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Principal Examiner's Feedback

October 2016

Pearson Edexcel International Advanced Level in Chemistry (WCH03) Paper 01

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Summer 2016
Publications Code WCH03_01_1610_ER*

Grade Boundaries

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Paper Introduction

There were some excellent candidates who had been very well prepared by their centres. They had thoroughly learned all the aspects of the practical work.

At the same time there were many weak candidates who clearly had little experience or knowledge of practical procedures.

Many questions required a detailed knowledge of a procedure, how the procedure works, and how it is used.

WCH03_01_Q01ai

Question Introduction

Only weaker candidates were unable to give a suitable material. It is surprising the number of rich centres using platinum wire. Fewer candidates were able to offer a suitable reason.

Item: QC0419000007279

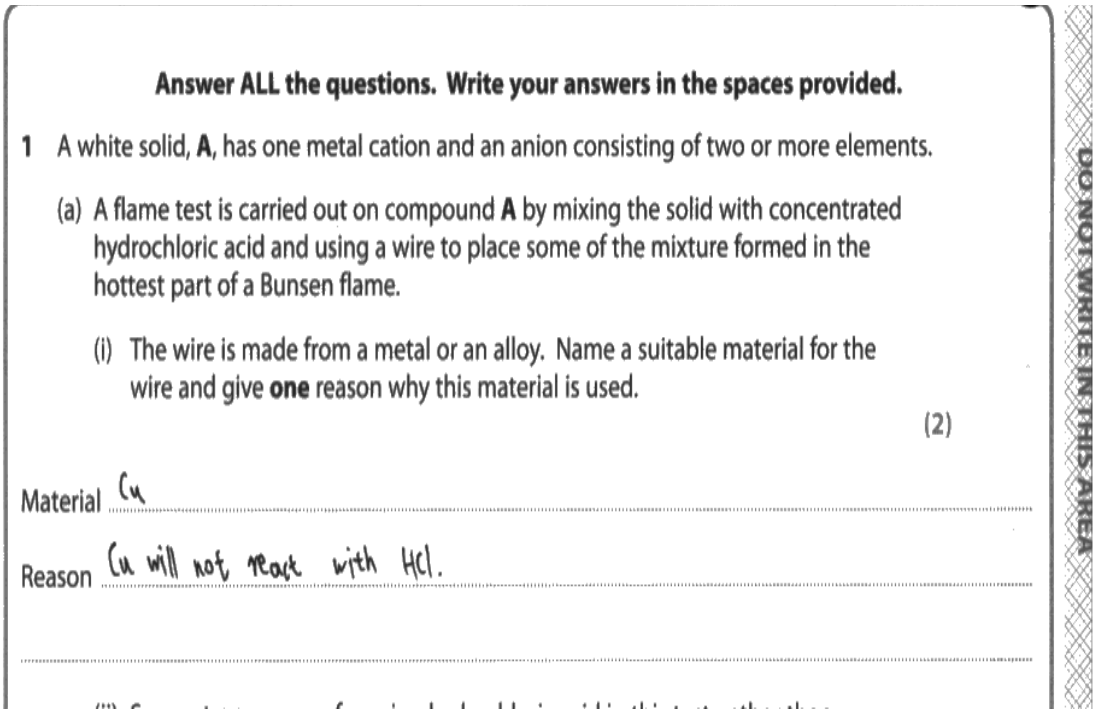
Examiner Comment

Copper is not used for the wire as it does oxidise when heated in air at high temperature.

Though the sytatement about copper is true it misses the important point of the high temperature reaction.

Examiner Tip

Learn details and reasons for the use of apparatus in experiments.



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

1 A white solid, **A**, has one metal cation and an anion consisting of two or more elements.

(a) A flame test is carried out on compound **A** by mixing the solid with concentrated hydrochloric acid and using a wire to place some of the mixture formed in the hottest part of a Bunsen flame.

(i) The wire is made from a metal or an alloy. Name a suitable material for the wire and give **one** reason why this material is used.

(2)

Material Cu

Reason Cu will not react with HCl.

