Examiners' Report

June 2010

GCE Chemistry 6CH01

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Introduction

The general consensus amongst the team of examiners was that is was pleasing to see candidates, in the main, applying their chemical knowledge effectively to the questions in this exam. There seemed to be little evidence of candidates running out of time, although on some occasions marks were clearly lost as candidates did not pick up on helpful cues, such as where words or phrases were given in bold type on the question paper. Reading the stem carefully prior to attempting the question set can never be underestimated.

There was a sense that the quality of written communication could have been better. Imprecise language, especially with the regard to naming of particles, was sometimes evident. Terms such as ion, atom, molecule and element were used arbitrarily by some candidates and this will have affected their score.

However, calculations such as those in question 16 and 17, were well answered with clear working very often shown. This is an important message to reinforce as it helps examiners to award partial credit even if the final answer is incorrect.

Section A was effectively handled by many candidates, the average score being around 13 marks. Not surprisingly, the vast majority found question 1 very straightforward and, in addition, candidates tended to score highly on all parts of question 14.

The most challenging questions were 2, 6, 7, 8 and 10. It's interesting to see questions 8 and 10 mentioned, in the light of earlier comments about the quality of calculations in Section B. Perhaps candidates need more opportunities to practise less structured calculations to ensure their understanding is embedded.

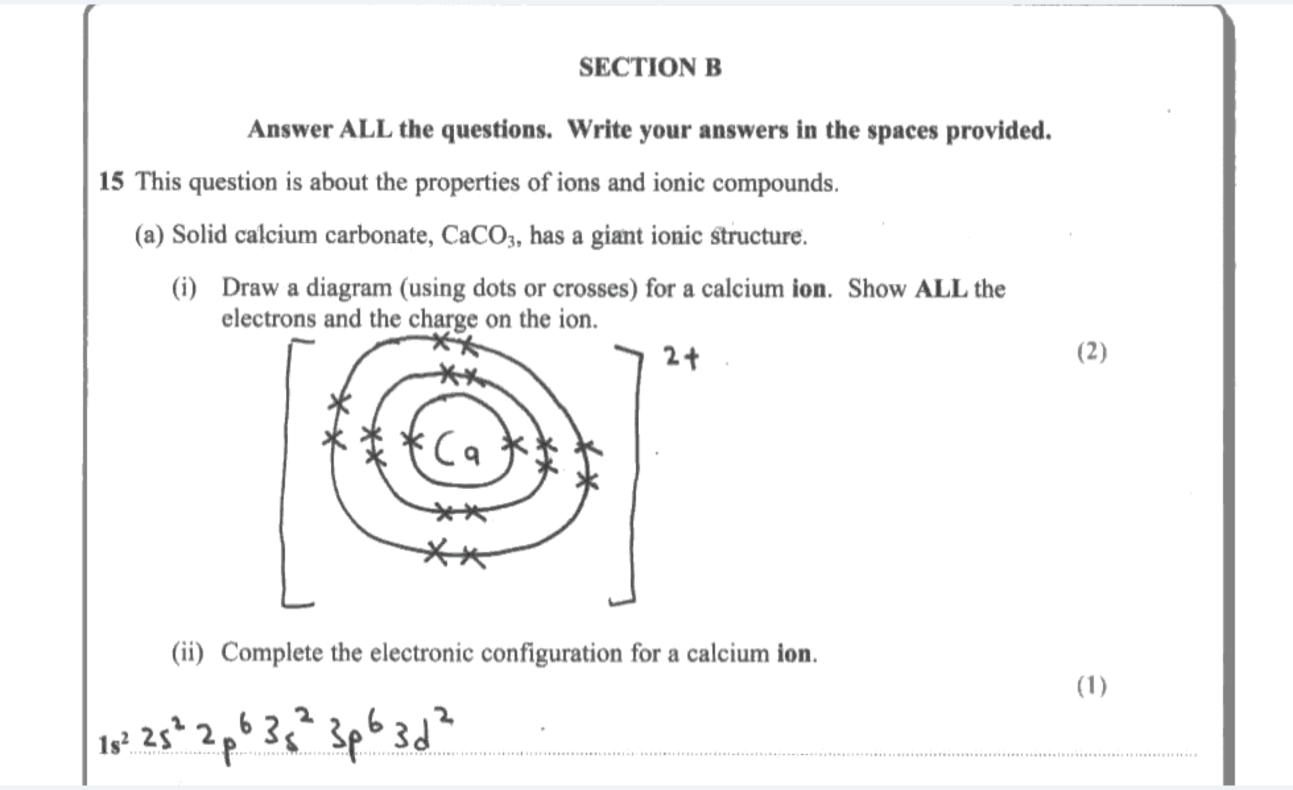
Question 6 required candidates to build on their simple view of bonding from GCSE to recognise that the bonding in lithium iodide is not purely ionic. Over a third of candidates realised this and so chose the electron density with the closest match to an anion being polarized by a cation. With hindsight, it may have been helpful to emphasise that the electron density maps were sketches rather than accurate representations.

Question 15(a) (i-ii)

Although for many this question was an easy start to the structured questions, a significant minority dropped at least one mark.

Surprisingly, this occurred in part (i) as well as part (ii), with an incorrect number of electron shells being the most common way to fail to score.

It's worth reminding candidates that transfer of key skills from GCSE, such as 'dot and cross' diagrams, is a feature of AS and they should not just focus their revision on new concepts, such as *s*, *p* and *d* orbitals.



SECTION B

Answer ALL the questions. Write your answers in the spaces provided.

15 This question is about the properties of ions and ionic compounds.

(a) Solid calcium carbonate, $CaCO_3$, has a giant ionic structure.

(i) Draw a diagram (using dots or crosses) for a calcium **ion**. Show **ALL** the electrons and the charge on the ion.

(2)

(ii) Complete the electronic configuration for a calcium **ion**.

(1)

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$

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Examiner Comments

This is a clear, well presented answer to part (i), scoring both marks. However, it looks like the candidate has attempted (incorrectly) to give the electronic configuration for a calcium atom in part (ii).

ResultsPlus
Examiner Tip

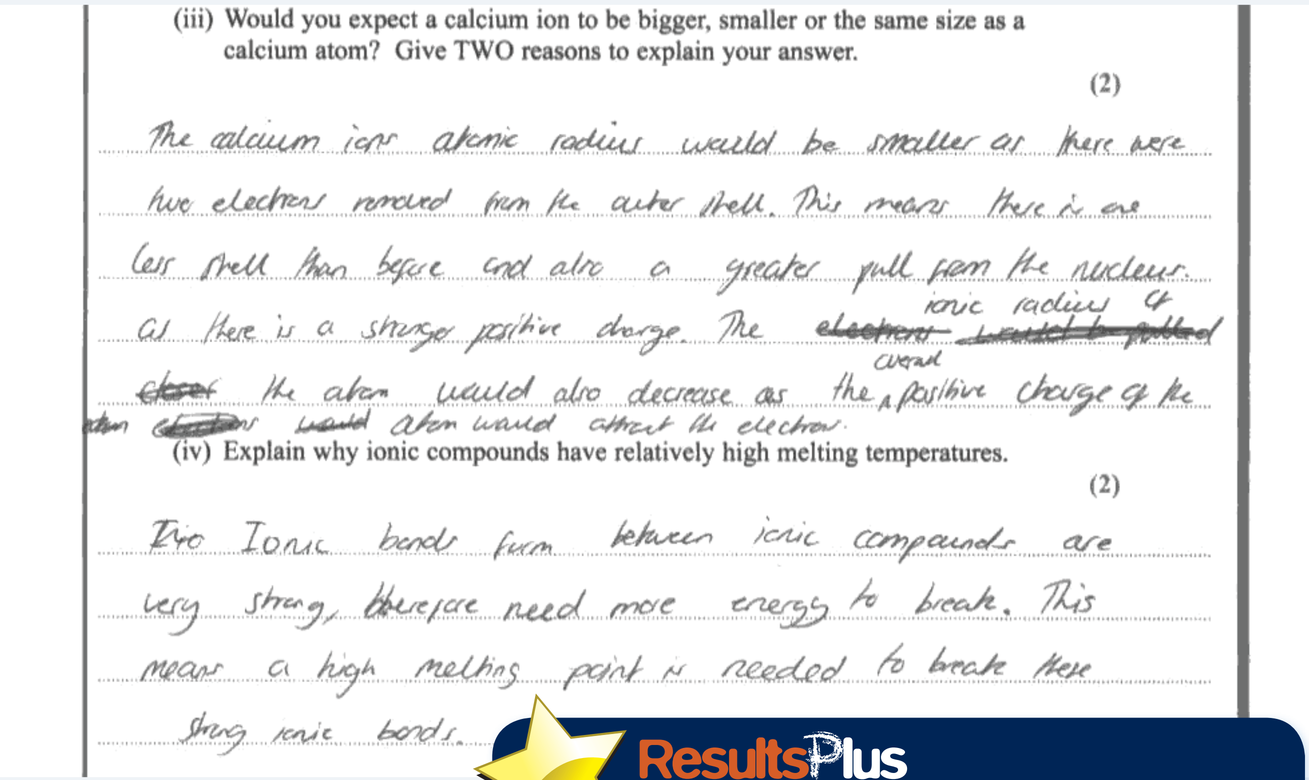
Pay careful attention to anything written in bold on the paper. It's done deliberately to help guide you towards answering the question. In this case it shows the question requires the electron configuration of the ion, not the atom.

Question 15 (a) (iii-iv)

It was quite rare to award two marks in part (iii) and this item did help discriminate at the higher grades.

Whilst the vast majority recognised the ion was smaller, justifications were not always clear. For instance, many described simply loss of electrons, rather than loss of an electron shell, which was not quite creditworthy. In addition, the idea of increasing effective nuclear charge, whilst acceptable in this context, did lead to a number of responses that suggested some candidates believed the actual nuclear charge was increasing, rather than the increase of its net effect on the remaining electrons. The best answers using this approach made it clear the number of protons remained the same, but now outweighed the number of electrons.

