

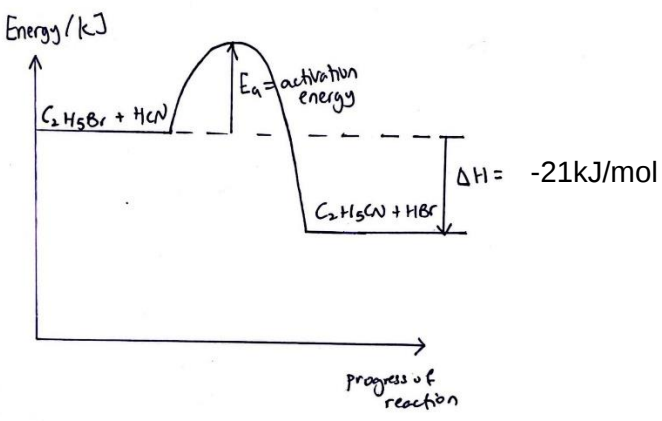
**Answers to Paper 2**

| Qn                | Key Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Remarks                                |           |           |                   |               |                     |                  |             |                                        |     |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-----------|-----------|-------------------|---------------|---------------------|------------------|-------------|----------------------------------------|-----|
| 1(a)              | graphite                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | [1]                                    |           |           |                   |               |                     |                  |             |                                        |     |
| 1(b)              | calcium chloride / sodium chloride / copper(II) carbonate (reject chemical formula)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | [1]                                    |           |           |                   |               |                     |                  |             |                                        |     |
| 1(c)              | copper(II) carbonate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | [1]                                    |           |           |                   |               |                     |                  |             |                                        |     |
| 1(d)              | copper, zinc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | [1]                                    |           |           |                   |               |                     |                  |             |                                        |     |
| 1(e)              | helium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | [1]                                    |           |           |                   |               |                     |                  |             |                                        |     |
| 1(f)              | zinc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | [1]                                    |           |           |                   |               |                     |                  |             |                                        |     |
| 2(a)              | <p><b>Experiment 1</b><br/>                     Anode: <math>4\text{OH}^- (\text{aq}) \rightarrow 2\text{H}_2\text{O} (\text{l}) + \text{O}_2 (\text{g}) + 4\text{e}^-</math><br/>                     Cathode: <math>\text{Ag}^+ (\text{aq}) + \text{e}^- \rightarrow \text{Ag} (\text{s})</math></p> <p><b>Experiment 2</b><br/>                     Anode: <math>\text{Ag} (\text{s}) \rightarrow \text{Ag}^+ (\text{aq}) + \text{e}^-</math><br/>                     Cathode: <math>\text{Ag}^+ (\text{aq}) + \text{e}^- \rightarrow \text{Ag} (\text{s})</math></p> <p>both cathode reactions</p> | <p>[1]</p> <p>[1]</p> <p>[1]</p>       |           |           |                   |               |                     |                  |             |                                        |     |
| 2(b)              | When aqueous silver nitrate reacts with aqueous sodium chloride it will form a <u>white precipitate of silver chloride</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | [1]                                    |           |           |                   |               |                     |                  |             |                                        |     |
| 2(c)              | <p>In Experiment 1, <u>no more silver</u> was deposited on the object as <u>all the silver ions in the electrolyte have been discharged</u>.</p> <p>In Experiment 2, this will not be a problem as the <u>silver ions discharged at the cathode</u> are continuously being <u>replaced by the silver anode</u> which <u>ionised / dissociate</u> into silver ions.</p>                                                                                                                                                                                                                                  | <p>[1]</p> <p>[1]</p>                  |           |           |                   |               |                     |                  |             |                                        |     |
| 2(d)              | <p><u>Iron</u> being <u>higher in the reactivity series / more reactive than silver</u>, will be able to <u>displace silver</u> from aqueous silver nitrate. Silver metal is deposited on the iron.</p> <p>But <u>gold</u> is <u>lower than silver</u> in the reactivity series, thus it <u>cannot displace silver</u> from aqueous silver nitrate.</p>                                                                                                                                                                                                                                                 | <p>[1]</p> <p>[1]</p>                  |           |           |                   |               |                     |                  |             |                                        |     |
| 3(ai)             | <table border="1"> <thead> <tr> <th>salt</th><th>reagent 1</th><th>reagent 2</th></tr> </thead> <tbody> <tr> <td>potassium sulfate</td><td>sulfuric acid</td><td>potassium hydroxide</td></tr> <tr> <td>lead(II) nitrate</td><td>nitric acid</td><td>lead(II) oxide /<br/>lead(II) carbonate</td></tr> </tbody> </table> <p>all correct [2]<br/>                     2 – 3 correct [1]<br/>                     0 – 1 correct [0]</p>                                                                                                                                                                   | salt                                   | reagent 1 | reagent 2 | potassium sulfate | sulfuric acid | potassium hydroxide | lead(II) nitrate | nitric acid | lead(II) oxide /<br>lead(II) carbonate | [2] |