DO NOT WRITE IN THIS AREA

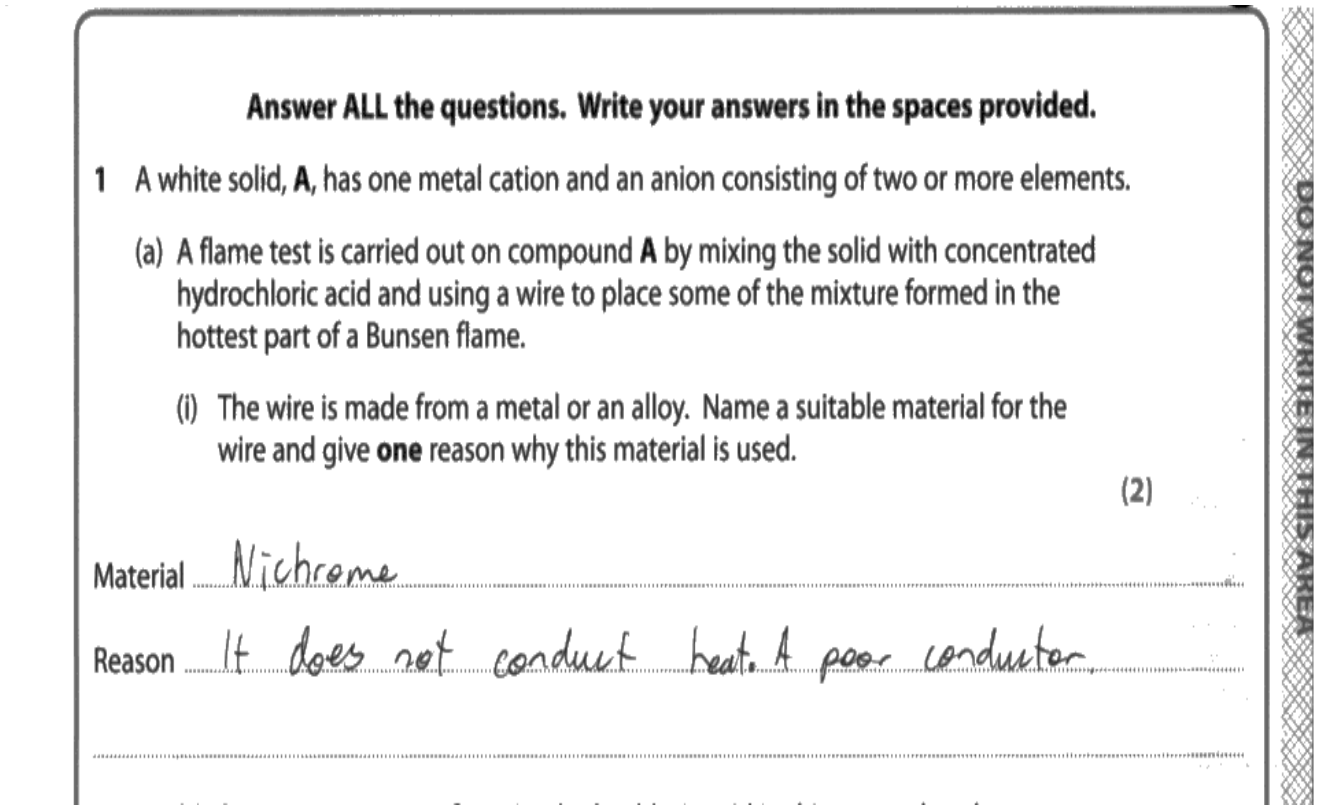
Item: QC0419000007635

Examiner Comment

The material is correct, but the candidate has never learned the reason for its use - Principally its lack of reactivity under the condidtions of the test.

Examiner Tip

Always consider why apparatus and chamicals are used in experiments.



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(i) The wire is made from a metal or an alloy. Name a suitable material for the wire and give **one** reason why this material is used.

(2)

Material Nichrome

Reason It does not conduct heat. A poor conductor.

DO NOT WRITE IN THIS AREA

WCH03_01_Q01aii

Question Introduction

This was a challenging item. Only the best candidates recognised the volatility of chlorides. More gained the rescue mark for recalling that most chlorides are soluble. But the majority of answers showed that the reasons for using hydrochloric acid had not been considered.