Part (iv) showed that most candidates understood the clear link between the strength of the many ionic bonds in a lattice and related this clearly to the input of energy needed to break up the structure. A few failed to score in this question either because they answered in terms of intermolecular forces or metallic bonds.



(iii) Would you expect a calcium ion to be bigger, smaller or the same size as a calcium atom? Give TWO reasons to explain your answer.

(2)

The calcium ions atomic radius would be smaller as there were
two electrons removed from the outer shell. This means there is one
less shell than before and also a greater pull from the nucleus
as there is a stronger positive charge. The ~~electrons~~ ionic radius of ~~would be pulled~~
~~closer~~ the atom would also decrease as the overall positive charge of the
atom ~~electrons~~ ~~would~~ atom would attract the electron.

(iv) Explain why ionic compounds have relatively high melting temperatures.

(2)

Two Ionic bonds form between ionic compounds are
very strong, therefore need more energy to break. This
means a high melting point is needed to break these
strong ionic bonds.

ResultsPlus

Examiner Comments

In part (iii) 'stronger positive charge' without further clarification seems to imply more protons in the nucleus, so this answer was only awarded one mark, for loss of an electron shell.

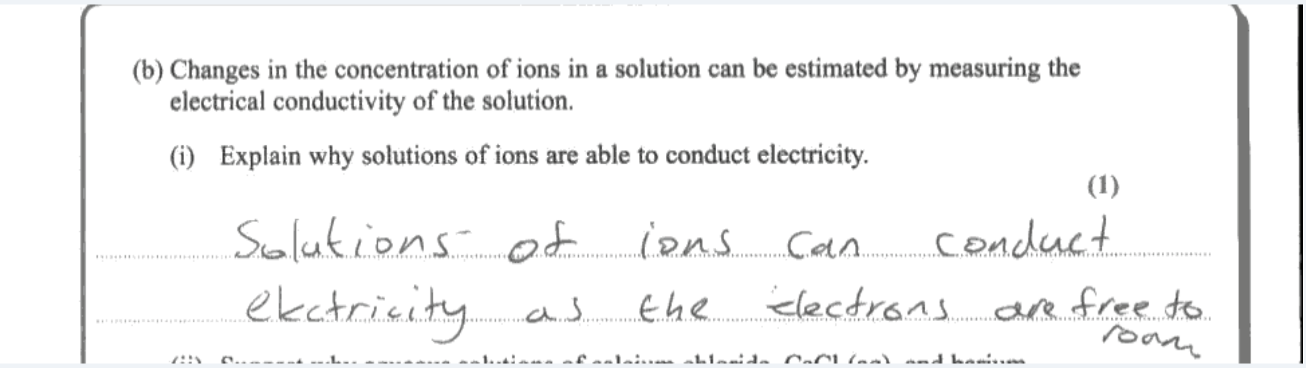
ResultsPlus

Examiner Tip

This answer would have been improved if the candidate had clarified why they believed they were subject to ‘greater positive charge’ for example by stating that the ion has more protons than electrons.

Question 15 (b) (i)

The majority of candidates believed that delocalised electrons caused conductivity in ionic solutions. Of those who recognised the charged particles were ions, most went on to score the mark by emphasizing their freedom to move.



(b) Changes in the concentration of ions in a solution can be estimated by measuring the electrical conductivity of the solution.

(i) Explain why solutions of ions are able to conduct electricity.

(1)

Solutions of ions can conduct ekctricity as the electrons are free to roam

(ii) Suggest why aqueous solutions of calcium chloride, CaCl (aq), and barium

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Examiner Comments

This answer didn't score as, although it recognises the movement of charged particles is needed for a substance to conduct, it states, incorrectly, that in the case of a solution those particles are electrons.

Question 15 (b) (ii)

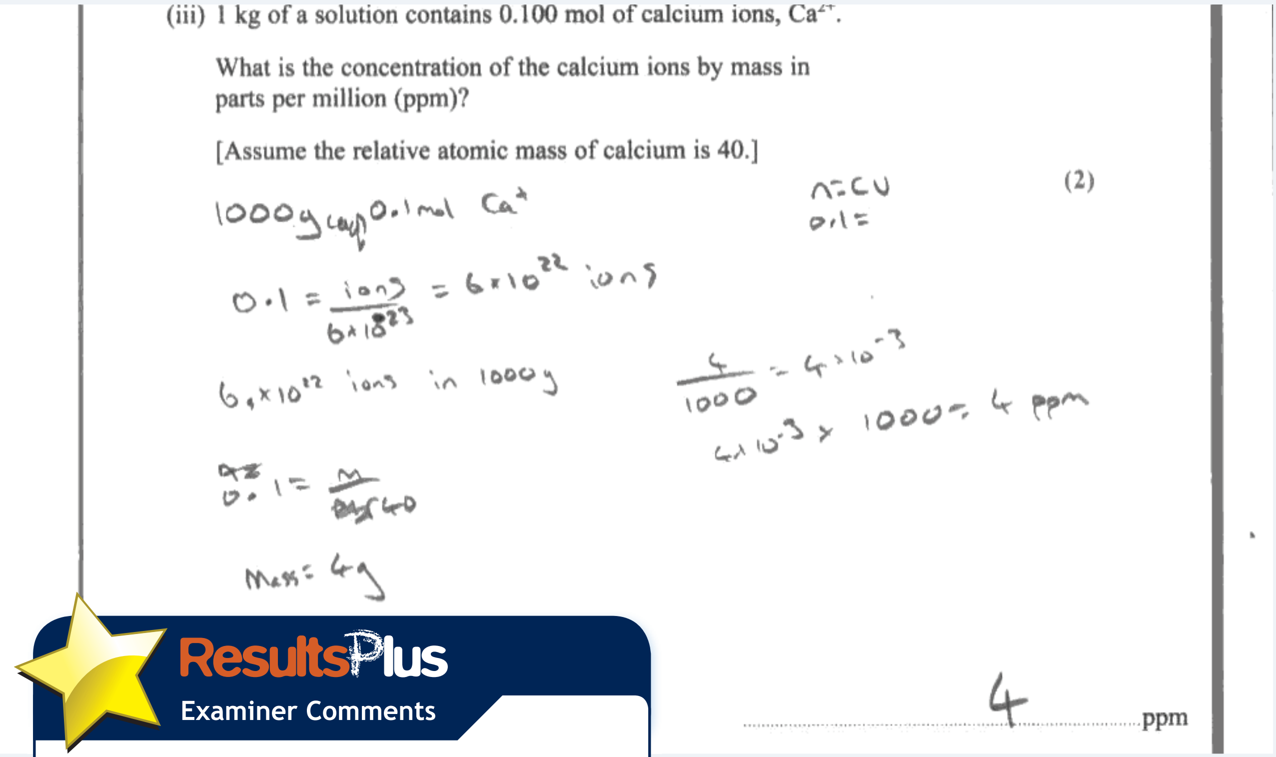
The misconception regarding electrons in b (i) further hindered candidates in this item. A very simple answer regarding the size of the ions affecting the conductivity would have sufficed. It was acceptable for such an argument to be based on the ions alone, or in their hydrated form, that they were different sizes, without any further justification.

However, many candidates tried to justify the difference in terms of number of electrons, as they seemed to believe, as shown in part (i), that compounds release electrons on dissolving to allow conduction.

Question 15 (b) (iii)

This calculation seemed unfamiliar to some candidates who, despite often scoring marks on calculations in questions 16 and 17, found this very difficult.

Although essentially a scaling exercise, many did not appreciate this and left their answer as parts per thousand. Many others divided through by a million rather than scaling up to parts per million. As this is a relatively straightforward task, the poor responses from some centres suggests its relative novelty to the specification means it isn't as well practised as some other numerical tasks.



(iii) 1 kg of a solution contains 0.100 mol of calcium ions, Ca^{2+}.

What is the concentration of the calcium ions by mass in parts per million (ppm)?

[Assume the relative atomic mass of calcium is 40.]

(2)

1000g ~~cap~~ 0.1mol Ca^+

n=CV

0.1=

$0.1 = \frac{\text{ions}}{6\times10^{23}} = 6\times10^{22}$ ions

6×10^{22} ions in 1000g

$\frac{4}{1000} = 4\times10^{-3}$

$4\times10^{-3} \times 1000 = 4$ ppm

~~0.2~~ $0.1 = \frac{m}{40}$

Mass = 4g

4 ppm

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Examiner Comments

Although this candidate is unsure how to scale to parts per million, they have made some effort to show what calculations they are attempting and label their answers accordingly. Hence we were able to award this candidate 1 mark for correctly determining the mass of calcium present in the solution.

ResultsPlus

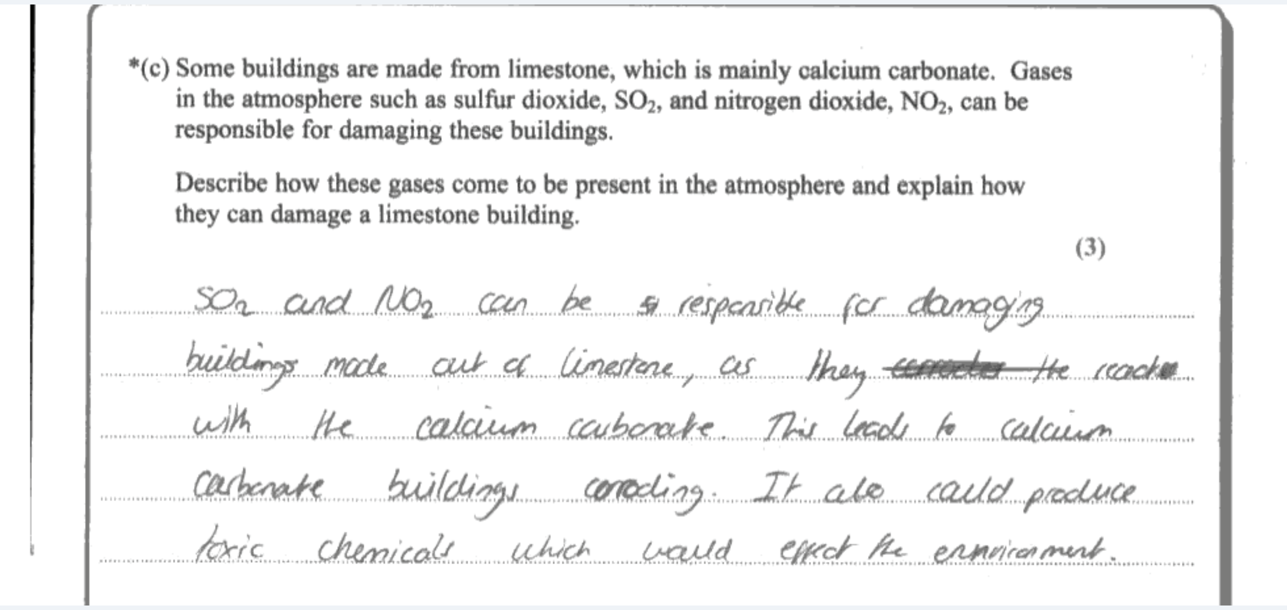
Examiner Tip

Try to always label any values you have calculated so it is clear to the examiner what you are attempting to do.

