

Commentary on candidate evidence

The candidate evidence has achieved the following marks for each question in this course component.

Question 1(b)(i)

Candidate 1

The candidate was awarded **0 marks**.

The candidate has given an incorrect response. They have incorrectly stated 'energy required to remove the 1st electron' and not one mole of electrons. They have not stated that this should be in the gas phase or gaseous atoms.

Candidate 2

The candidate was awarded **0 marks**.

The candidate has given a correct response however they have included extra information (non-metal) which is incorrect and is therefore a cancelling error, so the mark cannot be awarded.

Candidate 3

The candidate was awarded **1 mark**.

The candidate has given a correct response.

Question 1(b)(ii)

Candidate 1

The candidate was awarded **0 marks**.

The candidate has given an incomplete response as they have not stated that the 'shielding / screening effect' has increased with the increased number of shells, so the mark cannot be awarded.

Candidate 2

The candidate was awarded **0 marks**.

The candidate has given an incorrect response. The candidate has made no mention of screening or shielding and has indicated that the electron attraction decreases rather than the nucleus attraction for the electrons decreases and so the mark cannot be awarded.

Question 1(c)(i)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. They have correctly named hydrogen bonding as the strongest type of intermolecular force and are awarded the first mark. The second mark is not awarded as the candidate has not given enough detail in their explanation of how hydrogen bonding arises. They have made no mention of hydrogen bonding occurring between molecules and the candidate has used the phrase 'interact with nitrogen, oxygen or fluorine' but does not state if hydrogen is bonded directly to these atoms or if they are present on another molecule.

Candidate 2

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. They have correctly named hydrogen bonding, so the first mark is awarded. The candidate has not explained how hydrogen bonds arise. They have not mentioned hydrogen bonding occurs between molecules, so the second mark is not awarded.

Candidate 3

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. They have correctly named hydrogen bonding, so the first mark is awarded. The candidate has not mentioned that hydrogen bonding occurs between molecules containing hydrogen atoms bonded to an atom of high electronegativity difference compared to hydrogen, so the second mark cannot be awarded.

Candidate 4

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. They have correctly named hydrogen bonding, so the first mark is awarded. The second mark is not awarded as the candidate has not stated that the attractions are from the opposite ends of permanent dipoles.

Candidate 5

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. They have correctly named hydrogen bonding and are awarded the first mark. The candidate has given an incomplete explanation of how hydrogen bonding arises by omitting that hydrogen bonding occurs between molecules, so the second mark cannot be awarded.

Candidate 6

The candidate was awarded **1 mark**.

The candidate has correctly named hydrogen bonding and is awarded the first mark. The candidate has given an incorrect statement '... only occurs between N, O and F elements.' Since these elements exist as non-polar, pure covalent molecules, the second mark cannot be awarded.

Question 1(c)(ii)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. The candidate has correctly identified that there are more London dispersion forces, so the first mark is awarded. They have not stated that the number of electrons in the molecules increases from HCl to HI so the second mark cannot be awarded.

Candidate 2

The candidate was awarded **0 marks**.

The candidate has not identified London dispersion forces so is not awarded the first mark. The candidate has not made a correct statement about increasing numbers of electrons so is not awarded the second mark.

Candidate 3

The candidate was awarded **0 marks**.

The candidate has not related the increase in size with increased London dispersion forces, so the first mark is not awarded. They have not stated that the numbers of electrons increase, so the second mark is not awarded.

Question 2(b)(i)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given an incorrect final answer but was awarded a partial mark. The candidate has attempted to calculate by proportion. They have an incorrect ratio of mass to volume so the first partial mark for the proportion method cannot be awarded. The candidate has, however, correctly followed through from incorrect multiples of 122.6 and 24 and so one partial mark is awarded.

Candidate 2

The candidate was awarded **1 mark**.

The candidate has an incorrect final answer but was awarded a partial mark. The candidate has correctly calculated moles of KClO_3 (0.0375) so one partial mark is awarded. The candidate has incorrectly applied the 2:3 mole ratio so a second partial mark cannot be awarded.

Candidate 3

The candidate was awarded **1 mark**.

The candidate has given an incorrect final answer but was awarded a partial mark. The candidate has correctly calculated moles of KClO_3 , has used the 2:3 mole ratio correctly and has shown a correct method of converting from moles into litres, however they have written and used an incorrect number '1.34072' when they should have used 1.35072. Partial marking allows 1 mark to be awarded for either correctly calculating moles of KClO_3 or application of the mole ratio.

