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Examiners' Report
June 2012

GCE Chemistry 6CH07 01

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June 2012

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Introduction

The paper was generally well answered. Candidates were able to demonstrate their knowledge of practical techniques and the interpretation of results from practical experiments, though they found it much more difficult to calculate errors and assess their effects on the accuracy of the final results.

Significant weaknesses were shown in the combination of ΔH values using a Hess' Law cycle.

In numerical questions, too many candidates lost marks through premature truncation of numerical values or confusion between significant figures and decimal places.

Question 1(a)

This question was generally very well answered. Most candidates correctly identified all four solutions. The most common error was to confuse the two acids.

Question 1(b)

This question was also generally answered well. Most candidates recognised that the reaction between the acid and a carbonate gives effervescence.

(b) Explain how the observations allowed the student to distinguish between dilute hydrochloric acid and sodium chloride solution.

(1)

Dilute HCl reacts with a carbonate to give CO_2 & salt & water. It therefore gives off effervescence

ResultsPlus
Examiner Comments
This is a clear, correct answer.

(b) Explain how the observations allowed the student to distinguish between dilute hydrochloric acid and sodium chloride solution.

(1)

In test 2 sodium chloride produces a white precipitate and dilute HCl does not react.

ResultsPlus
Examiner Comments
The observations in test 2 are the same for hydrochloric acid and sodium chloride because they both contain chloride ions.

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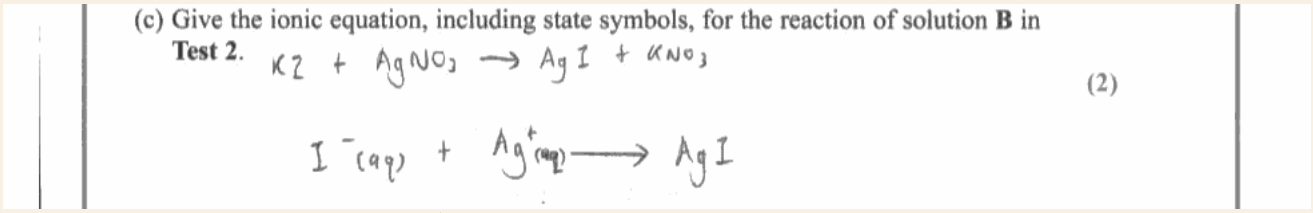
Examiner Tip
You must look for a test which gives different results with the two substances.

Question 1(c)

Many candidates produced the correct equation but some ignored the instruction to give the ionic equation and hence lost a mark. A significant minority gave incorrect signs for the ions – Ag2+ was particularly common.


(c) Give the ionic equation, including state symbols, for the reaction of solution **B** in **Test 2**.

$KI + AgNO_3 \rightarrow AgI + KNO_3$

(2)

$I^-_{(aq)} + Ag^+_{(aq)} \rightarrow AgI$

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Examiner Comments

This is so nearly correct, but the AgI state symbol is missing so a mark is lost.

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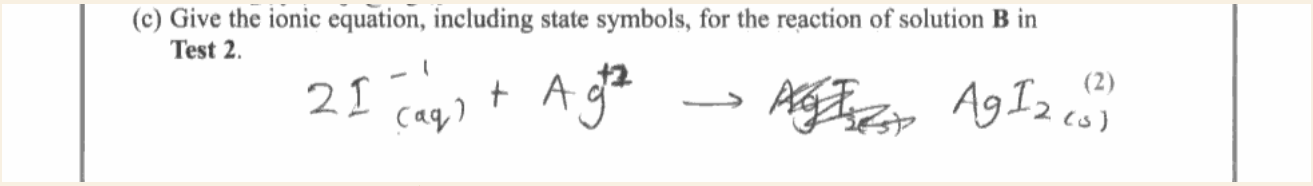
Examiner Tip

Put in ALL the state symbols.


(c) Give the ionic equation, including state symbols, for the reaction of solution **B** in **Test 2**.

$2I^-_{(aq)} + Ag^{+2} \rightarrow AgI_2(s)$ (2)

ResultsPlus
Examiner Comments

The ion charges are incorrect but a rescue mark could have been obtained if the state symbol was not missed from the Ag^{2+} ion.

ResultsPlus
Examiner Tip

Put in ALL the state symbols.

Question 1(d)

This question was well answered though some candidates confused this with the test for hydrogen chloride and said that white smoke was produced.

(d) What would you expect to **see** when dilute ammonia solution is added to the white precipitate formed by solution **C** in **Test 2**?

(1)

The white precipitate dissolves.

ResultsPlus
Examiner Comments

This is a concise, clear answer.

ResultsPlus
Examiner Tip

Long answers are often unnecessary - it is accuracy that counts.

(d) What would you expect to **see** when dilute ammonia solution is added to the white precipitate formed by solution **C** in **Test 2**?

(1)

No change as precipitate ~~in~~ formed by solution C in Test 2 is insoluble in dilute ammonia solution

ResultsPlus
Examiner Comments

This is incorrect - the precipitate does dissolve.

ResultsPlus
Examiner Tip

LEARN the tests for positive and negative ions.

Question 2(a)

This question was generally well answered though some candidates gave the barium ion charge as +1. Some were unable to identify the precipitate with sulfuric acid. Others assumed that a brown gas must be bromine.

2 A series of tests was carried out on a white powder, **E**, which is known to be a Group 2 nitrate.

(a) Complete the inference column for each test in the table below by giving a name or formula.

(4)

Test	Observation	Inference
Carry out a flame test on **E**.	Pale green flame	The metal ion is Barium ion
Add dilute sulfuric acid to an aqueous solution of **E**.	White precipitate	The precipitate is barium sulphate
Heat a sample of **E** very strongly. Test any gases given off with a glowing splint.	A brown gas is evolved The glowing splint relights	The brown gas is nitrogen dioxide The gas which relights the glowing splint is oxygen

ResultsPlus
Examiner Comments

An excellent answer.

(4)

Test	Observation	Inference
Carry out a flame test on **E**.	Pale green flame	The metal ion is Barium Ba^{+}
Add dilute sulfuric acid to an aqueous solution of **E**.	White precipitate	The precipitate is Barium Sulphate/Nitrate
Heat a sample of **E** very strongly. Test any gases given off with a glowing splint.	A brown gas is evolved The glowing splint relights	The brown gas is NO_2 The gas which relights the glowing splint is O_2

ResultsPlus
Examiner Comments

Group II ions have a +2 charge.

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Examiner Tip

Make sure that you can use the periodic table to work out the charges on simple ions.

Remember that nitrates are usually soluble in water.