| salt              | reagent 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | reagent 2                              |           |           |                   |               |                     |                  |             |                                        |     |
| potassium sulfate | sulfuric acid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | potassium hydroxide                    |           |           |                   |               |                     |                  |             |                                        |     |
| lead(II) nitrate  | nitric acid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | lead(II) oxide /<br>lead(II) carbonate |           |           |                   |               |                     |                  |             |                                        |     |

| Qn                        | Key Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Remarks                               |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-----------------------------|-------------------|----|-----------------|-----------|-----|------|------|------|------------|----|----|----|----|--------------|------------------|-------------------|-------------------|-------------------|--|---------|---------|---------|--------|----------------|---|---|---|---|--------------------------------------------|
| 3(aii)                    | $\text{K}_2\text{SO}_4 + \text{Pb}(\text{NO}_3)_2 \rightarrow \text{PbSO}_4 + 2\text{KNO}_3$<br><br>no. of mole of $\text{K}_2\text{SO}_4 = \frac{15}{1000} \times 2 = 0.03 \text{ mol}$<br><br>$\text{K}_2\text{SO}_4 : \text{PbSO}_4$<br>1 : 1<br><br>0.03 mol : 0.03 mol<br><br>mass of $\text{PbSO}_4 = 0.03 \times (207+32+4(16)) = 9.09 \text{ g}$                                                                                                                                                                                                                                                                                               | [1]<br><br>[1]<br><br><br><br><br>[1] |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| 3(bi)                     | willemite: $\text{SiO}_4^{4-}$<br><br>castorite: $\text{Si}_4\text{O}_{10}^{4-}$<br><br>chrysotile: $\text{Si}_2\text{O}_5^{2-}$<br><br>1 – 2 correct [1]<br>all correct [2]                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | [2]                                   |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| 3(bii)                    | <table border="1"><tr><td></td><td>Na</td><td>Al</td><td>Si</td><td>O</td></tr><tr><td>% by mass</td><td>8.7</td><td>10.3</td><td>32.3</td><td>48.7</td></tr><tr><td>molar mass</td><td>23</td><td>27</td><td>28</td><td>16</td></tr><tr><td>no. of moles</td><td><math>\frac{8.7}{23}</math></td><td><math>\frac{10.3}{27}</math></td><td><math>\frac{32.3}{28}</math></td><td><math>\frac{48.7}{16}</math></td></tr><tr><td></td><td>= 0.378</td><td>= 0.381</td><td>= 1.154</td><td>= 3.04</td></tr><tr><td>smallest ratio</td><td>1</td><td>1</td><td>3</td><td>8</td></tr></table><br><br>Empirical Formula = $\text{NaAlSi}_3\text{O}_8$ (shown) |                                       | Na                          | Al                | Si | O               | % by mass | 8.7 | 10.3 | 32.3 | 48.7 | molar mass | 23 | 27 | 28 | 16 | no. of moles | $\frac{8.7}{23}$ | $\frac{10.3}{27}$ | $\frac{32.3}{28}$ | $\frac{48.7}{16}$ |  | = 0.378 | = 0.381 | = 1.154 | = 3.04 | smallest ratio | 1 | 1 | 3 | 8 | <br><br><br><br><br><br><br>[1]<br><br>[1] |
|                           | Na                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Al                                    | Si                          | O                 |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| % by mass                 | 8.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 10.3                                  | 32.3                        | 48.7              |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| molar mass                | 23                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 27                                    | 28                          | 16                |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| no. of moles              | $\frac{8.7}{23}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | $\frac{10.3}{27}$                     | $\frac{32.3}{28}$           | $\frac{48.7}{16}$ |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
|                           | = 0.378                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | = 0.381                               | = 1.154                     | = 3.04            |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| smallest ratio            | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1                                     | 3                           | 8                 |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| 4(a)                      | calcium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | [1]                                   |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| 4(b)                      | <table border="1"><tr><td>number of electron shells</td><td>number of valence electrons</td></tr><tr><td>7</td><td>4</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | number of electron shells             | number of valence electrons | 7                 | 4  | <br><br><br>[1] |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| number of electron shells | number of valence electrons                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                       |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| 7                         | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                       |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| 4(c)                      | Similarity: They have the <u>same number of protons</u> which is <u>114</u> .