Question 2(b)(iii)

Candidate 1

The candidate was awarded **0 marks**.

The candidate has given an incorrect final answer. They have incorrect intermediate rounding using '0.0396'. Rounding to four decimal places should have given 0.0397 (from 0.03968254).

Candidate 2

The candidate was awarded **1 mark**.

The candidate has given a correct response.

Question 2(b)(iv)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has stated that 'more particles have the required energy to react' so the first mark can be awarded. The candidate has not mentioned successful collisions so the second mark cannot be awarded.

Candidate 2

The candidate was awarded **1 mark**.

The candidate has stated 'more reactants' which has been accepted as an alternative to more particles having greater than the activation energy, so the first mark is awarded. They have not however related this to more successful collisions, so the second mark is not awarded.

Candidate 3

The candidate was awarded **1 mark**.

The candidate is awarded the first mark for 'it gives more particles energy greater than or equal to the activation energy'. They have not said more successful collisions, so the second mark is not awarded.

Candidate 4

The candidate was awarded **1 mark**.

The candidate has not mentioned an increase in the number of particles with increased energy, so the first mark is not awarded. The second mark is awarded for stating more successful collisions.

Candidate 5

The candidate was awarded **1 mark**.

The first mark is awarded for 'more particles have energies equal to or greater than the activation energy'. The candidate has not mentioned more successful collisions, so the second mark is not awarded.

Question 4(c)(ii)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. The candidate has correctly identified that two parts with different polarities are present, so the first mark is awarded. The candidate has not explained that the non-polar part dissolves in non-polar liquids while the polar part dissolves in polar liquids, so the second mark is not awarded.

Candidate 2

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. The first mark is awarded for correctly identifying that two parts are present, 'hydrophobic tail' and 'hydrophilic head'. The candidate has stated that the hydrophobic tail binds to the non-polar liquids while the hydrophilic head binds to the polar liquids, however the term 'bind' is not equivalent to 'dissolves in' so the second mark is not awarded.

Candidate 3

The candidate was awarded **0 marks**.

The candidate has given an incorrect response. The candidate has indicated that there are two groups present but has not given any information on the polarities of these groups either as being different or as hydrophobic or hydrophilic, so the first mark is not awarded. The candidate has incorrectly stated that the non-polar and polar substances combine, so the second mark is not awarded.

Candidate 4

The candidate was awarded **0 marks**.

The candidate has given an incorrect response. They have not mentioned either two groups or different polarities so the first mark cannot be awarded. They have not mentioned dissolving in relation to polarity so the second mark cannot be awarded.

Candidate 5

The candidate was awarded **0 marks**.

The candidate has not mentioned two groups with different polarities are present, so the first mark is not awarded. The second mark is not awarded as the candidate has not stated which parts of the emulsifier dissolve in which liquid. They have also used the term 'bind' which is not equivalent to dissolve.

Candidate 6

The candidate was awarded **2 marks**.

The candidate has given a fully correct response. The first mark is awarded for stating that there are two parts present, polar and non-polar. The second mark is awarded for explaining which part dissolves in which type of liquid.

Question 6(a)(iii)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. The candidate has correctly stated that the 'active site of the enzyme will be denatured', so the first mark is awarded. They have not mentioned that intermolecular or hydrogen bonds are broken, so the second mark cannot be awarded.

Candidate 2

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. The candidate is awarded the first mark for either of the correct statements 'the enzyme will denature' or 'the enzyme will change shape'. They have not mentioned that intermolecular or hydrogen bonds are broken, so the second mark cannot be awarded.

Candidate 3

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. The first mark is awarded for 'begins to denature', however the candidate does not mention intermolecular, or hydrogen bonds being broken, so the second mark cannot be awarded. Optimum pH is not considered as a cancelling error.

Candidate 4

The candidate was awarded **0 marks**.

The candidate has answered incorrectly in terms of amino acids rather than enzymes and has also incorrectly stated that 'bonds denature', so the first mark is not awarded. The candidate has not specified the type of bond in their statement 'strength in bonds decrease' as either intermolecular or hydrogen bonds, so the second mark is not awarded.