(4)

Test	Observation	Inference
Carry out a flame test on **E**.	Pale green flame	The metal ion is Ba^{2+}
Add dilute sulfuric acid to an aqueous solution of **E**.	White precipitate	The precipitate is NO_3^{2-}
Heat a sample of **E** very strongly. Test any gases given off with a glowing splint.	A brown gas is evolved The glowing splint relights	The brown gas is Br_2 The gas which relights the glowing splint is O_2

ResultsPlus
Examiner Comments

An ionic precipitate has positive and negative ions.

Bromine isn't the only brown gas.

ResultsPlus
Examiner Tip

The two common brown gases are nitrogen dioxide and bromine.

Question 2(b)

A surprising number of candidates gave $BaNO_3$ as the formula. Others thought that the substance was barium sulfate.

Question 2(c)

This question proved very difficult with only a minority of candidates obtaining both marks. Some obtained one mark by writing the correct formulae for the products even though the equation was not balanced. A surprisingly common answer involved the formation of metallic barium – a highly unlikely product!

(c) Write an equation to show the reaction which occurs when a sample of **E** is heated very strongly. State symbols are **not** required.

(2)

$Ba(NO_3) \longrightarrow BaO + NO_2 + \frac{1}{2}O_2$

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Examiner Comments

The correct products are given, but the reactant formula is incorrect.

ResultsPlus
Examiner Tip

Practice writing the formulae of ionic compounds.

(c) Write an equation to show the reaction which occurs when a sample of **E** is heated very strongly. State symbols are **not** required.

(2)

$Ba(NO_3)_2 \longrightarrow Ba + 2NO_2 + O_2$.

ResultsPlus
Examiner Comments

This answer was not awarded any marks - metallic barium is not formed.

ResultsPlus
Examiner Tip

Heating a compound strongly is not going to cause the formation of a highly reactive metal!

Question 3(a)(i)

This question was generally very well answered though a few candidates did not gain the second mark because they stated that a colourless solution was formed.

Note that colour combinations like "blue-green" were not accepted.

Question 3(a)(ii)

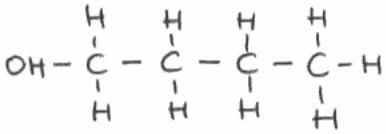
Most candidates correctly gave butan-1-ol but many gave butan-2-ol rather than the other primary alcohol isomer, 2-methylpropan-1-ol.

Displayed formulae were more often correct than condensed structural formulae – candidates would be well advised to use displayed formulae to answer this kind of question.

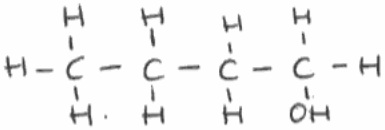
(ii) Give the two possible structural formulae for the compounds **X** and **Y** which both have the formula $C_4H_{10}O$.

(2)

First possible structural formula



Second possible structural formula



ResultsPlus
Examiner Comments

The same alcohol is given twice. Note that the first structure would also be penalised because of the O-H-C bonding.

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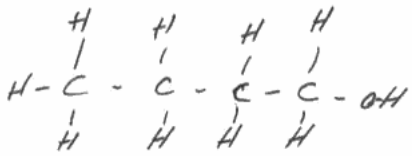
Examiner Tip

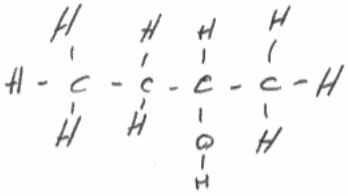
Remember to check that you haven't written the same isomer twice.

Note that writing out the fully displayed formula helps to avoid errors.

First possible structural formula



Second possible structural formula



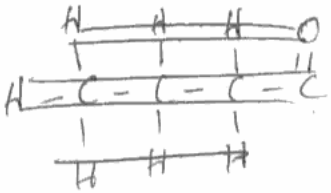
ResultsPlus
Examiner Comments

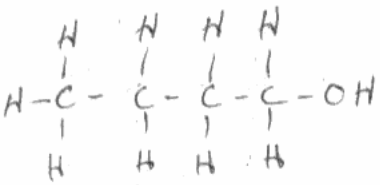
Propan-2-ol is a secondary alcohol so will oxidise to a ketone.

ResultsPlus
Examiner Tip

Primary alcohols do not necessarily have a straight carbon chain.

First possible structural formula





$CH_3CH_2CH_2CH_2OH$

Second possible structural formula

$CH_3-CH_2-CH_2-C=OH$

ResultsPlus
Examiner Comments

The second structure is incorrect. It has a carbon atom with three bonds and an oxygen atom with three bonds.

ResultsPlus
Examiner Tip

Drawing out fully displayed formulae can help you to avoid errors like this.

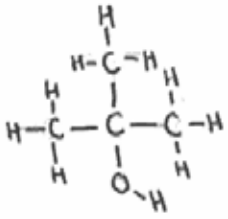
Question 3(b)

This question was generally well answered. Candidates who gave a displayed formula were far less likely to make errors than those attempting to write a condensed structural formula.

(b) A colourless liquid, **Z**, also with the formula $C_4H_{10}O$, resists oxidation on heating with acidified potassium dichromate(VI) solution.

Give the structural formula for liquid **Z**.

(1)



ResultsPlus
Examiner Comments

An excellent answer.

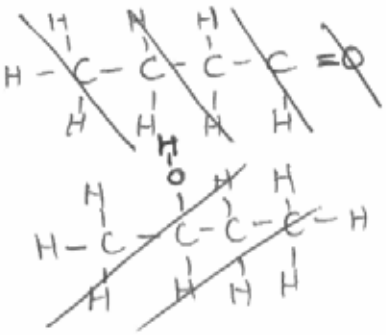
ResultsPlus
Examiner Tip

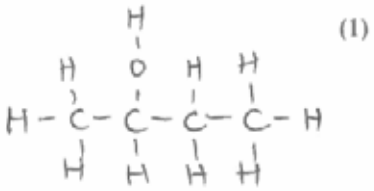
Using a fully displayed formula helps to avoid errors!

(b) A colourless liquid, **Z**, also with the formula $C_4H_{10}O$, resists oxidation on heating with acidified potassium dichromate(VI) solution.

Give the structural formula for liquid **Z**.

(1)





ResultsPlus
Examiner Comments

This is a secondary rather than a tertiary alcohol.

ResultsPlus
Examiner Tip

Only tertiary alcohols are not oxidised by acidified dichromate.

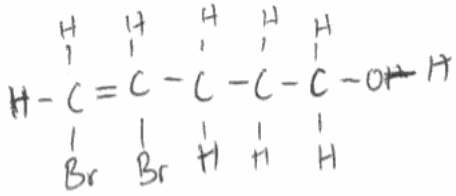
Question 3(c)(i)

This question was very well answered though a few candidates did not gain the second mark because they stated that the solution became "clear".