Question 15 (c)

Many responses showed a good understanding of the processes involved in this question and examiners were pleased to see generally sound chemical principles used to explain a ‘real life’ problem. When candidates failed to score it was generally due to omissions rather than incorrect chemistry. For instance, some ignored the first part of the question and didn’t discuss the source of the gases. Others gave vague generic answers for the source, such as ‘pollution from factories or industry’.

However, some excellent explanations of the formation of nitrogen oxides in car engines were seen from more able candidates. Some responses for the third mark did not score as they assumed the process was just physical, rather than chemical, tending to just describe erosion and not any preceding chemical reaction.



*(c) Some buildings are made from limestone, which is mainly calcium carbonate. Gases in the atmosphere such as sulfur dioxide, SO_2, and nitrogen dioxide, NO_2, can be responsible for damaging these buildings.

Describe how these gases come to be present in the atmosphere and explain how they can damage a limestone building.

(3)

SO_2 and NO_2 can be responsible for damaging buildings made out of limestone, as they ~~corrodes~~ the reacts with the calcium carbonate. This leads to calcium carbonate buildings corroding. It also could produce toxic chemicals which would effect the environment.

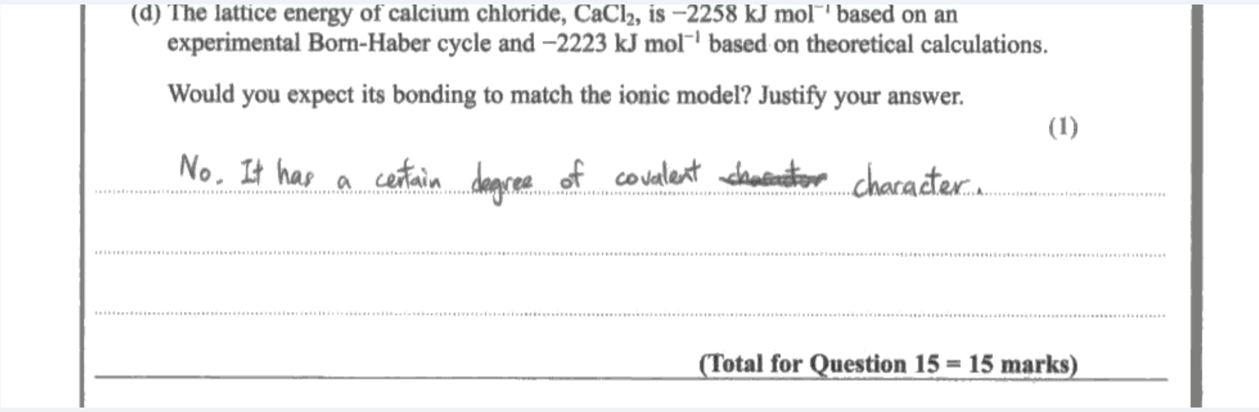
ResultsPlus

Examiner Comments

This answer shows understanding that a chemical reaction with the limestone is integral to the process damaging the building, but has not recognised the acidic nature of the two gases in aqueous solution. To improve, the candidate should have followed the guidance in the question and considered how the gases came to be present in the atmosphere in the first place.

Question 15 (d)

It was not expected that candidates should recall whether the bonding in calcium chloride is considered almost completely ionic or partly covalent, but that they should use the data to help form an opinion. Just under half the candidates managed to do this, with many of those arguing that the difference was small enough that the substance could be considered to match the ionic model. A minority of candidates came close to scoring by attempting to justify covalent character in terms of polarization, but neglected to use the data to support their argument.



(d) The lattice energy of calcium chloride, $CaCl_2$, is −2258 kJ mol^{-1} based on an experimental Born-Haber cycle and −2223 kJ mol^{-1} based on theoretical calculations.

Would you expect its bonding to match the ionic model? Justify your answer.

(1)

No. It has a certain degree of covalent ~~charactor~~ character.

(Total for Question 15 = 15 marks)

ResultsPlus

Examiner Comments

This candidate makes a statement that could be correct, as the specification does not expect candidates to recall the precise level of difference in theoretical and experimental lattice energies. However, they did not use the data to support their answer so just missed out on the mark.

ResultsPlus

Examiner Tip

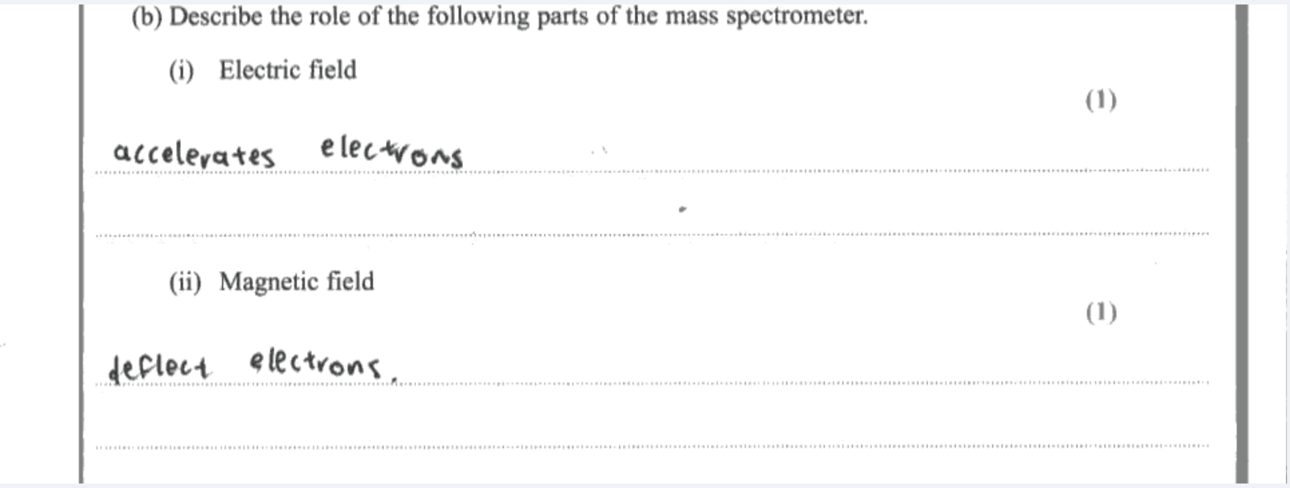
Data and information in the stem of a question is there to help candidates. Always read it carefully to see if it could be useful in your written answer.

Question 16 (a)

Although only a few candidates showed no understanding of the term isotope, it was common to see marks not awarded due to imprecise language. For instance, despite the request in the stem, a minority expressed their answer simply in terms of atomic and mass numbers rather than the sub-atomic particles involved. A minority used the term ‘nucleon’ and seemed to think that this term was an alternative for ‘neutron’. A common response used the expression ‘elements with the same number of protons but a different number of neutrons’ rather than ‘atoms of the same element with the same number of protons but a different number of neutrons’ and so scored one out of two.

Question 16 (b)

The majority of candidates have learnt the basic processes in a mass spectrometer and it was common to award 2 marks. When full credit was not awarded, it was again as a result of imprecise description of particles. Hence acceleration and deflection were recognised, but the particles involved were either omitted or described as electrons or atoms.



(b) Describe the role of the following parts of the mass spectrometer.

(i) Electric field (1)

accelerates electrons

(ii) Magnetic field (1)

deflect electrons.

