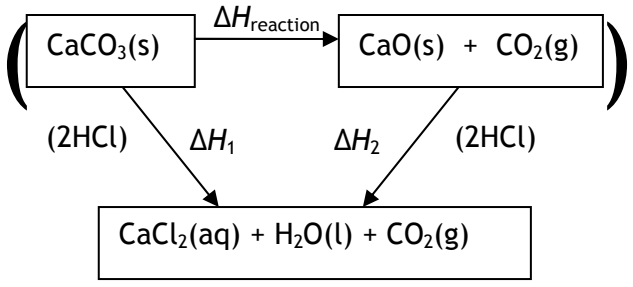
| Question Number | Acceptable Answers | Reject | Mark |
|---|---|---|---|
| **1(a)(i)** | $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$<br>ALLOW multiples<br>No other species to be allowed<br>IGNORE state symbols even if incorrect | $H_2CO_3$ instead of "$H_2O + CO_2$" on right hand side of equation | **1** |

| Question Number | Acceptable Answers | Reject | Mark |
|---|---|---|---|
| **1(a)(ii)** |  <br>**Mark each point independently**<br>**First mark:**<br>All three formulae in box, ignoring state symbols (even if incorrect)<br>**This mark is stand alone, NOT to be marked CQ on answer to (a)(i)** **(1)**<br>**Second mark:**<br>Two arrows, BOTH pointing downwards **(1)**<br>**Third mark:**<br>Left hand arrow labelled as $\Delta H_1$ **AND** right hand arrow labelled $\Delta H_2$ (whatever the direction of the arrows) **(1)** | Any other formulae | **3** |

| Question Number | Acceptable Answers | Reject | Mark |
|---|---|---|---|
| **1(a)(iii)** | $(\Delta H_{reaction}) = \boldsymbol{\Delta H_1 - \Delta H_2}$<br>This is a stand alone answer NOT to be marked CQ on (a)(ii) and/or (a)(i) | Any other expression | **1** |

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|---|---|---|---|
| **1(b)** | **Any two from:**<br>Heat /energy loss<br>OR<br>Heat /energy loss to surroundings<br>OR<br>Heat /energy loss to apparatus **(1)**<br><br>Measured under non-standard conditions **(1)**<br><br>Specific heat capacity of solutions is approximate **(1)**<br><br>Density of solution assumed to be 1 g $cm^{-3}$/same as (pure) water **(1)**<br><br>Large relative error in temperature measurement **(1)** | "Incomplete reaction"<br><br>"Incomplete combustion"<br><br>"Inaccuracy of equipment/apparatus"<br><br>"Human error"<br><br>$CO_2$ escapes<br><br>Bond enthalpies<br><br>Impurity of reactants<br><br>Transfer losses<br><br>Side-reactions | **2** |

| Question Number | Acceptable Answers | Reject | Mark |
|---|---|---|---|
| **2 (a) (i)** | (q = 250 x (31.5 − 21.0) x 4.18 =) **10972.5** (J)<br><br>*IGNORE* sf except 1 sf<br>*IGNORE* units even if incorrect<br>*IGNORE* any sign at this stage<br><br>*ALLOW* 10.97 (kJ) | 10000 (J) | **1** |

| Question Number | Acceptable Answers | Reject | Mark |
|---|---|---|---|
| **2 (a) (ii)** | ($M_r$ ethanol) = 46 **(1)**<br><br>(Mass ethanol burned = 63.21 − 62.47 =) 0.74 (g)<br><br>*ALLOW* 63.21 − 62.47 as alternative to 0.74 **(1)**<br><br>(Amount of ethanol = 0.74 ÷ 46 =) 0.0161 (mol) **(1)**<br><br>**NOTE***:* Moles of ethanol are CQ on molar mass and /or mass of ethanol burned<br><br>*IGNORE* sf except 1 sf<br><br>**NOTE***:* Correct answer with no working /limited working scores **(3)**<br><br>**Mark the three points independently** | 0.02 (mol) ethanol | **3** |

| Question Number | Acceptable Answers | Reject | Mark |
|---|---|---|---|
| **2 (a) (iii)** | Answer (i) ÷ (1000 x answer (ii)) **(1)**<br><br>**NOTE***:* Be aware of numbers held in calculator not corresponding to what is written in answer<br><br>Value and negative sign **(1)**<br><br>*IGNORE* sf except 1 sf<br><br>**NOTE***:* Answer consistent with (a)(i) and (a)(ii) with no working scores **(2)**<br><br>**E.g.** 10.9725 ÷ (0.74 ÷ 46) = − 682 (kJ $mol^{-1}$)<br><br>*ALLOW* Just kJ as the units<br><br>**NOTE***:* If correct answer is given in J $mol^{-1}$, the units of J $mol^{-1}$ must be clearly given for the second mark to be awarded. | Correct answer in J instead of J $mol^{-1}$ | **2** |

| Question Number | Acceptable Answers | Reject | Mark |
|---|---|---|---|
| **2 (b) (i)** | 100 x (1370 – Answer to (iii)) ÷ 1370 = value<br>e.g. 100 x (1370 – 682) ÷ 1370 = 50.2 % | Incorrect rounding of final answer **(0)** | **1** |

| Question Number | Acceptable Answers | Reject | Mark |
|---|---|---|---|
| **2 (b) (ii)** | Any **three** from:<br><br>Heat loss (from the beaker)/beaker not insulated/heat loss as no lid on beaker (containing the water) /no stirring **(1)**<br><br>Incomplete combustion (of the alcohol)/formation of soot (on beaker) **(1)**<br><br>Not all of the energy from the flame is used to heat the beaker and/or the water<br><br>OR<br><br>Too large a distance between flame and beaker / no draught excluder **(1)**<br><br>Heat capacity of the beaker is neglected/beaker absorbs heat/glass absorbs heat **(1)**<br><br>Evaporation of the (hot) alcohol **(1)**<br><br>Evaporation of the (hot) water **(1)** | More accurate thermometer<br><br>**Just** "experimental /human error"<br><br>Experiment carried out at a different (laboratory) temperature | **3** |

| Question Number | Acceptable Answers | Reject | Mark |
|---|---|---|---|
| **2 (b) (iii)** | $2\ C(s) + 3H_2(g) + ½\ O_2(g) \rightarrow C_2H_5OH(l)$<br>$\downarrow \qquad\qquad \downarrow$<br>$2CO_2 + 3H_2O$<br>$\triangle H_f = 2 \times (-394) + 3 \times (-286) - (-1370)$<br>$= -276\ (kJ\ mol^{-1})$<br><br>Correct expression or cycle **(1)**<br><br>Evidence for **both** doubling $\Delta H^{\theta}_c$ [C] **and** trebling $\Delta H^{\theta}_c$ [$H_2$] **(1)**<br><br>Correct sign and answer **(1)**<br><br>Correct answer with no working scores **(3)**<br><br>Correct answer with an incorrect cycle **(3)**<br><br>*IGNORE* units even if incorrect<br><br>**Alternatively the following answers score as shown even with incorrect cycle or incorrect units**<br><br>**NOTE***:*<br>(+)276 with or without working scores **(2)**<br><br>(+)690 with or without working scores **(2)**<br><br>−690 with or without working scores **(1)**<br><br>−552 with or without working scores **(2)**<br><br>−1134 with or without working scores **(2)**<br><br>(+)1134 with or without working scores **(1)**<br><br>(+)10 with or without working scores **(2)**<br><br>**REMINDER IF ANY OTHER ANSWER IS GIVEN: ALL WORKING MUST BE CHECKED TO SEE IF ANY MARKS CAN BE AWARDED** | | **3** |