Question 3(c)(ii)

This question was usually answered well, though some candidates added HBr to the double bond instead of adding HOBr or $Br_{2.}$

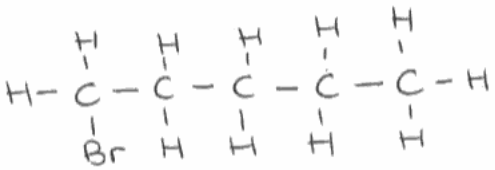
(ii) Give the displayed formula of the product formed in (c)(i). (1)



ResultsPlus
Examiner Comments
The double bond is left in the structure.

ResultsPlus
Examiner Tip
Carbon atoms can't form five bonds!

(ii) Give the displayed formula of the product formed in (c)(i). (1)

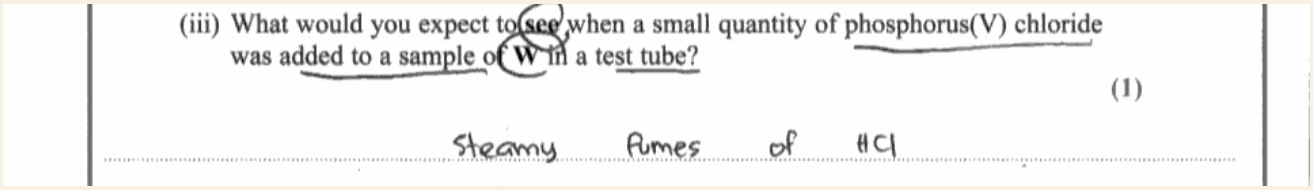


ResultsPlus
Examiner Comments
HBr added - no marks.

ResultsPlus
Examiner Tip
The reaction with bromine adds HOBr or $Br_{2.}$

Question 3(c)(iii)

Most candidates were aware that steamy fumes are given though a few thought that a smoke rather than a mist would be formed.

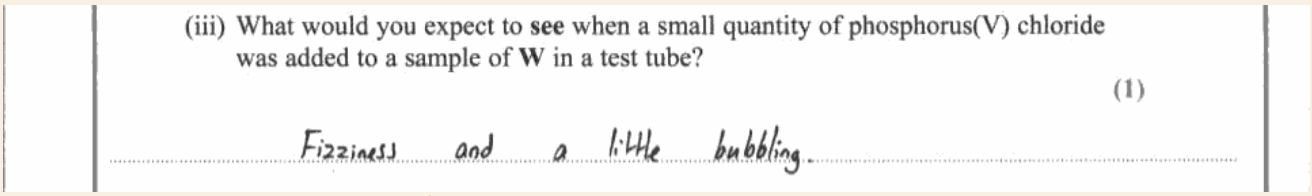

(iii) What would you expect to see when a small quantity of phosphorus(V) chloride was added to a sample of **W** in a test tube?

(1)

Steamy fumes of HCl

ResultsPlus
Examiner Comments

This is a concise, clear answer.


(iii) What would you expect to **see** when a small quantity of phosphorus(V) chloride was added to a sample of **W** in a test tube?

(1)

Fizziness and a little bubbling.

ResultsPlus
Examiner Comments

This answer misses the point of the test!

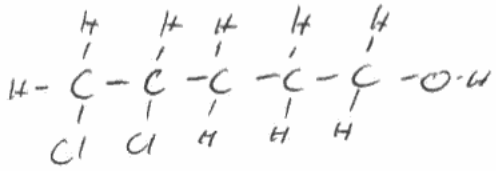
ResultsPlus
Examiner Tip

Give specific observations for a particular test. There is always fizzing when a gas is given off.

Question 3(c)(iv)

Many candidates made this question unnecessarily difficult by adding across the double bond. The addition of HCl was allowed since this would be formed in the reaction, but candidates often added Cl_2 or even Br_2.

(iv) Give the displayed formula of the **organic** product formed in (c)(iii). (1)



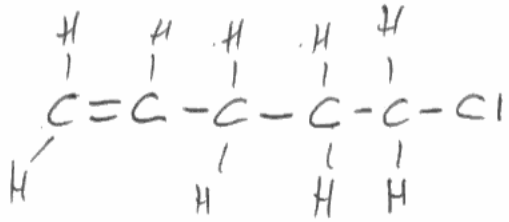
ResultsPlus
Examiner Comments

Two errors: the -OH group is not substituted and Cl_2 is added across the double bond.

ResultsPlus
Examiner Tip

Learn the tests for functional groups - including the equations for the reactions.

(iv) Give the displayed formula of the **organic** product formed in (c)(iii). (1)



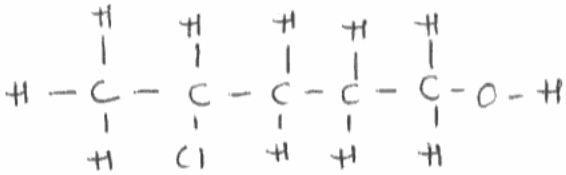
ResultsPlus
Examiner Comments

Fully correct.

ResultsPlus
Examiner Tip

All that is necessary is to substitute the OH with Cl.

(iv) Give the displayed formula of the **organic** product formed in (c)(iii). (1)



ResultsPlus
Examiner Comments

HCl is correctly added across the double bond but the -OH group is not substituted - so no marks.

ResultsPlus
Examiner Tip

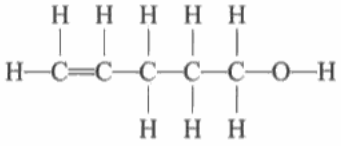
Learn the basic tests for functional groups.

Question 3(c)(v)

The answers to this question were quite well done though many candidates did not NAME the functional groups, giving formulae instead and losing the marks. Some confused "hydroxide", an ion, with "hydroxyl", a correct name for the -OH group.

(v) Identify, by **name**, the two functional groups present in compound **W**.

(2)



First functional group

~~group~~ carbon double bond carbon group

Second functional group

– hydroxide group

ResultsPlus
Examiner Comments

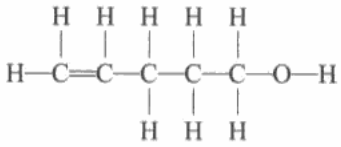
"Carbon-carbon double bond" was allowed for "alkene" but "hydroxide" refers to an ion, not to an organic functional group.

ResultsPlus
Examiner Tip

Do not confuse "hydroxyl" and "hydroxide".

(v) Identify, by **name**, the two functional groups present in compound **W**.