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Examiner Comments

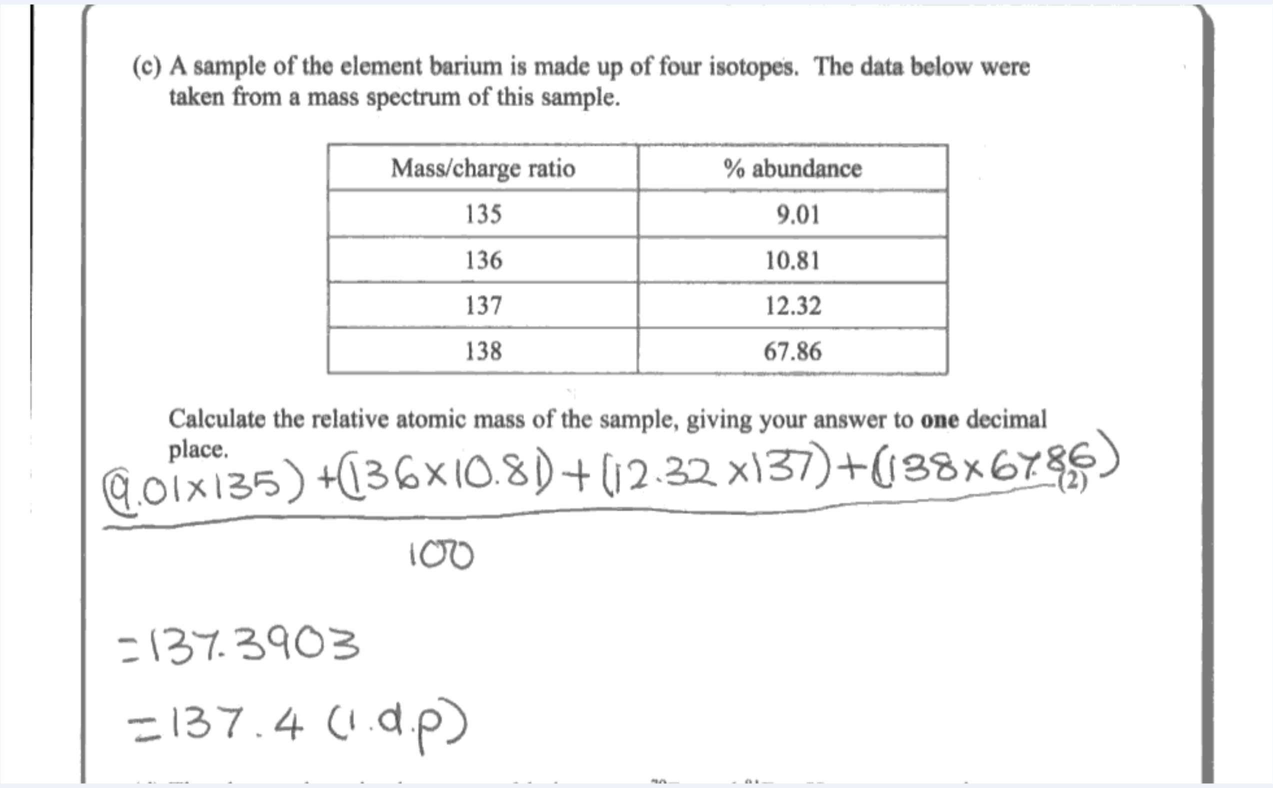
One mark awarded as acceleration and deflection were recognised, but in terms of electrons rather than ions.

ResultsPlus
Examiner Tip

When naming any particle, (e.g. atom, ion, molecule etc), always stop and think to double check if you are sure that it is the precise species involved.

Question 16 (c)

Given that the conceptual difficulty of this problem is probably similar to that in 15 (b) (iii), the answers to this item were much better. Very many candidates scored both marks, showing clear working and rounding to one decimal place. The familiarity of this type of problem from previous papers and specifications undoubtedly helped and this shows that chemical calculations are accessible to all at this level provided sufficient practice is done. The few errors tended to be linked to rounding up, which was occasionally omitted or incorrect.



(c) A sample of the element barium is made up of four isotopes. The data below were taken from a mass spectrum of this sample.

Mass/charge ratio	% abundance
135	9.01
136	10.81
137	12.32
138	67.86

Calculate the relative atomic mass of the sample, giving your answer to **one** decimal place.

(2)

$$\frac{(9.01\times135)+(136\times10.81)+(12.32\times137)+(138\times67.86)}{100}$$

$=137.3903$

$=137.4$ (1.d.p)

ResultsPlus

Examiner Comments

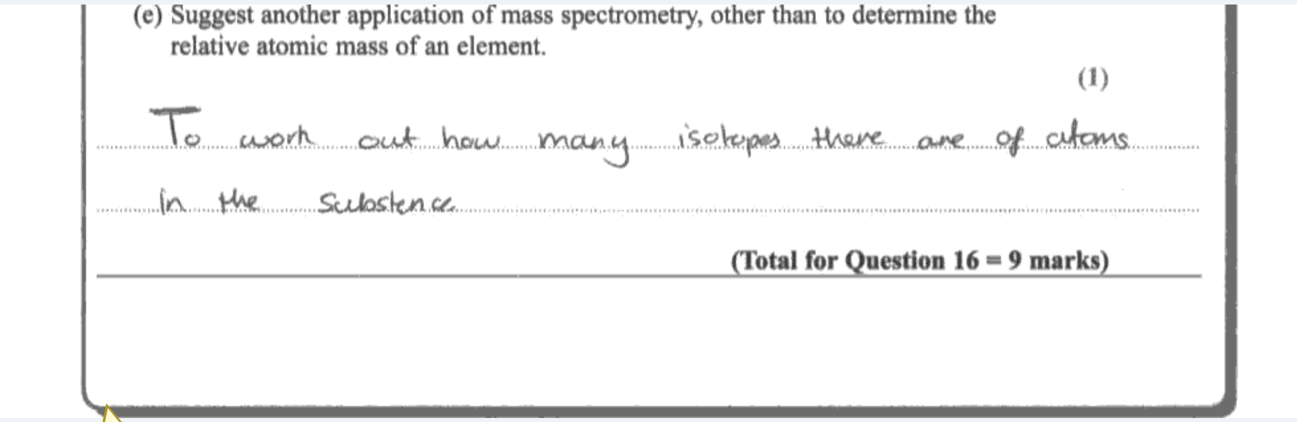
This is an example of a very well set out calculation with working clearly shown and the final answer indicated to one decimal place as requested in the question.

Question 16 (d)

Despite some criticisms of the ad-hoc use of terms to describe particles in other questions, many candidates were not fazed by the concept of a molecular ion and, as a result, this question helped discriminate at the higher levels. However, weaker answers ignored the information in the stem and simply described peaks due to the two isotopes.

Question 16 (e)

The specification highlights several applications of mass spectrometry that could be exemplified to illustrate how it can be used in a 'real life' context. By far the most popular suggestion by candidates was to identify drugs in the bodies of athletes. However, it was also common to see answers that simply repeated the kind of processes already ruled out by the question, such as to determine isotopic masses of elements.



(e) Suggest another application of mass spectrometry, other than to determine the relative atomic mass of an element.

(1)

To work out how many isotopes there are of atoms in the Substence

(Total for Question 16 = 9 marks)

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Examiner Comments

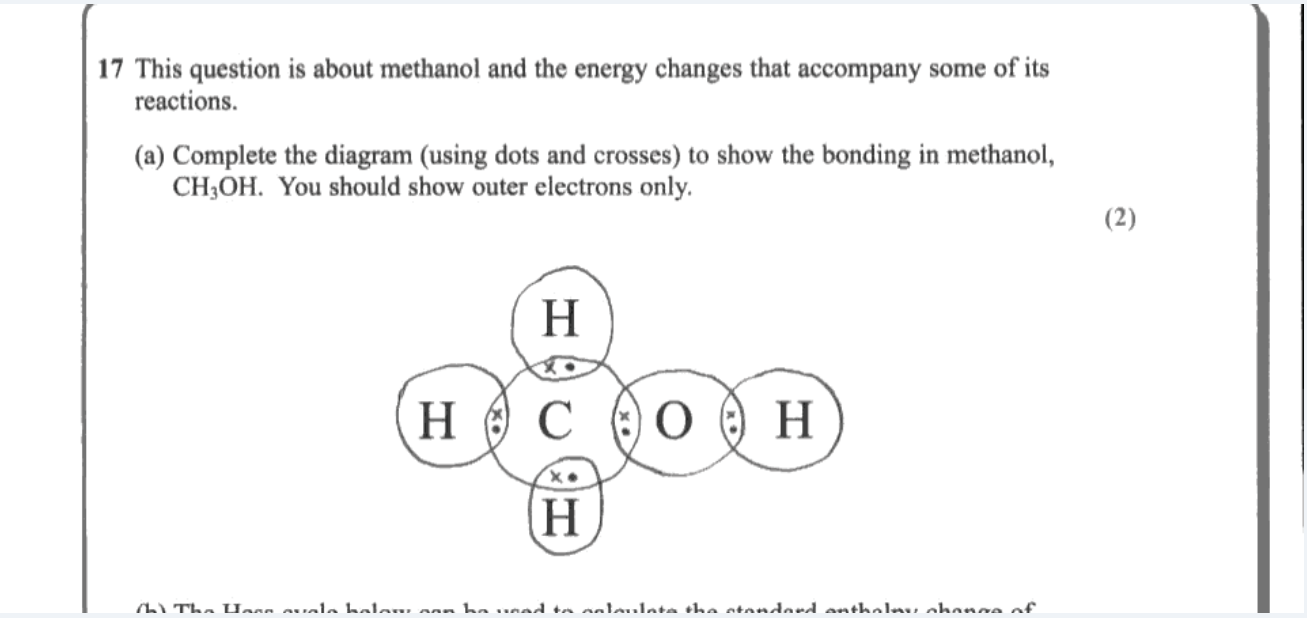
This answer did not score any credit, as it's essentially a derivative of the process excluded in the question.

ResultsPlus
Examiner Tip

Look at the examples in the specification. Whilst you are not expected to recall each one in detail, they are good examples to help you show you understand how mass spectrometry can be used.

Question 17 (a)

This item was very well answered and the majority of candidates gained two marks because they clearly showed all electron pairs present around the carbon and oxygen atoms.



17 This question is about methanol and the energy changes that accompany some of its reactions.

(a) Complete the diagram (using dots and crosses) to show the bonding in methanol, CH_3OH. You should show outer electrons only.

(2)

(b) The Hess cycle below can be used to calculate the standard enthalpy change of

ResultsPlus

Examiner Comments

This response only scored one mark as, although all the bonding electrons are present, the candidate omitted to show the lone pairs present on the oxygen atom.