Candidate 5

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. The candidate is awarded the first mark for either of the correct statements 'enzyme to denature' or 'changed shape'. They have not mentioned that intermolecular or hydrogen bonds are broken, so the second mark cannot be awarded.

Candidate 6

The candidate was awarded **2 marks**.

The candidate has given a fully correct response with the statement 'intermolecular bonds break and the enzyme is denatured' and is awarded both marks.

Question 6(a)(iv)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has not drawn the reactants in contact with each other, so the first mark is not awarded. They have a viable method for collecting and measuring the gas, so the second mark is awarded. The candidate has not labelled the oxygen gas collected, so the third mark is not awarded.

Candidate 2

The candidate was awarded **1 mark**.

The candidate has not drawn the reactants in contact with each other, so the first mark is not awarded. They have a viable method for collecting and measuring the gas, so the second mark is awarded. The candidate has not labelled the oxygen gas collected, so the third mark is not awarded.

Candidate 3

The candidate was awarded **2 marks**.

The candidate has drawn the reactants in contact with each other, so the first mark is awarded. They have a viable method for collecting and measuring the gas, so the second mark is awarded. The candidate has not labelled the syringe as being the position of the oxygen gas collected, so the third mark is not awarded.

Candidate 4

The candidate was awarded **3 marks**.

The candidate has drawn the reactants in contact with each other, so the first mark is awarded. They have a viable method for collecting and measuring the gas, so the second mark is awarded. The candidate has labelled the syringe as being the position of the oxygen gas collected, so the third mark is awarded.

Question 6(b)(ii)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given a partially correct response. The candidate has stated correctly that vitamin C is polar but has not explained that this is due to the presence of hydroxyl groups, so the first mark is not awarded. They have correctly linked the solubility of vitamin C to the polarity of water and hydrogen bonding, so the second mark is awarded.

Candidate 2

The candidate was awarded **1 mark**.

The candidate has given a partially correct response.

The candidate has correctly stated that vitamin C is polar but has made no mention of hydroxyl groups in relation to vitamin C. While they have circled a hydroxyl group in the structure, they have connected this to an incorrect explanation in reference to water, so cannot be awarded the first mark. They have made a statement correctly linking the solubility of vitamin C to the polarity of water, so the second mark is awarded.

Candidate 3

The candidate was awarded **1 mark**.

The candidate has given a partially correct response.

The candidate has mentioned hydroxyl groups, and has said these are polar, however, they have not said that the molecule is polar and so cannot be awarded the first mark. They have given an explanation linking the polarity of water with solubility by stating that water is polar and 'like dissolves like', so the second mark is awarded.

Candidate 4

The candidate was awarded **1 mark**.

The candidate has given a partially correct response.

The candidate has not mentioned polarity or hydroxyl groups so the first mark cannot be awarded. They have made a statement linking solubility to hydrogen bonding, so the second mark is awarded.

Candidate 5

The candidate was awarded **2 marks**.

The candidate has given a fully correct response. They have stated that 'vitamin C contains some hydroxyl groups' and that 'these groups can form hydrogen bonds with water', so they have been awarded the first mark. They have given a correct diagram showing vitamin C and water forming a hydrogen bond and have also made a statement linking this to solubility which means they have been awarded the second mark.

Question 6(c)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given an incorrect response but can be awarded a partial mark.

The candidate has correctly calculated the mass in mg of solanine required for a 65kg adult and so has been awarded the first partial mark. The candidate has not shown a scaling to a mass of potatoes; instead they have given an incorrect unit conversion so no further partial marks can be awarded.

Candidate 2

The candidate was awarded **2 marks**.

The candidate has given a correct numerical answer so is awarded the first two marks. However, they have given an incorrect unit and so cannot be awarded the third mark.

Question 7(a)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given an incorrect response but can be awarded a partial mark. They have given the correct expression for the calculation of enthalpy in the combustion experiment and so can be awarded the first partial mark. They have not applied the correct concept for the calculation of the mass burned in the experiment so cannot be awarded further marks.

Candidate 2

The candidate was awarded **3 marks**.

The candidate has given a fully correct response.

Question 7(b)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given an incorrect response; however, they can be awarded 1 partial mark. They have not retrieved four correct values from the data book (C-O instead of C=O) so cannot be awarded the first partial mark. They have three correct values and have shown by their calculation that they have recognised bond breaking is endothermic and bond making is exothermic so can be awarded the second of the partial marks.