(2)



First functional group

Alkenes

Second functional group

Alcohols

ResultsPlus
Examiner Comments

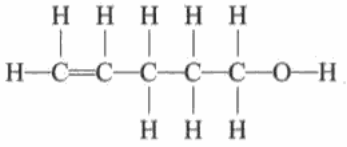
This is a fully correct answer.

ResultsPlus
Examiner Tip

Learn the names of the functional groups.

(v) Identify, by **name**, the two functional groups present in compound **W**.

(2)



First functional group

C = C

Second functional group

O - H

ResultsPlus
Examiner Comments

The question asked for NAMES of functional groups - so no marks.

ResultsPlus
Examiner Tip

Read the question!

Question 4(a)

Most candidates obtained at least three marks on this question. The most common error was to fail to appreciate that the reaction is endothermic so ΔH is positive.

Some candidates gave no sign at all despite the fact that the question clearly asked that a sign be included, so lost a mark.

(iii) Use your answers to (a)(i) and (ii) to calculate, in kJ mol^{-1}, the enthalpy change, ΔH_1, when one mole of $KHCO_3(s)$ reacts completely with the acid. Include the sign for ΔH_1.

(2)

1046 ÷ 1000 = 1.045

$\Delta H_1 = \frac{1.045}{0.0348}$

= + 30.03 kJ mol^{-1}

ResultsPlus
Examiner Comments

An excellent answer.

ResultsPlus
Examiner Tip

Don't forget to include the "+" - the question asked for the sign.

(iii) Use your answers to (a)(i) and (ii) to calculate, in kJ mol^{-1}, the enthalpy change, ΔH_1, when one mole of $KHCO_3(s)$ reacts completely with the acid. Include the sign for ΔH_1.

(2)

$\frac{1045}{0.0348}$ = 30028.7

30028.7 ÷ 1000 = −30.03 kJ mol^{-1}

ResultsPlus
Examiner Comments

This is correct except for the sign of ΔH.

ResultsPlus
Examiner Tip

The temperature falls so the reaction is endothermic - ΔH is positive.

Question 4(b)(i)

Many candidates failed to appreciate that a comparison was involved here - so both reactions must be discussed in the answer. It wasn't enough to simply say that one temperature change was bigger than the other - this will almost always be the case.

(b) In the second experiment, the enthalpy change for the reaction between potassium carbonate and dilute hydrochloric acid was calculated from the results.

$$K_2CO_3(s) + 2HCl(aq) \rightarrow 2KCl(aq) + H_2O(l) + CO_2(g)$$

The molar enthalpy change, ΔH_2, for this reaction was calculated to be –34.0 kJ mol^{-1}.

(i) State **one** way in which the temperature change is different when equal numbers of moles of potassium hydrogencarbonate and potassium carbonate react separately with the same volume of excess dilute hydrochloric acid.

(1)

When pottasium hydrogencarbonate reacts with dilute hydrochloric acid, the reaction is endothermic (heat energy absorbed) (positive enthalpy change).

When pottasium carbonate reacts, the reaction is exothermic (heat energy produced) (negative enthalpy change).

ResultsPlus
Examiner Comments

This is an excellent answer.

ResultsPlus
Examiner Tip

Always refer to both items in a comparison.

(b) In the second experiment, the enthalpy change for the reaction between potassium carbonate and dilute hydrochloric acid was calculated from the results.

$$K_2CO_3(s) + 2HCl(aq) \rightarrow 2KCl(aq) + H_2O(l) + CO_2(g)$$

The molar enthalpy change, ΔH_2, for this reaction was calculated to be –34.0 kJ mol^{-1}.

(i) State **one** way in which the temperature change is different when equal numbers of moles of potassium hydrogencarbonate and potassium carbonate react separately with the same volume of excess dilute hydrochloric acid.

(1)

The ~~concentration~~ strength of the two, K_2CO_3 and $KHCO_3$, differ hence the temperature change is different.

~~The equipments~~

ResultsPlus
Examiner Comments

It isn't enough just to state that the temperature change is different.

ResultsPlus
Examiner Tip

The "strength" of a chemical doesn't really mean anything on its own and two reactions normally have different temperature changes. Avoid vague statements like this!

(b) In the second experiment, the enthalpy change for the reaction between potassium carbonate and dilute hydrochloric acid was calculated from the results.

$$K_2CO_3(s) + 2HCl(aq) \rightarrow 2KCl(aq) + H_2O(l) + CO_2(g)$$

The molar enthalpy change, ΔH_2, for this reaction was calculated to be –34.0 kJ mol^{-1}.

(i) State **one** way in which the temperature change is different when equal numbers of moles of potassium hydrogencarbonate and potassium carbonate react separately with the same volume of excess dilute hydrochloric acid.

(1)

The ~~temper~~ secon reaction e with K_2CO_3 is exothermic, it gives out heat.

ResultsPlus
Examiner Comments

The answer given is correct but there is no comparison - so no marks.

ResultsPlus
Examiner Tip

Always discuss both items in a comparison.

Question 4(b)(ii)

This question was very well answered - helped by the fact that there are a large number of possible correct answers.

(ii) Give **one** assumption made when calculating the values of ΔH_1 and ΔH_2 from experimental results.

(1)

That the specific heat capacity of HCl is the same as ~~water's~~ water's.

ResultsPlus
Examiner Comments
This is one possible correct answer.

(ii) Give **one** assumption made when calculating the values of ΔH_1 and ΔH_2 from experimental results.

(1)

More moles of HCl used the more ~~moles~~ exothermic the experiment is.

ResultsPlus
Examiner Comments
The HCl is in excess, so this cannot be correct.

ResultsPlus
Examiner Tip
Read the whole question carefully. Using more of a reagent in excess cannot alter the reaction.

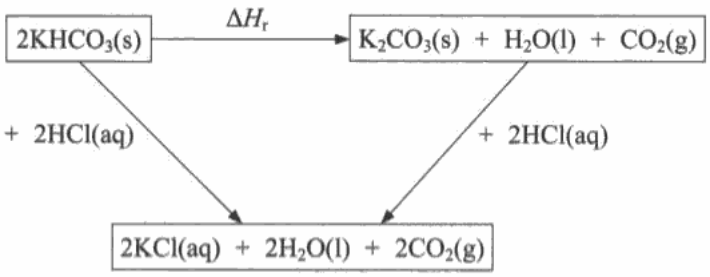
Question 4(c)(i)

This question was very poorly answered. Very few candidates appreciated that the first equation had been doubled so ΔH_1 had to be doubled too.

(c) The values of ΔH_1 and ΔH_2 may be used to determine the enthalpy change for the following reaction (ΔH_r).

$$2KHCO_3(s) \rightarrow K_2CO_3(s) + H_2O(l) + CO_2(g)$$

A Hess cycle based on these reactions is shown below.



