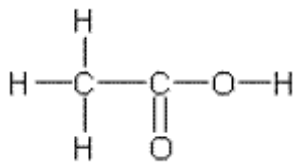
*Do not penalise the use of “sticks”*

4

(iii) Primary **OR** 1° (alcohol)

1

(iv) Displayed formula for ethanoic acid, CH<sub>3</sub>COOH



All the bonds must be drawn out and this includes the O – H bond

Ignore bond angles.

1

[11]

**M5.(a)** (i) Green

Ignore shades of green.

1

(ii) Excess acidified potassium dichromate(VI)

1

Reflux (for some time)

1

In the diagram credit should be given for

- a vertical condenser

*Lose M3 and M4 for a distillation apparatus.*

1

- an apparatus which would clearly work

*Do not allow this mark for a flask drawn on its own.*

*Penalise diagrams where the apparatus is sealed.*

1

(iii) Distillation

1

Immediately (the reagents are mixed)

1

(b) Keep away from naked flames

*Allow heat with water-bath or heating mantle.*

*If a list is given ignore eye protection, otherwise lose this mark.*

1

(c) (i) Tollens' or Fehling's reagents

*Incorrect reagent(s) loses **both** marks.*

*Accept mis-spellings if meaning is clear.*

1

Silver mirror / red ppt. formed

*Accept 'blue to red' but not 'red' alone.*

1

(ii) Sodium carbonate (solution) / Group II metal

*Allow indicator solutions with appropriate colours.*

*Accept any named carbonate or hydrogen carbonate.*

1

Effervescence / evolves a gas

*Accept 'fizzes'.*

1

(d) Propanoic acid

*If this mark is lost allow one mark if there is reference to stronger intermolecular forces in the named compound.*

*Lose M1 and M3.*

1

Contains hydrogen bonding

1

Some comparison with other compounds explaining that the intermolecular forces are stronger in propanoic acid

1

[15]