<br>Difference: $^{289}\text{F}$ has 175 neutrons but $^{288}\text{F}$ has 174 neutrons<br>(must state both)                                                                                                                                                                                                                                                                                                                                                                                                                                                              | [1]<br><br>[1]                        |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| 4(di)                     | <br><br>correct diagram (ratio of cations : electrons must be 1 : 1 )<br>correct label                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <br><br><br>[1]<br>[1]                |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| 4(dii)                    | good conductor of electricity / good conductor of heat / malleable / ductile / high melting and boiling point                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | [1]                                   |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| 4(diii)                   | It reacts with acids to form salt and water                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | [1]                                   |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |
| 5(a)                      | $R_f$ value of phaeophytin = $5 / 8 = 0.625$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | [1]                                   |                             |                   |    |                 |           |     |      |      |      |            |    |    |    |    |              |                  |                   |                   |                   |  |         |         |         |        |                |   |   |   |   |                                            |

| Qn     | Key Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Remarks           |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 5(b)   | Extract from frozen spinach contains <u>four pigments</u> which are chlorophyll, xanthophyll, phaeophytin and an unknown pigment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | [1]               |
| 5(c)   | Extract from market is fresher as it <u>does not contain phaeophytin</u> as presence of phaeophytin shows that <u>chlorophyll has decomposed</u> .<br>(reverse argument accepted)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | [1]<br>[1]        |
| 6(a)   | Dissolve fertiliser in <u>water, filter</u> and use the filtrate for the following test.<br>Add <u>aqueous sodium hydroxide</u> into both solutions.<br>if <u>white precipitate</u> formed, the fertiliser is <u>calcium dihydrogenphosphate</u><br>if <u>no white precipitate formed</u> , the fertiliser is <u>ammonium phosphate</u><br>(must give both results)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | [1]<br>[1]<br>[1] |
| 6(bi)  | A <u>decreasing temperature</u> leads to a <u>higher yield</u> of ammonia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | [1]               |
| 6(bii) | Advantage: A <u>higher pressure</u> of 300 atm leads to a <u>higher yield of ammonia</u><br>Disadvantage: Maintaining a higher pressure of 300 atm incurs a <u>larger cost / more expensive</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | [1]<br>[1]        |
| 6(c)   | Plant growth <u>depends on soil acidity or pH</u> / plants have <u>optimum pH</u> (for growth)<br>Add <u>Ca(OH)<sub>2</sub> / slaked lime</u> to reduce the acidity in soil.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | [1]<br>[1]        |
| 7(ai)  | Y, iron, X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | [1]               |
| 7(aii) | <u>green solution turns colourless</u><br><u>grey deposit/solid</u> formed<br><u>X is more reactive than iron</u> as X displaced iron from iron(II) sulfate solution to form iron                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | [1]<br>[1]<br>[1] |
| 7(bi)  | greater volume of <u>water</u> on <u>soil surface</u> which will <u>react with iron in the steel post</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | [1]               |
| 7(bii) | (Galvanising coats the steel with a more reactive metal zinc)<br><u>Zinc will corrode in place of the iron</u> in steel,<br>It is preferred because even when the layer is scratched, the <u>iron in steel will still not rust</u> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | [1]<br>[1]        |
| 8(a)   | Addition polymers are formed from <u>monomers that are unsaturated</u> / have C=C monomers while condensation polymers are formed from <u>monomers that have different functional groups</u> .<br>Addition polymers are formed <u>without losing any molecules</u> while condensation polymers are formed with the <u>removal of small molecules such as water</u> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | [1]<br>[1]        |
| 8(bi)  | <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <math display="block">  \begin{array}{cccccccc}  \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} \\    &amp;   &amp;   &amp;   &amp;   &amp;   &amp;   &amp;   \\  \text{N} &amp; -\text{C} &amp; -\text{C} &amp; -\text{C} &amp; -\text{C} &amp; -\text{C} &amp; -\text{C} &amp; -\text{N} \\    &amp;   &amp;   &amp;   &amp;   &amp;   &amp;   &amp;   \\  \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H}  \end{array}  </math> </div> <div style="text-align: center;"> <math display="block">  \begin{array}{ccccccc}  \text{O} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{O} \\     &amp;   &amp;   &amp;   &amp;   &amp;    \\  \text{C} &amp; -\text{C} &amp; -\text{C} &amp; -\text{C} &amp; -\text{C} &amp; -\text{C} \\  / &amp;   &amp;   &amp;   &amp;   &amp; \backslash \\  \text{H}-\text{O} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; \text{O}-\text{H}  \end{array}  </math> </div> </div> | [2]               |