(i) Use Hess's Law to complete an expression for ΔH_r in terms of ΔH_1 and ΔH_2. (1)

$\Delta H_r = 2(\Delta H_1) - \Delta H_2$

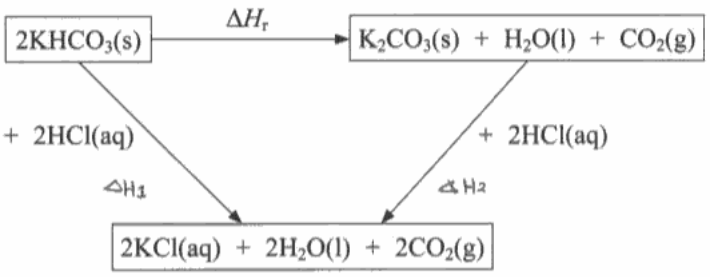
ResultsPlus
Examiner Comments
This is a rare correct answer!

ResultsPlus
Examiner Tip
Make sure you know how to use Hess' Law even when enthalpies of formation or enthalpies of combustion are not involved.

(c) The values of ΔH_1 and ΔH_2 may be used to determine the enthalpy change for the following reaction (ΔH_r).

$$2KHCO_3(s) \rightarrow K_2CO_3(s) + H_2O(l) + CO_2(g)$$

A Hess cycle based on these reactions is shown below.



(i) Use Hess's Law to complete an expression for ΔH_r in terms of ΔH_1 and ΔH_2. (1)

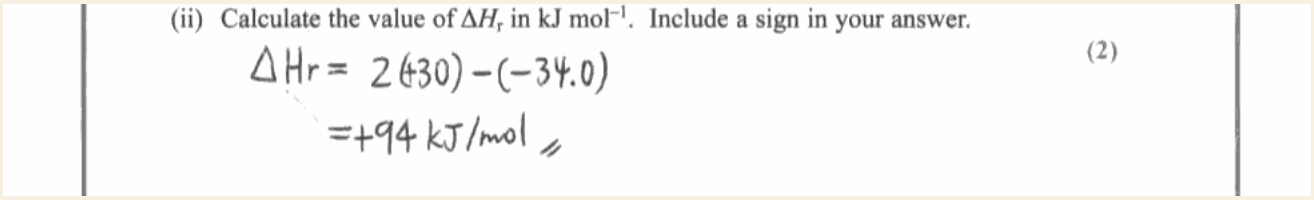
$\Delta H_r = \Delta H_1 - \Delta H_2$

ResultsPlus
Examiner Comments
This answer demonstrates a very common error.

ResultsPlus
Examiner Tip
Check the number of moles in the equations.

Question 4(c)(ii)

This was poorly answered because few candidates had derived the correct formula in the previous part of the question. Some candidates spoiled an otherwise correct answer by failing to explicitly give the positive sign - which was asked for in the question.

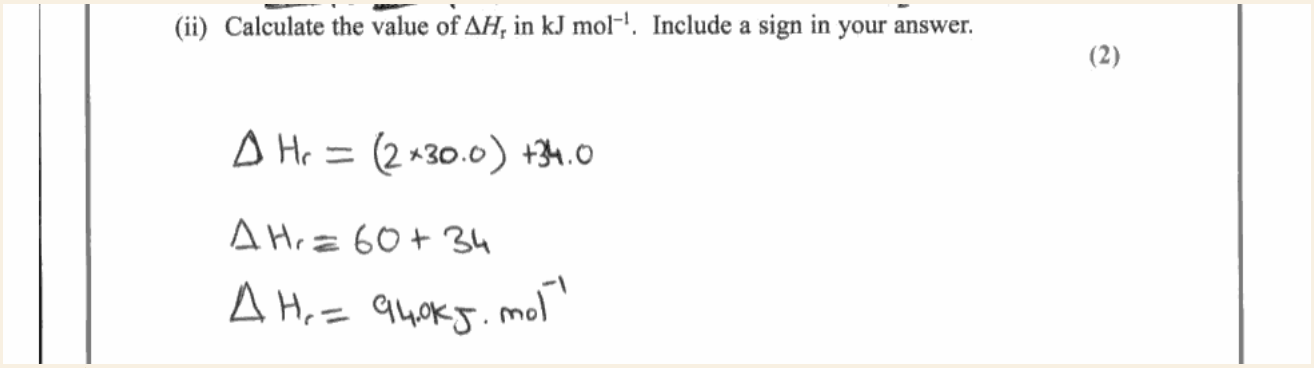

(ii) Calculate the value of ΔH_r in kJ mol^{-1}. Include a sign in your answer. (2)

$\Delta Hr = 2(+30) - (-34.0)$

$= +94$ kJ/mol

ResultsPlus
Examiner Comments
This is an excellent, clear answer.

ResultsPlus
Examiner Tip
Always include the sign when the question asks for it.


(ii) Calculate the value of ΔH_r in kJ mol^{-1}. Include a sign in your answer. (2)

$\Delta H_r = (2 \times 30.0) + 34.0$

$\Delta H_r = 60 + 34$

$\Delta H_r = 94.0$ kJ. mol^{-1}

ResultsPlus
Examiner Comments
This is a good answer but one mark is lost for omitting the sign.

ResultsPlus
Examiner Tip
Always include the sign when the question asks for it.

Question 5(a)(i)

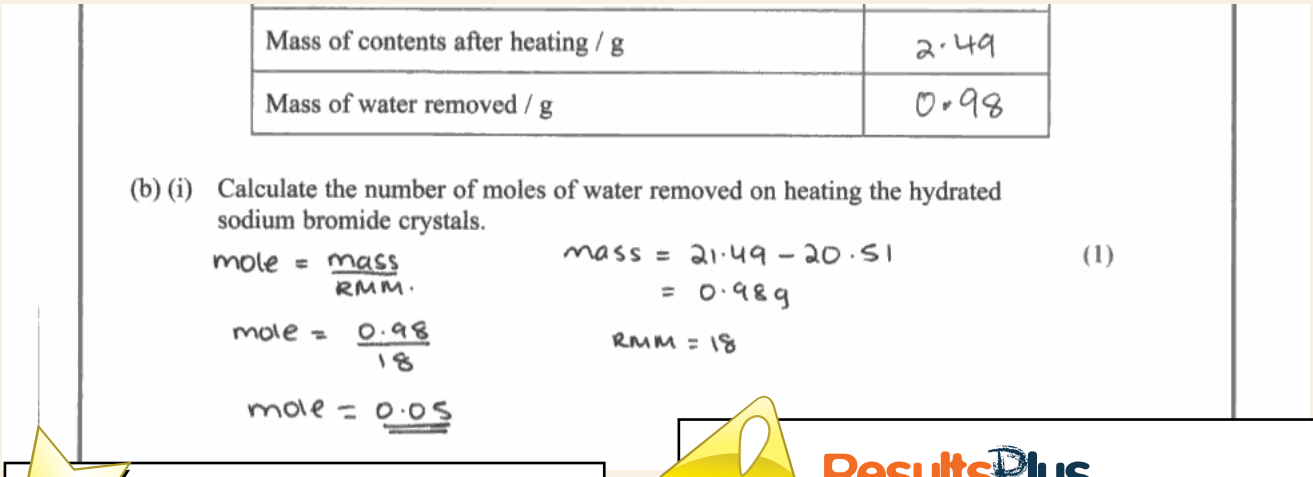
This question was very well answered.

