

$$\mathbf{M2} = (75 \times 4.18 \times 5.5)$$

$$1724 \text{ (J)} \text{ OR } 1.724 \text{ (kJ)} \text{ OR } 1.72 \text{ (kJ)} \text{ OR } 1.7 \text{ (kJ)}$$

(also scores **M1**)

*Ignore incorrect units in **M2**.*

M3 Using 0.0024 mol

$$\text{therefore } \Delta H = \underline{\underline{-718}} \text{ (kJ mol}^{-1}\text{)}$$

(Accept a range from -708 to -719 but do not penalise more than 3 significant figures)

*Penalise **M3** ONLY if correct numerical answer but sign is incorrect.*

*Therefore **+718** gains two marks.*

*If units are quoted in **M3** they must be correct.*

*If $\Delta T = 278.5$, CE for the calculation and penalise **M2** and **M3**.*

M4 and **M5** in any order

Any **two** from

- incomplete combustion
- heat loss
- heat capacity of Cu not included
- some ethanol lost by evaporation
- not all of the (2.40×10^{-3} mol) ethanol is burned / reaction is incomplete
*If $c = 4.81$ (leads to 1984) penalise **M2** ONLY and mark on for **M3** = -827*

5

- (c) (i) **M1** enthalpy / heat / energy change (at constant pressure) or enthalpy / heat / energy needed in breaking / dissociating (a) covalent bond(s)

Ignore bond making.

M2 averaged for that type of bond over different / a range of molecules / compounds

Ignore reference to moles.

2

- (ii) **M1**

$$\underline{\underline{\sum B(\text{reactants}) - \sum B(\text{products}) = \Delta H}}$$

OR

$$\underline{\underline{\text{Sum of bonds broken} - \text{Sum of bonds formed} = \Delta H}}$$

OR

$$B(\text{C-C}) + B(\text{C-O}) + B(\text{O-H}) + 5B(\text{C-H}) + 3B(\text{O=O}) \\ - 4B(\text{C=O}) - 6B(\text{O-H}) = \Delta H = -1279$$

Correct answer gains full marks.

*Credit **1 mark** for **-496** (kJ mol⁻¹)*

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 a correct method; this requires either a correct cycle with 2CO_2 and $3\text{H}_2\text{O}$ OR a clear statement of **M1** which could be in words and scores **only M1**.

M2 (also scores **M1**)

$$348+360+463+5(412)+ 3\text{B}(\text{O}=\text{O})$$

$$(\mathbf{3231}) \quad (\text{or } \mathbf{2768} \text{ if O-H cancelled})$$

$$- 4(805) - 6(463) = \Delta H = - 1279$$

$$(\mathbf{5998}) \quad (\text{or } \mathbf{5535} \text{ if O-H cancelled})$$

$$3\text{B}(\text{O}=\text{O}) = \mathbf{1488} \text{ (kJ mol}^{-1}\text{)}$$

Credit a maximum of one mark if the only scoring point is bonds formed adds up to **5998 (or 5535)** OR bonds broken includes the calculated value of **3231 (or 2768)**.

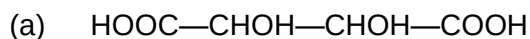
M3

$$\text{B}(\text{O}=\text{O}) = \mathbf{496} \text{ (kJ mol}^{-1}\text{)}$$

Award 1 mark for -496

Students may use a cycle and gain full marks

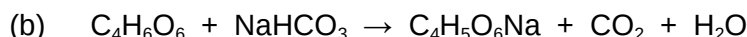
Q2.



Any suitable structural formula.

Displayed formula not required but bond sequences must be correct if shown.

1



OR



Allow equations based on the structural formula.

Allow multiples including fractions.

Allow any structure for $\text{C}_4\text{H}_6\text{O}$ or $\text{C}_4\text{H}_5\text{O}_6\text{Na}$

1

- (c) Suitable named indicator (eg litmus, methyl orange, Universal Indicator) / identified reactive metal (Mg, Zn or Fe)

Do not allow phenolphthalein without explanation of how a colour change would be seen.

Incorrect reagent, chemical error = 0 / 2

1

Appropriate colour in acid (eg red) / gas evolved

1

- (d) (i) Reagent: Acidified potassium dichromate (solution)

If incomplete (correct) reagent, lose M1 but mark on.

Incorrect reagent, chemical error = 0 / 3

Allow acidified potassium manganate(VII)

1

Obs: orange to green

Purple to colourless (solution).

1

Obs: no (visible) change

Allow 'no visible reaction', but do not allow 'no reaction' without qualification.

1

- (ii) Both would give the same result / both oxidised by reagent / both react with the reagent or similar

Allow consequential answer from (i).

Chemical error if reagent in (i) is incorrect, 0 / 1

1

- (e) The water would allow the tartaric acid and sodium hydrogencarbonate to react (before use)

Ignore any reference to water reacting with the ingredients.

Ignore references to prevention of 'caking' or 'clumping'.

Ignore references to shelf life without qualification.

1

- (f) Acid reacts (with NaHCO_3 / Na_2CO_3) to form CO_2

Allow 'neutralises (NaHCO_3 / Na_2CO_3) to form CO_2 '.

- (g) It is only used in very small quantities
Allow 'decomposes in the reaction'.
Do not allow 'reacts' without qualification.
Ignore reference to formation of salts.