Candidate 2

The candidate was awarded **1 mark**.

The candidate has given an incorrect response; however, they can be awarded 1 partial mark. They have retrieved four correct values from the data book so can be awarded the first partial mark.

Candidate 3

The candidate was awarded **1 mark**.

The candidate has given a response with an ambiguous sign (it appears that they have scored it out or attempted to change it so this would be regarded as an incorrect response). A correct numerical value with an incorrect sign can be awarded 1 mark.

Candidate 4

The candidate was awarded **1 mark**.

The candidate has given an incorrect response; however, they can be awarded 1 partial mark. They have not retrieved four correct values from the data book (C-O instead of C=O) so cannot be awarded the first partial mark. They have three correct values and have shown by their calculation that they have recognised bond breaking is endothermic and bond making is exothermic, so can be awarded the second of the partial marks.

Question 7(c)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given an incorrect response but may be awarded up to 1 partial mark.

The candidate has shown working with the correct use of the atom economy relationship but with incorrect stoichiometry so can be awarded one partial mark.

Question 7(e)(i)

Candidate 1

The candidate was awarded **0 marks**.

The candidate has given an incorrect response but may be awarded up to 1 partial mark.

The candidate has shown evidence of understanding that the first and second values should be reversed but has also reversed the fifth value, so cannot be awarded a partial mark for this. The candidate has shown evidence of understanding that the enthalpy values should be multiplied by the appropriate stoichiometric values, however, they have only used four values so cannot be awarded the partial mark for this either.

Candidate 2

The candidate was awarded **0 marks**.

The candidate has given an incorrect response. Since they have only used four out of the five values, they cannot be awarded a partial mark.

Candidate 3

The candidate was awarded **0 marks**.

The candidate has given an incorrect response.

The candidate has not reversed the first two values so cannot be awarded a partial mark via the first option. They have multiplied the last two values by three instead of 12, so cannot be awarded a partial mark via the second option.

Candidate 4

The candidate was awarded **1 mark**.

The candidate has given an incorrect response but can be awarded up to 1 partial mark.

The candidate has noted in their working that they should reverse the first two values, however, they have not actually carried this out so cannot be awarded a partial mark by the first option. They have correctly multiplied by the appropriate stoichiometric values so can be awarded a partial mark by the second option.

Question 8(b)

Candidate 1

This candidate was awarded **1 mark**.

The candidate has correctly calculated the moles of both sorbic acid and potassium hydroxide so the first mark can be awarded. They have not demonstrated their understanding of limiting reactant as they have not made a statement linking the number of moles of each reactant present with the mole ratio (' $0.125 > 0.0625$ ' does not demonstrate this), so the second mark cannot be awarded.

Candidate 2

This candidate was awarded **1 mark**.

The candidate has correctly calculated the moles of potassium hydroxide. They have used an incorrect Gram Formula Mass (GFM) for sorbic acid (122) so the number of moles here is incorrect, so the first mark cannot be awarded. They have a statement demonstrating their understanding of limiting reactant, so the second mark can be awarded.

Candidate 3

This candidate was awarded **2 marks**.

The candidate has correctly calculated the moles of both sorbic acid and potassium hydroxide and used correct rounding to 0.06 so the first mark can be awarded. They have a statement demonstrating their understanding of limiting reactant, so the second mark can be awarded.

Candidate 4

This candidate was awarded **2 marks**.

The candidate has correctly calculated the moles of both sorbic acid and potassium hydroxide. Although the candidate has written an incorrect numerical value of 0.05 in their calculation of moles of potassium hydroxide, this has been treated as a slip, as it is clear from their working that the correct value of 0.25 has actually been used, so the first mark can be awarded. They have a statement demonstrating their understanding of limiting reactant, so the second mark can be awarded.

Question 8(c)

Candidate 1

The candidate was awarded **1 mark**.

The candidate has given an incorrect response but can be awarded up to 1 partial mark.

The candidate has correctly calculated the number of moles present in 330cm^3 so is awarded a partial mark by the first option.

Candidate 2

The candidate was awarded **1 mark**.

The candidate has given an incorrect response but can be awarded up to 1 partial mark.

The candidate has started the calculation with an incorrect concept but has later correctly calculated the number of moles present in 330cm^3 so is awarded a partial mark by the first option.