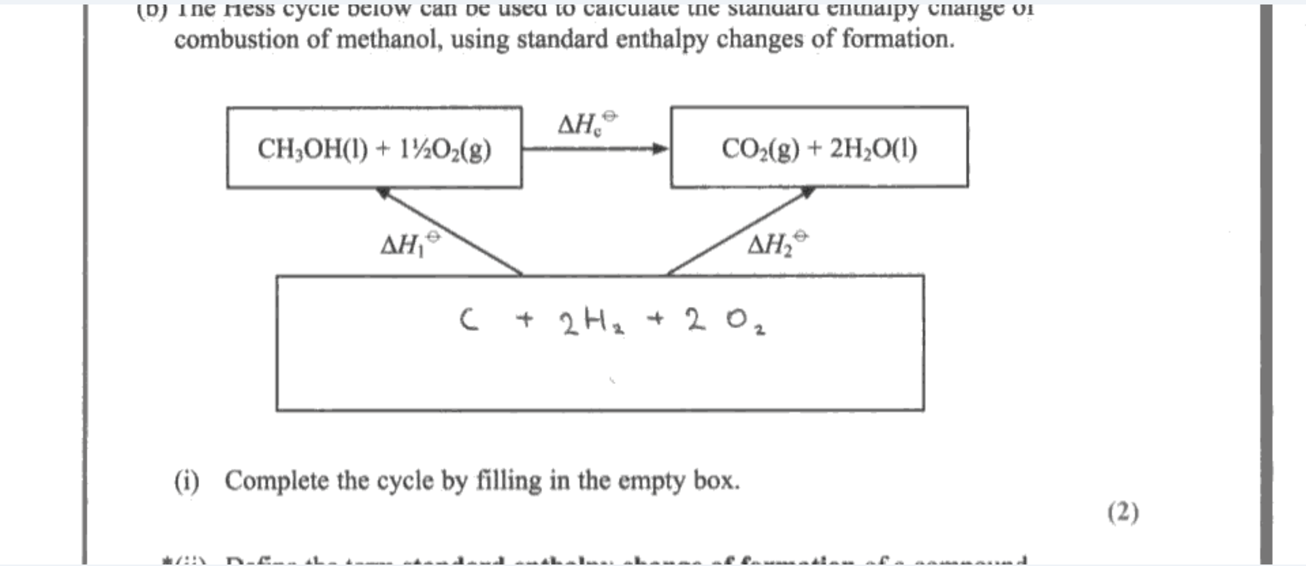
ResultsPlus

Examiner Tip

Check 'dot and cross' diagrams to ensure all bond and lone pairs are shown, where appropriate.

Question 17 (b) (i)

Whilst most candidates could indicate the formulae of the required elements, the question discriminated to an extent as a significant minority either could not balance the equation (especially the oxygen) or omitted one or more state symbols.



(b) The Hess cycle below can be used to calculate the standard enthalpy change of combustion of methanol, using standard enthalpy changes of formation.

(i) Complete the cycle by filling in the empty box.

(2)

*(ii) Define the term standard enthalpy change of formation of a compound

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Examiner Comments

This answer only scored one mark as the candidate has missed out the state symbols.

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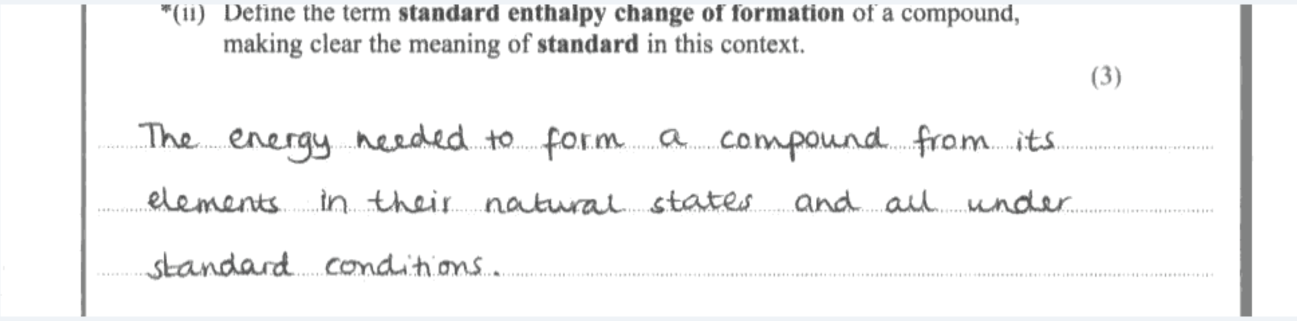
Examiner Tip

If asked to complete a cycle, look at the format used to help you see the expected style of your answer. For instance, here all the species already present have state symbols. Hence anything you include should have state symbols too.

Question 17 (b) (ii)

Responses to this question showed that most candidates had made the effort to memorise this basic definition. A view persists that the enthalpy change of formation is always endothermic, so a small number of answers made statements such as 'the energy required...' so missed the first mark. A few also ignored the pointer in the question and did not elaborate on what was meant by standard conditions.



*(ii) Define the term **standard enthalpy change of formation** of a compound, making clear the meaning of **standard** in this context.

(3)

The energy needed to form a compound from its elements in their natural states and all under standard conditions.

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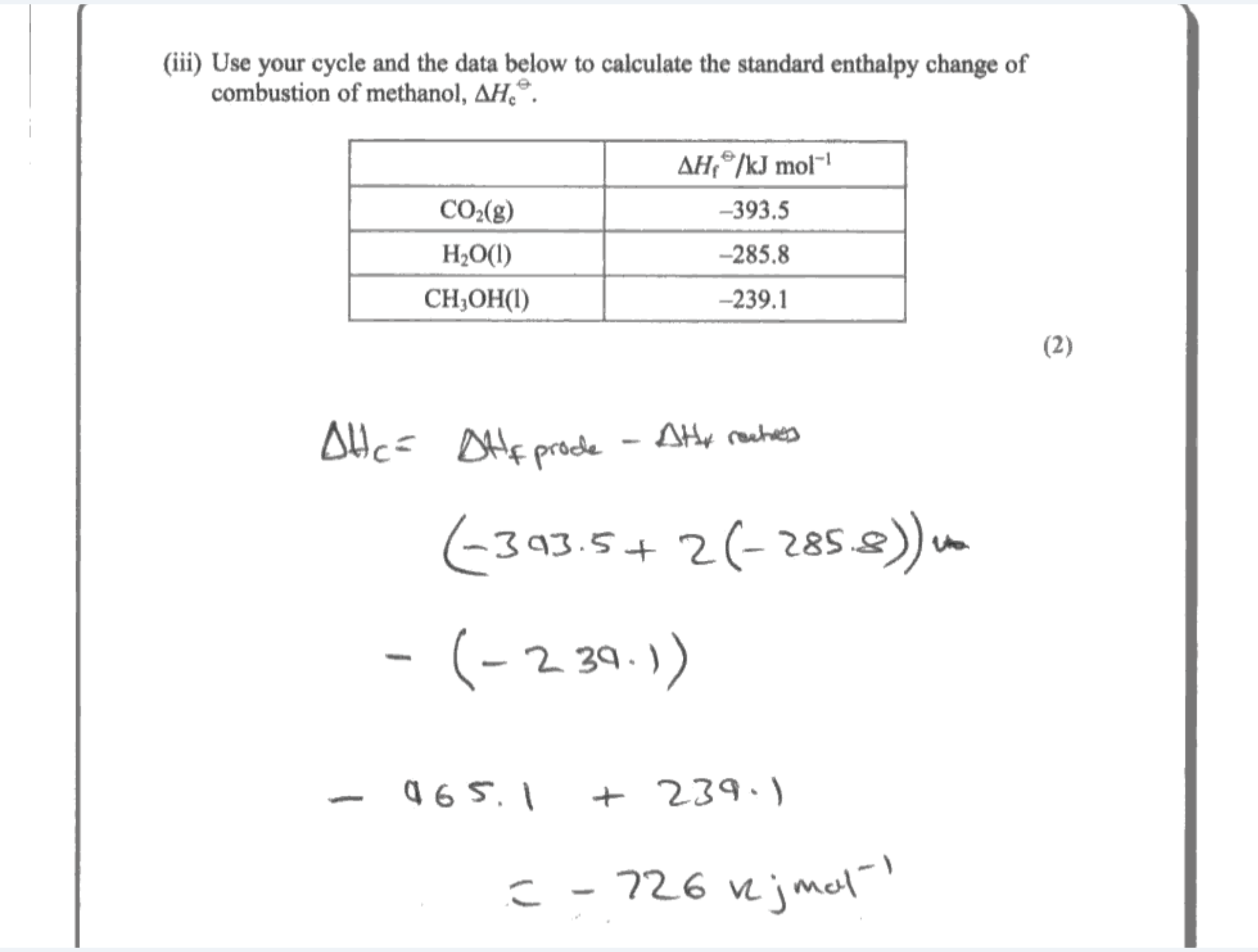
Examiner Comments

This example illustrates the two most common errors identified in the introduction.

Question 17 (b) (iii)-(c)

The calculations showed sound understanding of the use of the Hess cycle, with the most common error being the failure to multiply the standard enthalpy of formation of water by two. Parts c (i) and (ii) presented few problems, although a small number candidates rounded up their answers at this early stage, leading to inaccuracies later. Part c (iii) presented more challenges. In fairness, candidates had to follow all the clear instructions given to score here, but it was frustrating to see a sound answer miss out as the answer was not quoted to three significant figures – as required in the question. Part c (iv) discriminated well as weaker candidates tended to really on generic statements about errors rather than considering this specific experiment.



(iii) Use your cycle and the data below to calculate the standard enthalpy change of combustion of methanol, $\Delta H_c^{\ominus}$.