Question 5(a)(ii)

This question was also very well answered.

Question 5(b)(i)

This too was very well answered. A few candidates threw away a mark by giving an answer accurate to only one significant figure.



Mass of contents after heating / g	2·49
Mass of water removed / g	0·98

(b) (i) Calculate the number of moles of water removed on heating the hydrated sodium bromide crystals.

(1)

mole = mass / RMM

mole = 0·98 / 18

mole = 0·05

mass = 21·49 − 20·51
= 0·98g

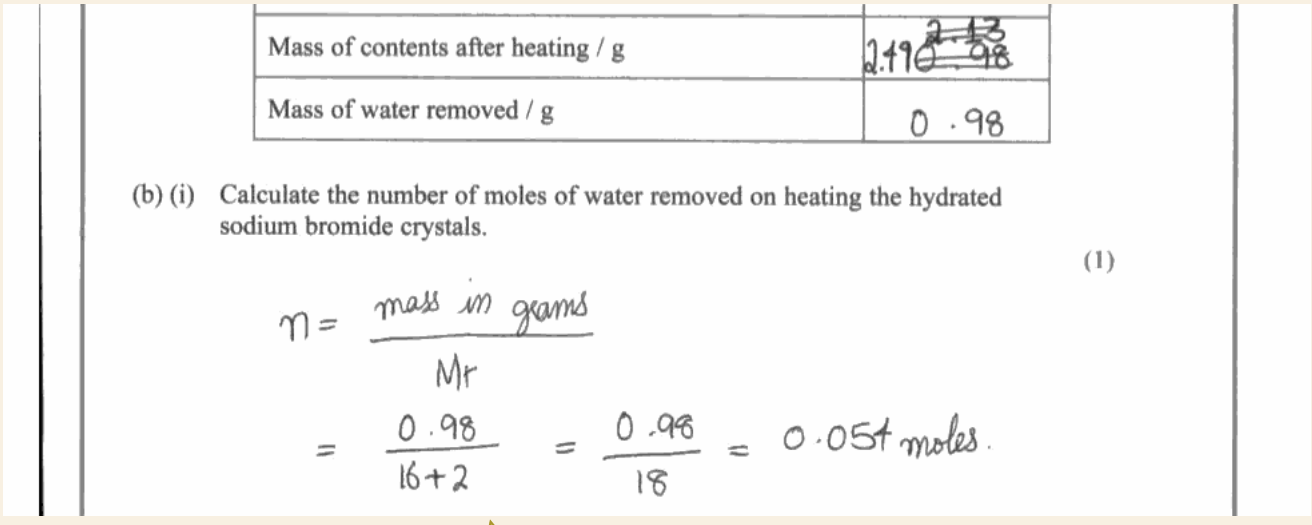
RMM = 18

ResultsPlus
Examiner Comments

This is an example of a good answer ruined by inaccuracy - the answer should be given to at least 2 significant figures.

ResultsPlus
Examiner Tip

If the question doesn't ask for a specific number of significant figures, it is very rarely wrong to give answers to three significant figures. So, if in doubt - use 3 significant figures!



Mass of contents after heating / g	2.49 ~~2.13~~ ~~0.98~~
Mass of water removed / g	0 ·98

(b) (i) Calculate the number of moles of water removed on heating the hydrated sodium bromide crystals.

(1)

$n = \frac{\text{mass in grams}}{Mr}$

$= \frac{0.98}{16+2} = \frac{0.98}{18} = 0.054$ moles.

ResultsPlus
Examiner Comments

This is a good, clear answer.

Question 5(b)(ii)

This question was also very well answered.

Mass of contents before heating / g	3.47
Mass of contents after heating / g	2.49
Mass of water removed / g	0.98

(b) (i) Calculate the number of moles of water removed on heating the hydrated sodium bromide crystals.

(1)

$n = \frac{m}{M} = \frac{0.98}{18} = 0.054$ moles

(ii) Calculate the number of moles of anhydrous sodium bromide, NaBr, formed after heating.

(2)

$n = \frac{m}{M} = \frac{2.49}{102.9} = 0.0242$ moles

ResultsPlus
Examiner Comments

This is an excellent answer.

Mass of contents after heating / g	2.49
Mass of water removed / g	0.98

(b) (i) Calculate the number of moles of water removed on heating the hydrated sodium bromide crystals.

(1)

$H_2O = 18$

$\frac{0.98}{18} = 0.054$ moles

(ii) Calculate the number of moles of anhydrous sodium bromide, NaBr, formed after heating.

(2)

$\frac{0.98}{102.9} = 9.5 \times 10^{-3}$

ResultsPlus
Examiner Comments

The molar mass is correct but the wrong mass is used, so one mark is lost.

ResultsPlus
Examiner Tip

Show your workings - the correct molar mass rescued one mark even though the wrong mass was used.

Question 5(b)(iii)

Considering that the two previous parts were usually very well answered, it was surprising how many candidates failed to give the correct answer here. Some confused significant figures with decimal places and some truncated their answers to 5(b)(i) and 5(b)(ii) to only one significant figure and so obtained a very inaccurate answer to this part, losing a mark.

(iii) Use your answers from (b)(i) and (ii) to calculate the value of **x**. Give your answer to **two** significant figures.

(2)

$x = \frac{0.0544}{0.0242} = 2.249...$

$x = 2.2$

ResultsPlus
Examiner Comments
This is a good, clear answer.

(iii) Use your answers from (b)(i) and (ii) to calculate the value of **x**. Give your answer to **two** significant figures.

(2)

$NaBr \cdot x H_2O$

NaBr = 0.02 mol
H_2O = 0.05 mol.

0.02 : 0.05
1 : x
= 5/2
= 2.5

$\therefore NaBr \cdot \frac{5}{2} H_2O$

ResultsPlus
Examiner Comments
Truncation errors made this answer inaccurate and cost one mark.