| Qn     | Key Answers                                                                                                                                                                                                                                                                                                                                                                                                                 | Remarks                                     |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| 8(bii) | <p>Mr of a repeated unit of nylon-6,6 (<math>C_{12}H_{22}N_2O_2</math>) = <math>12(12)+22(1)+2(14)+2(16)= 226</math></p> <p>For Mr = 12 000, the number of repeated units (n) = <math>12\ 000 \div 226 = 53.1</math></p> <p>For Mr = 20 000, the number of repeated units (n) = <math>20\ 000 \div 226 = 88.5</math></p> <p>Range of average number of repeating units, n, is <math>54 \leq n \leq 88</math> / 54 to 88</p> | <p>[1]</p> <p>[1]</p>                       |
| 8(c)   |                                                                                                                                                                                                                                                                                                                                                                                                                             | [1]                                         |
| 8(cii) | similarity: Both contain the amide linkage.                                                                                                                                                                                                                                                                                                                                                                                 | [1]                                         |
| 9(a)   | 1,2,3                                                                                                                                                                                                                                                                                                                                                                                                                       | [1]                                         |
| 9(b)   | Going down Group 2, the <u>atomic radii increase</u> as the <u>number of electron shell increases</u> from one member to the next.                                                                                                                                                                                                                                                                                          | <p>[1]</p> <p>[1]</p>                       |
| 9(c)   | When a beryllium atom forms a beryllium ion, the <u>radius decreases</u> to less than half that of the atom.                                                                                                                                                                                                                                                                                                                | [1]                                         |
| 9(d)   | <p>Barium would react <u>vigorously</u> with cold water.</p> <p>(reject explosively)</p> <p>As the <u>reactivity increases down the Group</u>.</p>                                                                                                                                                                                                                                                                          | <p>[1]</p> <p>[1]</p>                       |
| 9(e)   | <p>Beryllium hydroxide is <u>amphoteric in nature</u>.</p> <p>It can <u>react with alkaline solution</u>.</p>                                                                                                                                                                                                                                                                                                               | <p>[1]</p> <p>[1]</p>                       |
| 9(f)   | <p><u>Effervescence</u> will be observed.</p> <p>Calcium reacts with water <u>moderately/quickly/readily</u>.</p> <p><math>Ca(s) + H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)</math></p> <p>correct balanced chemical equation</p> <p>correct state symbols (awarded if balanced chem equation is written)</p>                                                                                                               | <p>[1]</p> <p>[1]</p> <p>[1]</p> <p>[1]</p> |
| 10(ai) | <p>energy require for bond breaking (use new numbers)</p> <p>= <math>6(413)+347+276+891 = +3992\text{kJ}</math></p> <p>energy released for bond forming</p> <p>= <math>5(413)+2(347)+891+363 = -4013\text{kJ}</math></p> <p>enthalpy change = <math>3992+(-4013) = -21\text{ kJ/mol}</math></p> <p>ecf (incorrect energy for bond breaking and forming but subtract correctly)</p>                                          | <p>[1]</p> <p>[1]</p>                       |

| Qn                                 | Key Answers                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Remarks                                                                                                     |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------|-----------------|----------------------|-----------------|-----------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-----------------------|