	$\Delta H_f^{\ominus}$/kJ mol^{-1}
$CO_2(g)$	–393.5
$H_2O(l)$	–285.8
$CH_3OH(l)$	–239.1

(2)

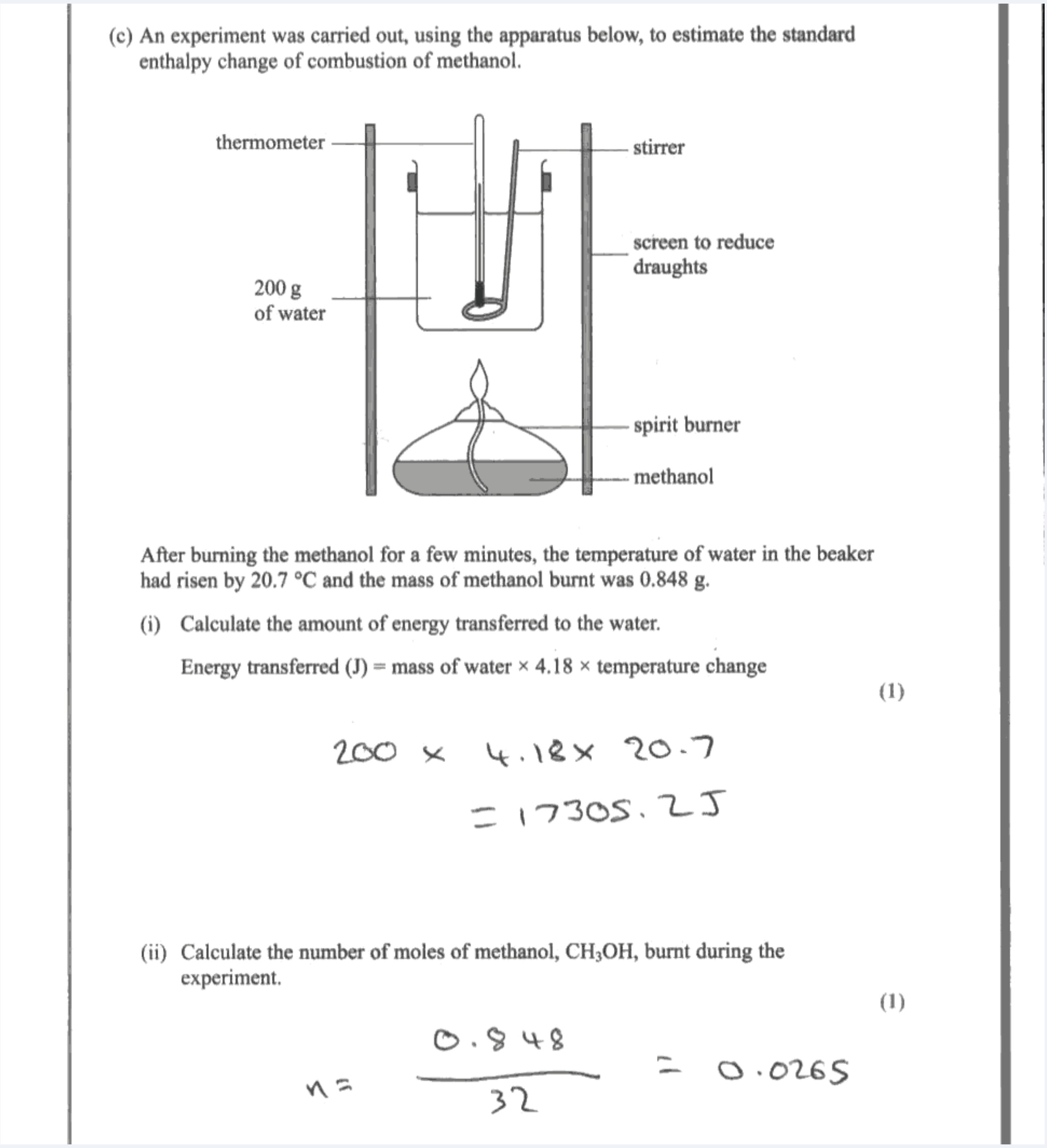
ΔH_c = ΔH_f prods − ΔH_f reactnts

$(-393.5 + 2(-285.8))$

$-(-239.1)$

$-965.1 + 239.1$

$= -726$ kjmol^{-1}



(c) An experiment was carried out, using the apparatus below, to estimate the standard enthalpy change of combustion of methanol.

After burning the methanol for a few minutes, the temperature of water in the beaker had risen by 20.7 °C and the mass of methanol burnt was 0.848 g.

(i) Calculate the amount of energy transferred to the water.

Energy transferred (J) = mass of water × 4.18 × temperature change

(1)

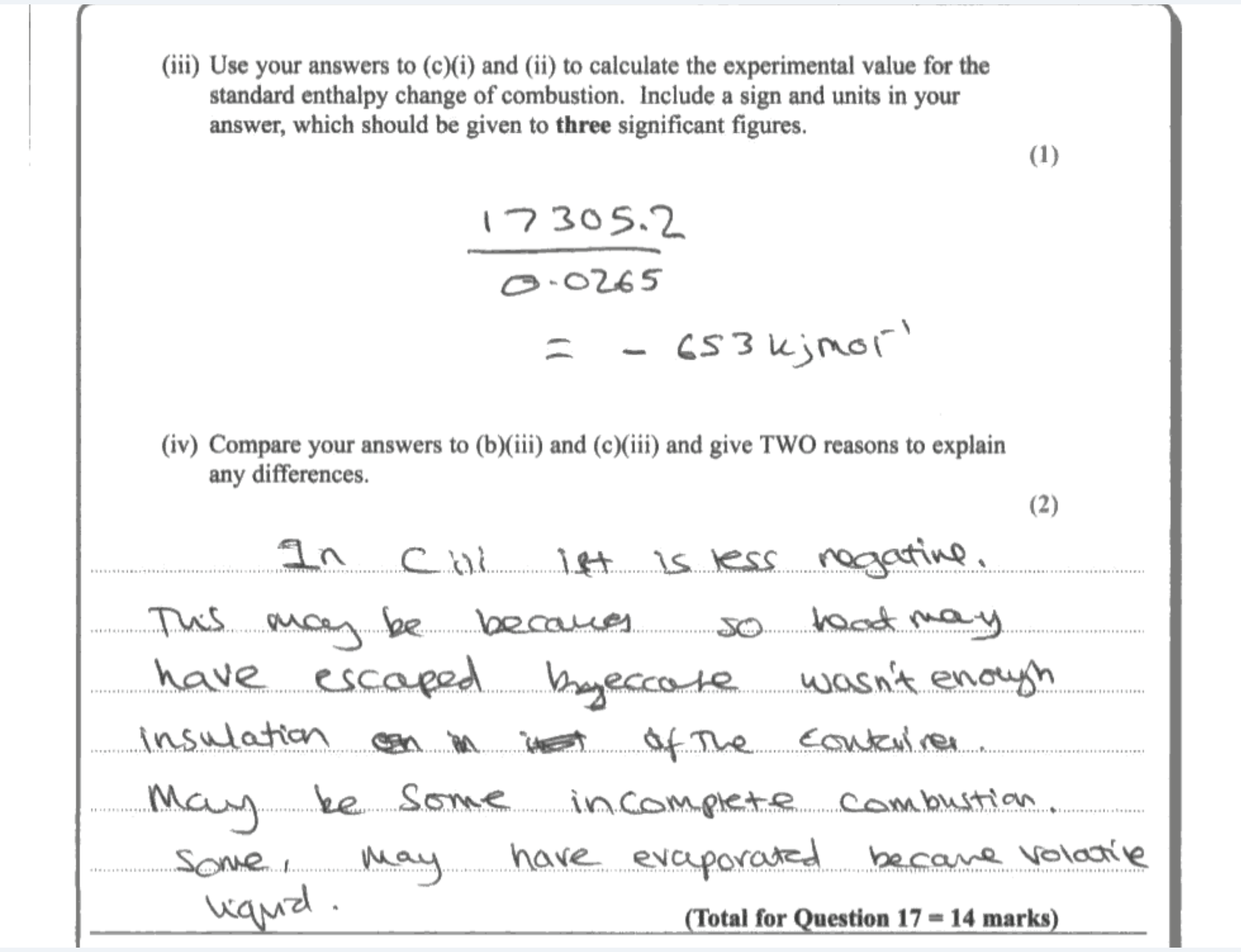
$200 \times 4.18 \times 20.7$

$= 17305.2\text{J}$

(ii) Calculate the number of moles of methanol, CH_3OH, burnt during the experiment.

(1)

$n = \frac{0.848}{32} = 0.0265$



(iii) Use your answers to (c)(i) and (ii) to calculate the experimental value for the standard enthalpy change of combustion. Include a sign and units in your answer, which should be given to **three** significant figures.

(1)

$$\frac{17305.2}{0.0265}$$

$$= -653\ \text{kjmol}^{-1}$$

(iv) Compare your answers to (b)(iii) and (c)(iii) and give TWO reasons to explain any differences.

(2)

In C(ii) ΔH is less negative.
This may be because so heat may
have escaped because wasn't enough
insulation ~~on~~ ~~in~~ ~~[illegible]~~ of The container.
May be Some incomplete combustion.
Some, may have evaporated because volatile
liquid.

(Total for Question 17 = 14 marks)

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Examiner Comments

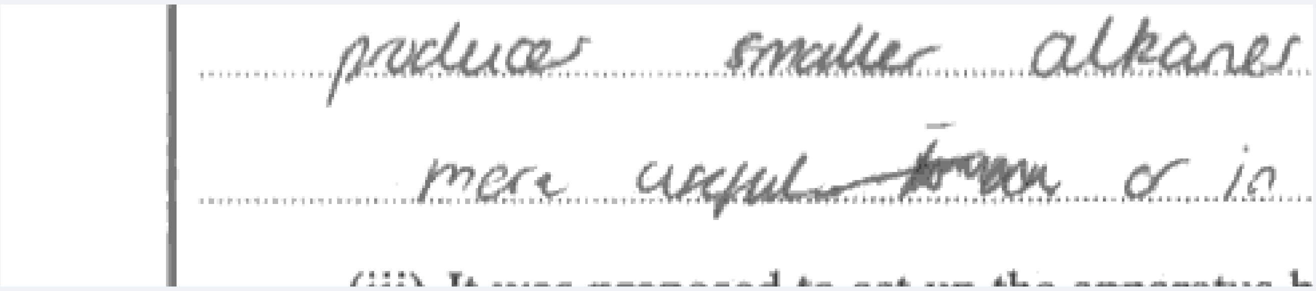
Although this answer does not score the heat loss mark, as they have not identified where the heat may have gone, the candidate has considered the experiment and identified two potential sources of error. Hence, two marks were scored for recognising that any combustion experiment may have errors due to incomplete combustion and that, as this example involves a liquid fuel, its volatility may lead to some of the fuel escaping by evaporation. This answer would have been awarded two marks had the candidate identified that the evaporation may have occurred after combustion, but before the reweighing of the sample.