Question 10(a)(iii)

Candidate 1

The candidate was awarded **0 marks**.

The candidate has correctly stated that fluorine and chlorine are not present, however they have used the term molecules. This is a cancelling error and so cannot be awarded the mark.

Candidate 2

The candidate was awarded **0 marks**.

The candidate has correctly stated that halogens are not present, however they have also used the term molecules. This is a cancelling error and so cannot be awarded the mark.

Question 11(a)(ii)

Candidate 1

The candidate was awarded **0 marks**.

The candidate has shown correct working but has not completed their response by writing a formula so the mark cannot be awarded.

Candidate 2

The candidate was awarded **0 marks**.

The candidate has given an incorrect response. They have drawn an incorrect structural formula so the mark cannot be awarded. A correct structural formula would be an acceptable response.

Candidate 3

The candidate was awarded **0 marks**.

The candidate has given an incorrect response.

Candidate 4

The candidate was awarded **1 mark**.

The candidate has given a correct response.

Question 11(b)

Candidate 1

The candidate was awarded **2 marks**.

The candidate has incorrectly stated that sodium hydroxide, rather than oxalic acid, is the solute, so cannot be awarded the first mark. They have correctly stated and described transferring quantitatively, so the second mark is awarded. They have correctly described filling up to the line and named a volumetric flask as the apparatus used, so the third mark is awarded.

Candidate 2

The candidate was awarded **2 marks**.

The candidate has not stated the oxalic acid should be dissolved and so cannot be awarded the first mark. They have correctly described transferring quantitatively so the second mark is awarded. They have correctly described filling up to the line and named a volumetric flask as the apparatus used, so the third mark is awarded.

Question 11(c)(i)

Candidate 1

The candidate was awarded **0 marks**.

The candidate has drawn the outline of a bulb pipette, however they have also incorrectly included multiple graduation marks and it does not taper to a point so the mark cannot be awarded.

Candidate 2

The candidate was awarded **0 marks**.

The candidate has not drawn a pipette. They have drawn a tap which would indicate either a dropping funnel or a burette, so the mark cannot be awarded.

Candidate 3

The candidate was awarded **0 marks**.

The candidate has incorrectly drawn a Pasteur or dropping pipette, so the mark cannot be awarded.

Candidate 4

The candidate was awarded **0 marks**.

The candidate has correctly drawn the outline of a bulb pipette, however they have included two graduation marks instead of just one, so the mark cannot be awarded.

Question 11(d)

Candidate 1

The candidate was awarded **0 marks**.

The candidate has incorrectly calculated the number of moles of NaOH as 0.625. As the candidate has not shown any other working it is not possible to award any of the available partial marks.

Candidate 2

The candidate was awarded **2 marks**.

The candidate has given an incorrect response but can be awarded partial marks using the scheme of two concept marks and one arithmetic mark.

The candidate has correctly calculated the number of moles oxalic acid, ($0.02675 \times 0.126 = 3.3705 \times 10^{-3}$ moles) so the first concept mark for the relationship between moles, volume, and concentration is awarded. The candidate has correctly applied knowledge of relationship between moles of oxalic acid and sodium hydroxide, ($2 \times 3.3705 \times 10^{-3} = 6.741 \times 10^{-3}$) so the second concept mark is awarded. The candidate has incorrectly calculated the final step by dividing by 25 instead of 0.025 so the final mark is not awarded.

Candidate 3

The candidate was awarded **2 marks**.

The candidate has given a correct numerical response but has included incorrect units, mol^{-1} instead of mol l^{-1} , so a maximum of 2 marks can be awarded. This penalty would only be applied if this was the first instance of incorrect units given in the paper as per the general marking principles.

Candidate 4

The candidate was awarded **1 mark**.

The candidate has given an incorrect response but may be awarded partial marks using the scheme of two concept marks and one arithmetic mark.

The candidate has incorrectly paired the values in a valid titration formula. Therefore, the first of the concept marks (knowledge of the relationship between moles, volume, and concentration) cannot be awarded. The candidate has inserted the correct stoichiometric values into their valid titration formula so the second concept mark (knowledge of the relationship between moles of oxalic acid and sodium hydroxide) can be awarded. The final partial mark can only be awarded if the first two concept marks are achieved. Since the candidate did not achieve these concept marks, the final mark cannot be awarded.