| 10(aii)                            |  <p>correct axes and correct labelling the reactants &amp; products<br/>(must be chemical formulae of balanced equation)</p> <p>correct enthalpy change and shape (refer to level of reactants and products)</p> <p>correct activation energy</p> <p>ecf from wrong <math>\Delta H</math> in (b)(i)</p> <p>ecf based on shape of curve that students draw</p>                                                                                                                                                                                                  | <p>[1]</p> <p>[1]</p> <p>[1]</p>                                                                            |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
| 10(aiii)                           | HBr dissociates in water to produce hydrogen/ $H^+$ ions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | [1]                                                                                                         |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
| 10(bi)                             | There is a difference of a $CH_2$ unit from one member to the next consecutive member in a homologous series / same functional group                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | [1]                                                                                                         |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
| 10(bii)                            | $C_nH_{2n}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | [1]                                                                                                         |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
| 10(biii)                           | Substitution<br>Presence of light is needed in this reaction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | [1]<br>[1]                                                                                                  |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
| 11(a)                              | acidified potassium manganate (VII) (reject oxygen)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | [1]                                                                                                         |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
| 11(bi)                             | <table border="1"> <tr> <td>name of series</td><td>alcohols</td><td>carboxylic acid</td></tr> <tr> <td>name of third member</td><td><u>propanol</u></td><td><u>propanoic acid</u></td></tr> <tr> <td>structural formula of third member</td><td> <math display="block">  \begin{array}{c}  H &amp; H &amp; H \\    &amp;   &amp;   \\  H-C &amp; -C &amp; -C-O-H \\    &amp;   &amp;   \\  H &amp; H &amp; H  \end{array}  </math> </td><td> <math display="block">  \begin{array}{c}  H &amp; H &amp; O \\    &amp;   &amp;    \\  H-C &amp; -C &amp; -C-O-H \\    &amp;   &amp; \\  H &amp; H &amp;  \end{array}  </math> </td></tr> </table> | name of series                                                                                              | alcohols | carboxylic acid | name of third member | <u>propanol</u> | <u>propanoic acid</u> | structural formula of third member | $  \begin{array}{c}  H & H & H \\    &   &   \\  H-C & -C & -C-O-H \\    &   &   \\  H & H & H  \end{array}  $ | $  \begin{array}{c}  H & H & O \\    &   &    \\  H-C & -C & -C-O-H \\    &   & \\  H & H &  \end{array}  $ | <p>[1]</p> <p>[1]</p> |
| name of series                     | alcohols                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | carboxylic acid                                                                                             |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
| name of third member               | <u>propanol</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <u>propanoic acid</u>                                                                                       |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
| structural formula of third member | $  \begin{array}{c}  H & H & H \\    &   &   \\  H-C & -C & -C-O-H \\    &   &   \\  H & H & H  \end{array}  $                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | $  \begin{array}{c}  H & H & O \\    &   &    \\  H-C & -C & -C-O-H \\    &   & \\  H & H &  \end{array}  $ |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
| 11(bii)                            | $  \begin{array}{c}  O \\     \\  H-C-H  \end{array}  $                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | [1]                                                                                                         |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |
| 11(ci)                             | $C_2H_4 + H_2O \rightarrow C_2H_5OH$<br><br>Any two<br>high temperature / high pressure / catalyst of phosphoric acid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p>[1]</p> <p>[1]</p>                                                                                       |          |                 |                      |                 |                       |                                    |                                                                                                                |                                                                                                             |                       |

| Qn       | Key Answers                                                                                                                                                                                                                | Remarks                            |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| 11(cii)  | no. of moles of glucose = $36 \times 10^6 / 180 = 2 \times 10^5$ mol<br><br>glucose : ethanol<br>1 : 2<br>$0.2 \times 10^6$ mol : $0.4 \times 10^6$ mol<br><br>mass of ethanol = $0.4 \times 10^6 \times 46 = 18.4$ tonnes | [1]<br><br><br><br><br><br><br>[1] |
| 11(ciii) | ethene obtained from crude oil / petroleum / fossil fuels which is a finite resource / non-renewable / will run out<br><br>glucose obtained from plants so continuous supply / renewable resource / will not run out.      | [1]<br><br>[1]                     |