Question 18 (a) (i)

Most candidates could identify a suitable raw material in this question. Those who missed out tended to give either a specific fraction from crude oil or simply stated 'oil', leaving doubt as to which oil they meant.

Question 18 (a) (ii)

Although a few described fractional distillation, most recognised the basic principles of cracking. However, many did not highlight the importance of either heat or a catalyst as part of the process. A minority spent quite a bit of time and space describing the economic advantages of the process, but this really describes why it's done, rather than what it is.



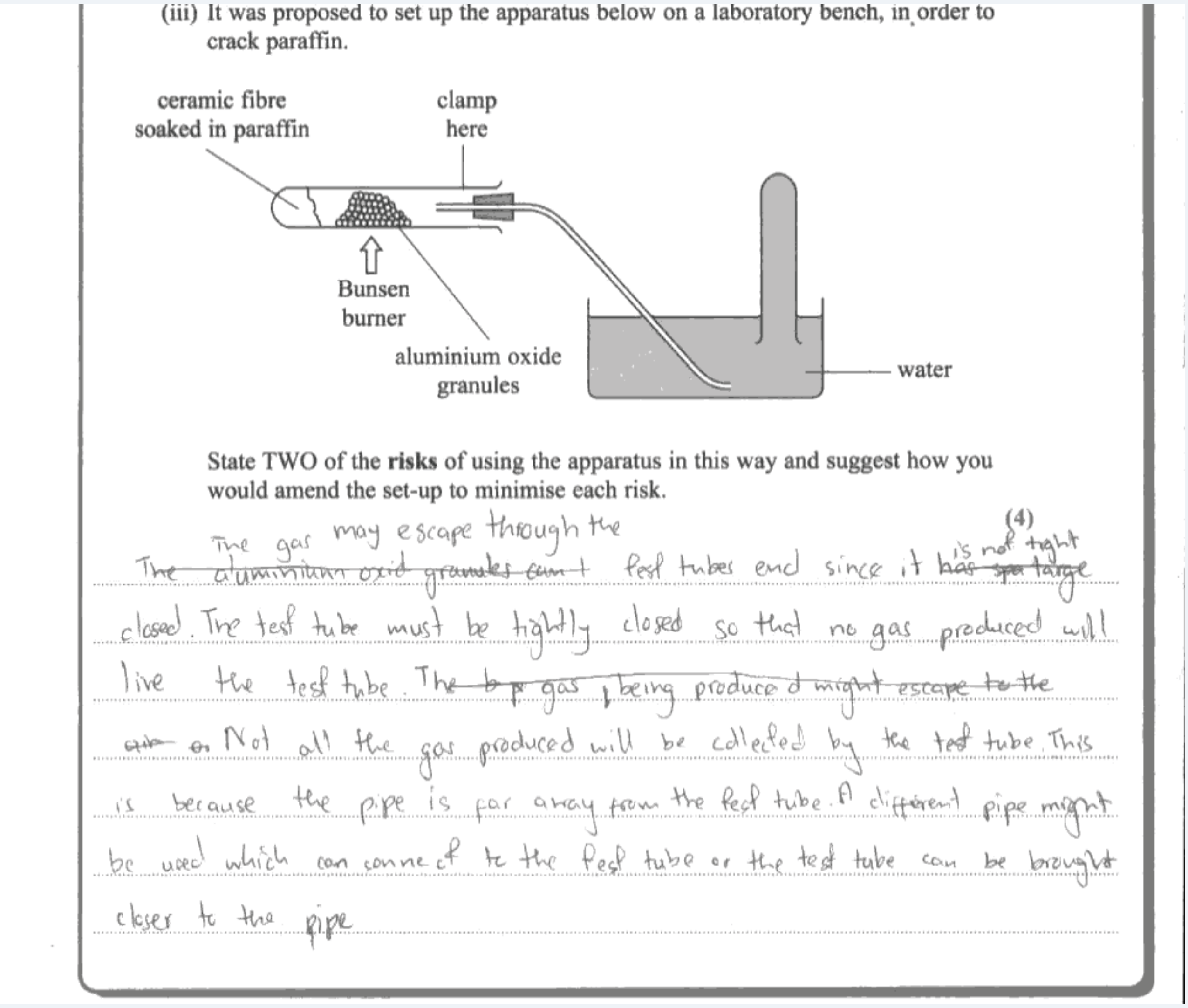
produces smaller alkanes
more useful ~~form~~ or in
(iii) It was proposed to set up the apparatus b

ResultsPlus
Examiner Comments

This example illustrates the key points made in the introduction.

Question 18 (a) (iii)

Many of the answers to this question gave the examination team the impression that some candidates had little experience of this type of practical work. Whilst not a compulsory feature of the specification, this experiment seems a useful context for the teaching of cracking. In addition, practical work gives candidates the opportunity to speak from experience when answering this type of question, rather than solely interpreting the information they are given. Many of the suggested risks showed no real consideration of the actual hazards and resulted in many generic and, sometimes, inappropriate amendments. For instance, many answers were concerned about the flame from the Bunsen burner, not because it might ignite escaping gases from the unsealed boiling tube, but because it was too hot and might crack the tube. Suggestions then relied on using insufficient heat, such as that from a water bath. A number of answers showed little appreciation of collection of gases over water and thought that this gas could not escape through the water and hence pressure would build up in the apparatus. Others simply thought the gas would be unable to displace the water so the collection tube should start off containing air and not water. Many considered aluminium oxide to be too reactive and that it might catch fire. Some of the better answers did recognise the faults with the set up, but did not recognise why this might be hazardous and so did not score maximum marks.



(iii) It was proposed to set up the apparatus below on a laboratory bench, in order to crack paraffin.

State TWO of the **risks** of using the apparatus in this way and suggest how you would amend the set-up to minimise each risk.

(4)

The ~~aluminium oxid granules cant~~ The gas may escape through the test tubes end since it ~~has spa large~~ is not tight closed. The test tube must be tightly closed so that no gas produced will live the test tube. Th~~e b p gas, being produced might escape to the air or~~ Not all the gas produced will be collected by the test tube. This is because the pipe is far away from the test tube. A different pipe might be used which can connect to the test tube or the test tube can be brought closer to the pipe

ResultsPlus

Examiner Comments

This is a good attempt as the answer recognises two problems with the set up and identifies sensible amendments to solve each problem. However, they could improve the answer by highlighting the risk caused by these faults by considering some of the potential hazards, such as flammability of the escaping vapours.

Question 18 (b) (i)

There were few errors on this example of basic recall, though perhaps surprisingly more seemed to know the catalyst, nickel, than the reagent, hydrogen.

Question 18 (b) (ii)

The vast majority could draw the structure, but errors in the name were more common. Either missing numbers or a missing ‘di’ resulted in the loss of a mark here.

Question 18 (b) (iii)

Although many recalled the correct colour change, a large number of ‘orange to green’ changes were suggested. This maybe indicates how many times the former has been asked in the past! A few didn’t pay attention to the ‘small amount’ mentioned in the question and so suggested a final colour of brown.

Question 18 (c) (i-ii)

The mechanism was well answered by many, though one wonders how many candidates have attempted to memorise this common example, rather than propose it from an understanding of the actual process. This is perhaps illustrated by some of the more common mistakes. For instance, I would suggest that a mistake showing an electron pair moving from the hydrogen atom in HBr is more likely to arise from trying to recall the mechanism rather than apply understanding of how organic molecules might interact. The most frequent near misses were use of partial charges on the bromide ion and/or carbocation and an electron pair emanating from the hydrogen atom, rather than the H – Br bond in the first step.

Part (ii) was less well done and, although some recognised that a major and minor product may form and could predict which would predominate, they could not suggest why two products can form.

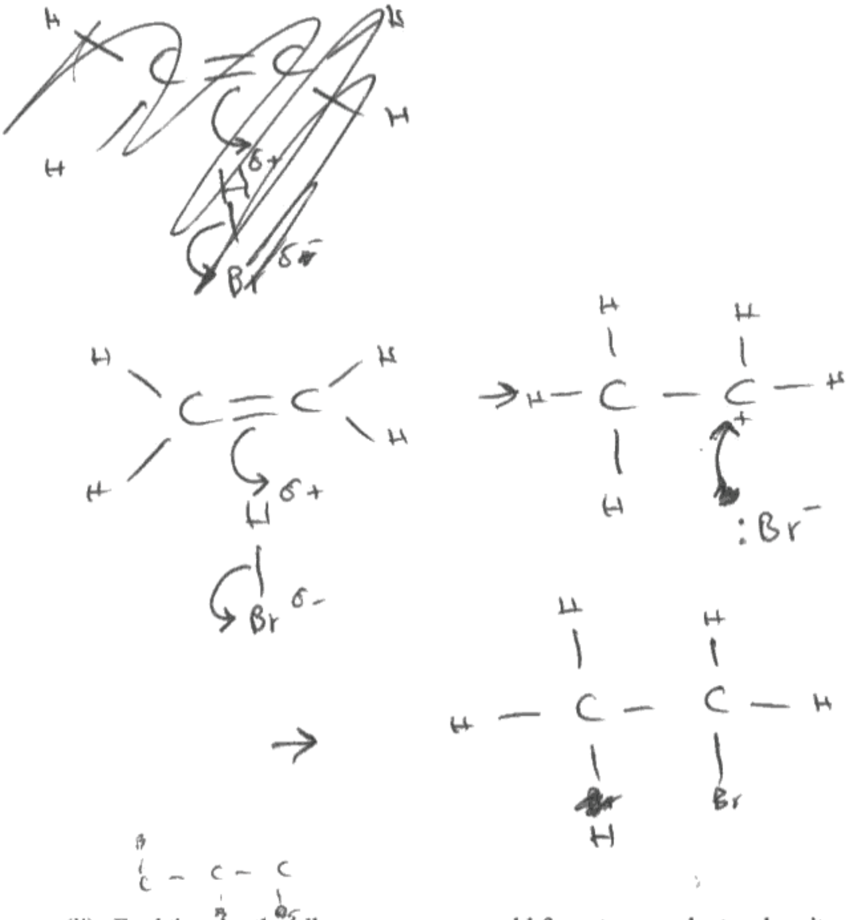
ResultsPlus

Examiner Comments

The mechanism shows all three points clearly. However, in (ii) the response suggests three products are possible as three carbocations can form, even though the carbocation has to form on either of the carbon atoms in the double bond. This could imply that the candidate has learnt the mechanism by heart without an appreciation of what is actually occurring in the reaction.