ResultsPlus
Examiner Tip
Work to 3 significant figures!

Question 5(c)

A very large number of candidates failed to appreciate that two balance readings are involved in measuring the mass of the crystals so the error must be doubled.

(c) Each mass reading in the table has a maximum error of ±0.005 g.

Calculate the percentage error in the mass of the contents of the crucible before heating the 3.47 g of crystals.

(2)

$\frac{0.005}{21.49} \times 100 = 0.023\%$ //

ResultsPlus
Examiner Comments

The error is not doubled and the error is not divided by the true value of the mass of the crystals. So both marks are lost.

ResultsPlus
Examiner Tip

Think about the true value, when calculating a percentage error.

(c) Each mass reading in the table has a maximum error of ±0.005 g.

Calculate the percentage error in the mass of the contents of the crucible before heating the 3.47 g of crystals.

(2)

$\frac{\pm 0.005}{3.47} \times 100 = 0.144\%$

ResultsPlus
Examiner Comments

The error is not doubled so one mark is lost.

ResultsPlus
Examiner Tip

If two readings are involved, the error must be doubled.

(c) Each mass reading in the table has a maximum error of ±0.005 g.

Calculate the percentage error in the mass of the contents of the crucible before heating the 3.47 g of crystals.

(2)

$\frac{0.005 \times 2}{3.47} \times 100\% = 0.288\%$

ResultsPlus
Examiner Comments

This reponse gives the correct answer.

Question 5(d)(i)

Many candidates failed to appreciate that the additional mass due to the carbon deposits would make the apparent loss of mass less.

(d) The correct value for **x** is 2.

Two possible errors that might occur during the experiment are described below.

For each error, predict the effect the error would have on

- the apparent mass of water removed
- the calculated value of **x**

(i) Carbon from the Bunsen burner flame was deposited on the crucible during heating.

(2)

Apparent mass of water removed:

It would have seemed as if less mass of water was removed (as the crucible would have had more mass afterwards)

Value of **x**:

Value of x was smaller

ResultsPlus
Examiner Comments
This is a good answer.

(d) The correct value for **x** is 2.

Two possible errors that might occur during the experiment are described below.

For each error, predict the effect the error would have on

- the apparent mass of water removed
- the calculated value of **x**

(i) Carbon from the Bunsen burner flame was deposited on the crucible during heating.

(2)

Apparent mass of water removed:

decreased value of mass of water removed

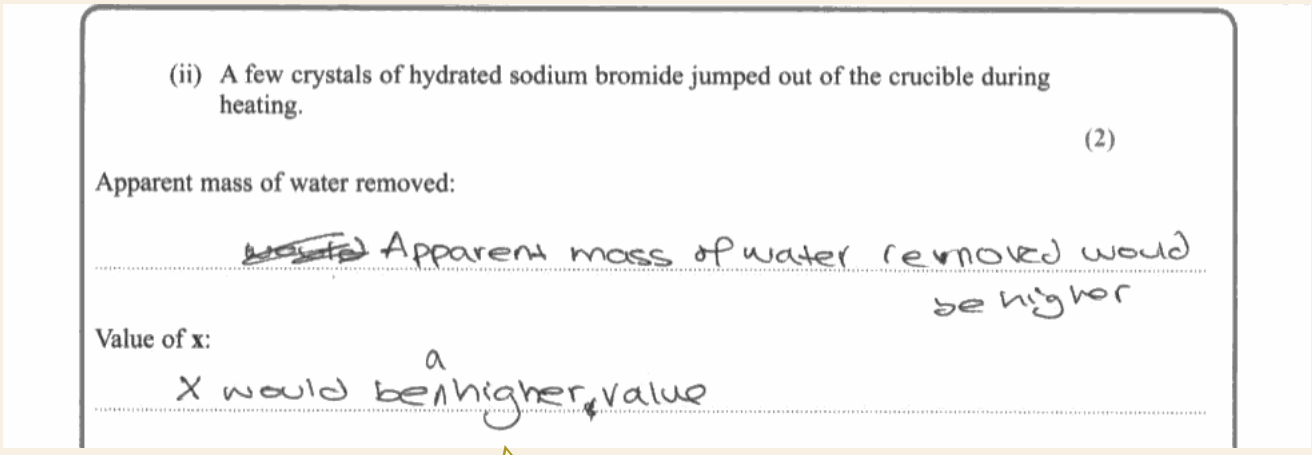
Value of **x**:

increased value of x.

ResultsPlus
Examiner Comments
The candidate has not appreciated that the apparent loss of less water, means less water of crystallisation.

Question 5(d)(ii)

Candidates again found it difficult to relate the loss of crystals to the apparent change in mass.



(ii) A few crystals of hydrated sodium bromide jumped out of the crucible during heating.

(2)

Apparent mass of water removed:

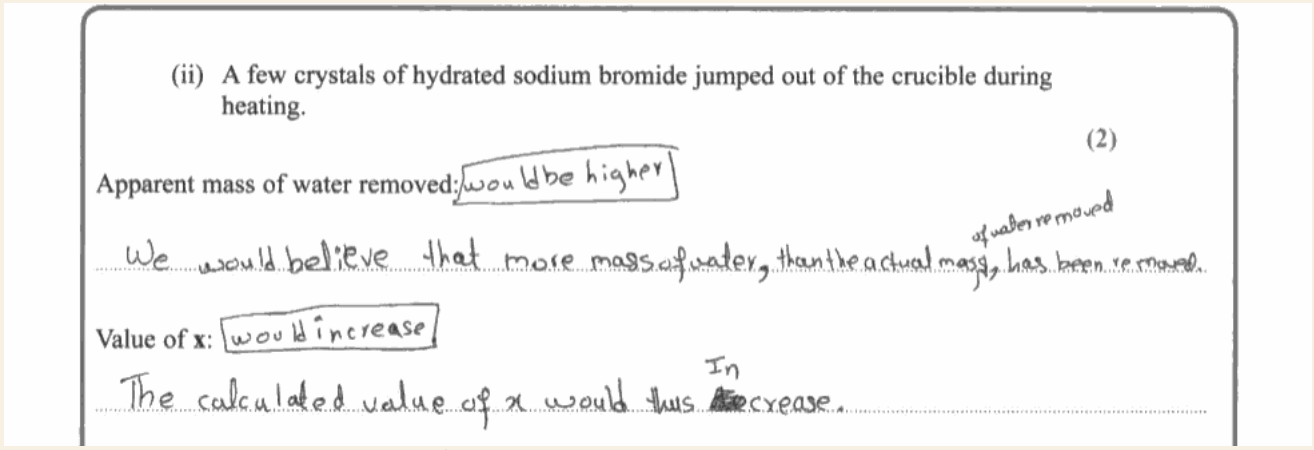
~~Incorrect~~ Apparent mass of water removed would be higher

Value of **x**:

X would be a higher value

ResultsPlus
Examiner Comments

This is a good answer.