(c) (i) Use displayed formulae to show the mechanism for **Reaction 3**.

(3)



(ii) Explain why the alkene, propene, could form two products when it reacts with hydrogen bromide in a similar way.

(1)

Because ~~[illegible]~~ 3 possible ~~Carbo~~ can carbocations ~~forms~~ form so ~~[illegible]~~ The Bromine can attach to any of the then.

ResultsPlus

Examiner Tip

Try to make sure that as well as remembering mechanisms you understand what is happening at each step. This will help you, as you will become more confident at showing a mechanism by considering how the species interact, instead of having to remember intricate diagrams.

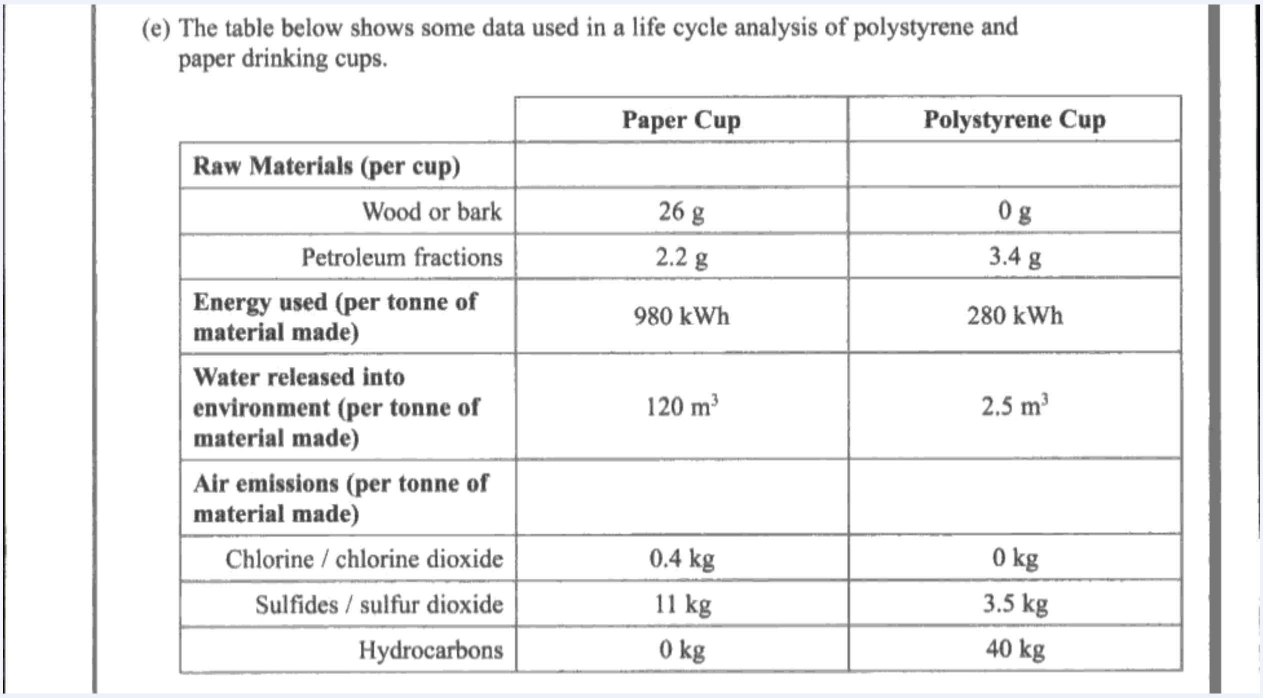
Question 18 (d)

Candidates showed they understand how two unsaturated monomers link together and in this case only a few ignored the instruction to show two repeat units.

Question 18 (e)

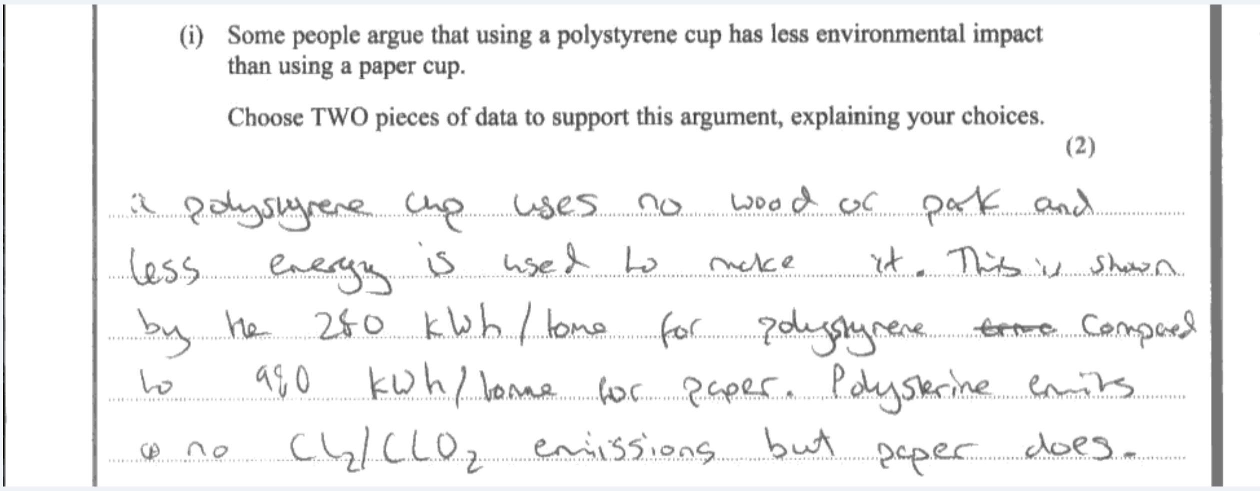
I think candidates are getting better at this sort of question and most candidates did attempt to use the data rather than making generalised statements about the environmental impact of the two cups. The question did discriminate, whereas weaker answers simply quoted supporting data, better answers clearly justified why the data supported their argument. So weaker candidates may have said that the polystyrene cup uses less energy, better ones will have linked this to less use of fossil fuels. A few candidates spent a long time attempting to portray sulfur dioxide as a greenhouse gas for which they received no credit.

In part (ii), a significant minority ignored the question and made statements about each material they considered to be correct. This did not stop them from scoring, but in a sense didn't really answer the question.



(e) The table below shows some data used in a life cycle analysis of polystyrene and paper drinking cups.

	Paper Cup	Polystyrene Cup
Raw Materials (per cup)		
Wood or bark	26 g	0 g
Petroleum fractions	2.2 g	3.4 g
Energy used (per tonne of material made)	980 kWh	280 kWh
Water released into environment (per tonne of material made)	120 m^3	2.5 m^3
Air emissions (per tonne of material made)		
Chlorine / chlorine dioxide	0.4 kg	0 kg
Sulfides / sulfur dioxide	11 kg	3.5 kg
Hydrocarbons	0 kg	40 kg

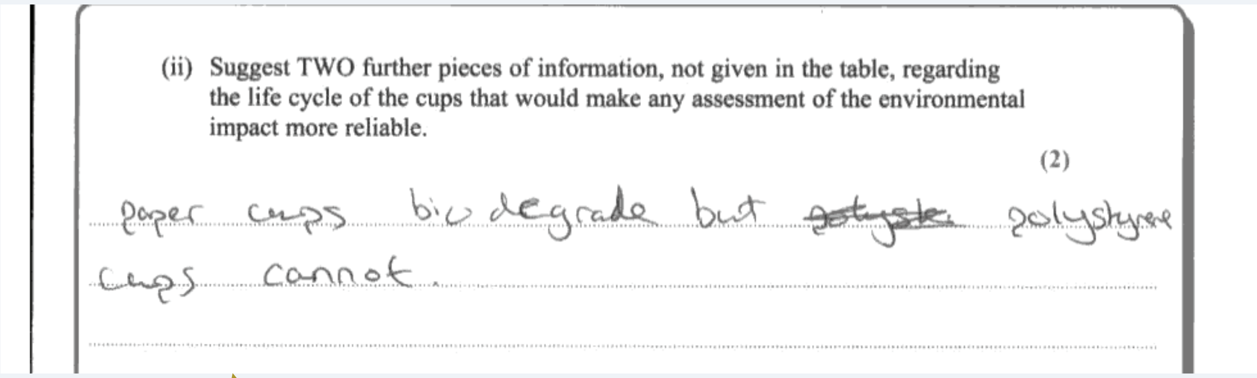


(i) Some people argue that using a polystyrene cup has less environmental impact than using a paper cup.

Choose TWO pieces of data to support this argument, explaining your choices.

(2)

a polystyrene cup uses no wood or park and less energy is used to make it. This is shown by the 280 kWh / tonne for polystyrene ~~tonne~~ compared to 980 kWh/tonne for paper. Polysterine emits no Cl_2/ClO_2 emissions but paper does.



(ii) Suggest TWO further pieces of information, not given in the table, regarding the life cycle of the cups that would make any assessment of the environmental impact more reliable.

(2)

paper cups biodegrade but ~~polyst~~ polystyrene cups cannot.

ResultsPlus

Examiner Comments

This answer chooses three pieces of relevant data but makes no attempt to explain how they support the idea that polystyrene has less environmental impact. It could have been improved by considering why emitting fewer chlorine compounds and using less energy, is environmentally advantageous.

Grade Boundaries

Grade	Max. Mark	A	B	C	D	E	N	U
Raw boundary mark	80	62	56	50	44	39	34	0
Uniform boundary mark	120	96	84	72	60	48	36	0

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