(ii) A few crystals of hydrated sodium bromide jumped out of the crucible during heating.

(2)

Apparent mass of water removed: would be higher

We would believe that more mass of water, than the actual mass of water removed, has been removed.

Value of **x**: would increase

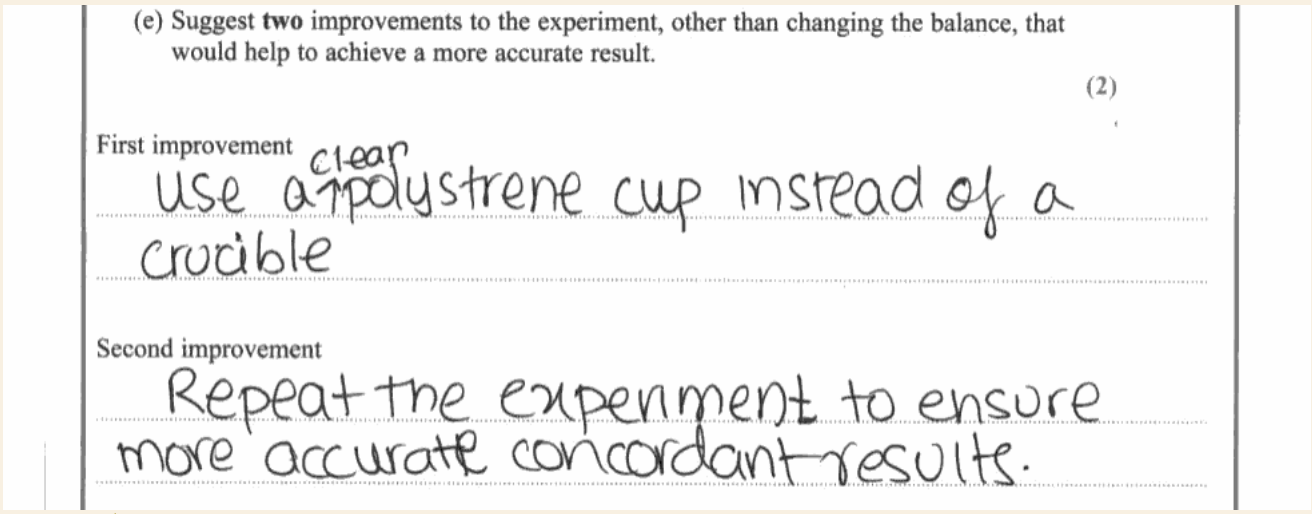
The calculated value of x would thus In crease.

ResultsPlus
Examiner Comments

After some hesitation, the candidate gets it right!

Question 5(e)

This question proved difficult with many candidates missing the straightforward answer of putting a lid on the crucible to stop the solid jumping out. Only a small minority were aware that the best technique is to heat to constant mass.



(e) Suggest **two** improvements to the experiment, other than changing the balance, that would help to achieve a more accurate result.

(2)

First improvement

Use a clear polystrene cup instead of a crucible

Second improvement

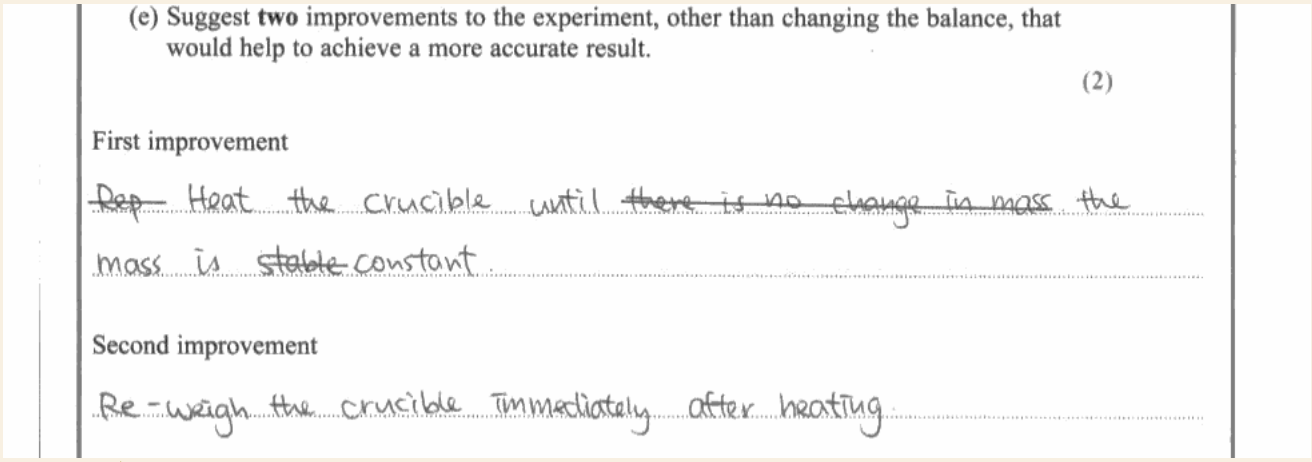
Repeat the experiment to ensure more accurate concordant results.

ResultsPlus
Examiner Comments

This response gives one correct and one unrealistic suggestion.

ResultsPlus
Examiner Tip

It is not a good idea to heat polystyrene with a Bunsen burner!



(e) Suggest **two** improvements to the experiment, other than changing the balance, that would help to achieve a more accurate result.

(2)

First improvement

~~Rep~~ Heat the crucible until ~~there is no change in mass~~ the mass is ~~stable~~ constant

Second improvement

Re-weigh the crucible immediately after heating

ResultsPlus
Examiner Comments

One good answer is partially repeated - but only gains one mark.

ResultsPlus
Examiner Tip

Don't repeat the same idea when two answers are required.

(e) Suggest **two** improvements to the experiment, other than changing the balance, that would help to achieve a more accurate result.

(2)

First improvement

~~Dep~~ Heat the crucible until ~~there is no change in mass~~ the mass is ~~stable~~ constant.

Second improvement

Re-weigh the crucible immediately after heating.

ResultsPlus
Examiner Comments

A water bath isn't hot enough.

ResultsPlus
Examiner Tip

A Bunsen burner generates a much higher temperature than a water bath.

Paper Summary

The full range of marks was available. The best candidates scored very highly indeed and even the weakest candidates were able to demonstate what they knew.

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