Item: QC0419000007284

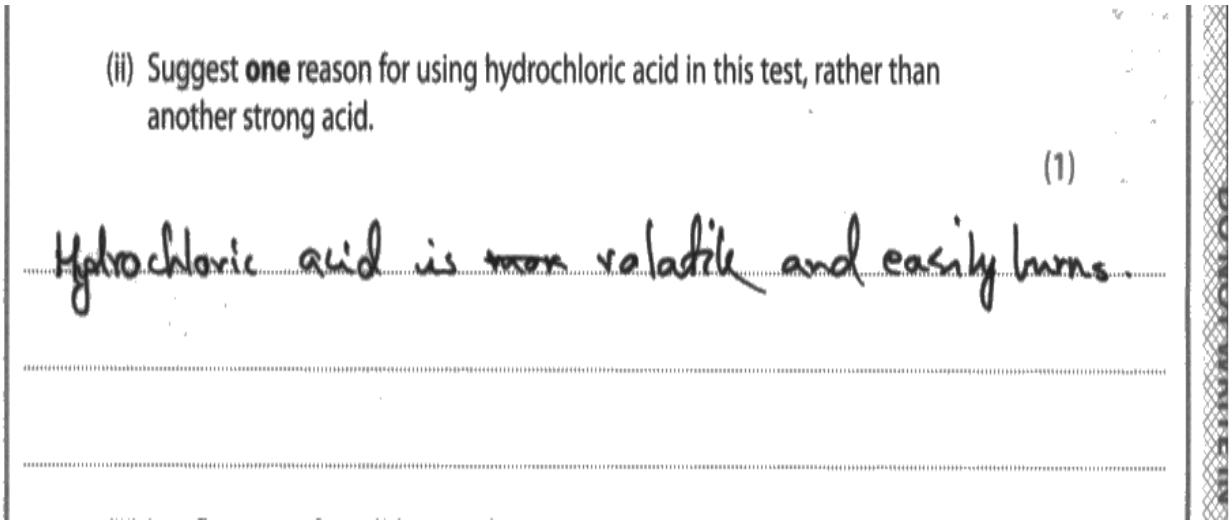
Examiner Comment

This was a common error. To give that the volatility of the hydrochloric acid was the reason.

Examiner Tip

The second statement is worrying as hydrochloric acid does not burn.

Do not give additional information unless you are certain it is correct.


(ii) Suggest **one** reason for using hydrochloric acid in this test, rather than another strong acid.

(1)

Hydrochloric acid is ~~more~~ volatile and easily burns.

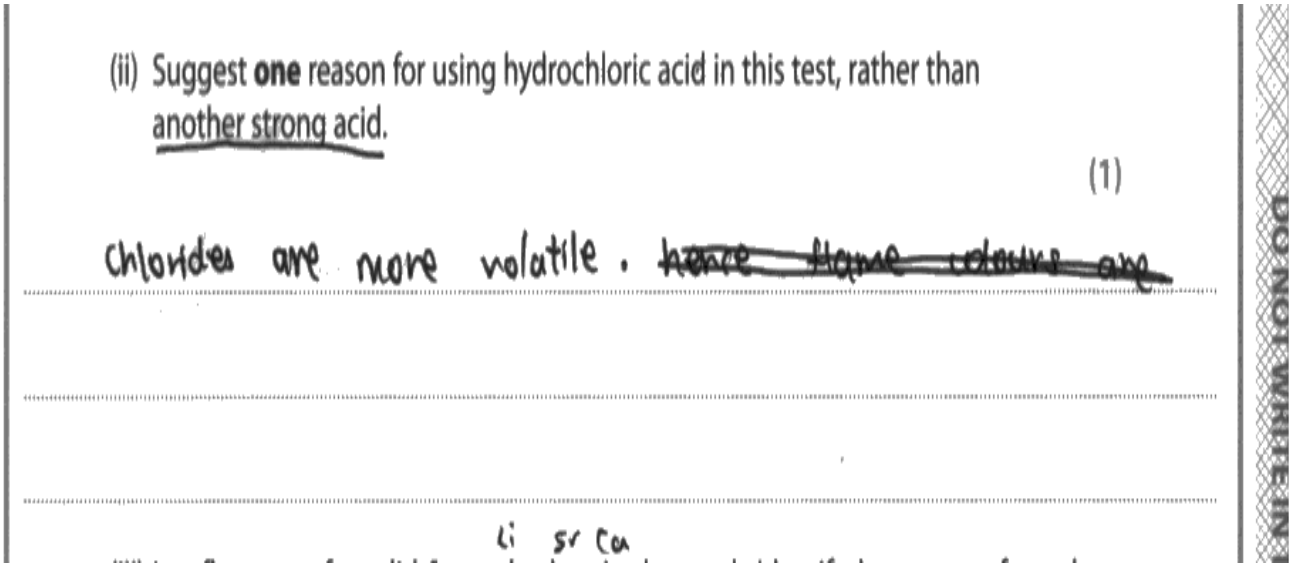
Item: QC0419000007313

Examiner Comment

This is an example of the best answers seen, stating that chlorides are volatile so vaporise easily.

Examiner Tip

Another example of knowing the reason for the use of a particluar chemical.


(ii) Suggest **one** reason for using hydrochloric acid in this test, rather than another strong acid.

(1)

chlorides are more volatile. ~~hence flame colours are~~

Li Sr Ca

DO NOT WRITE IN

WCH03_01_Q02a

Question Introduction

There were many weak answers stating 'ethanol is a solvent' which was insufficient. At this level a more distilled answer is required.

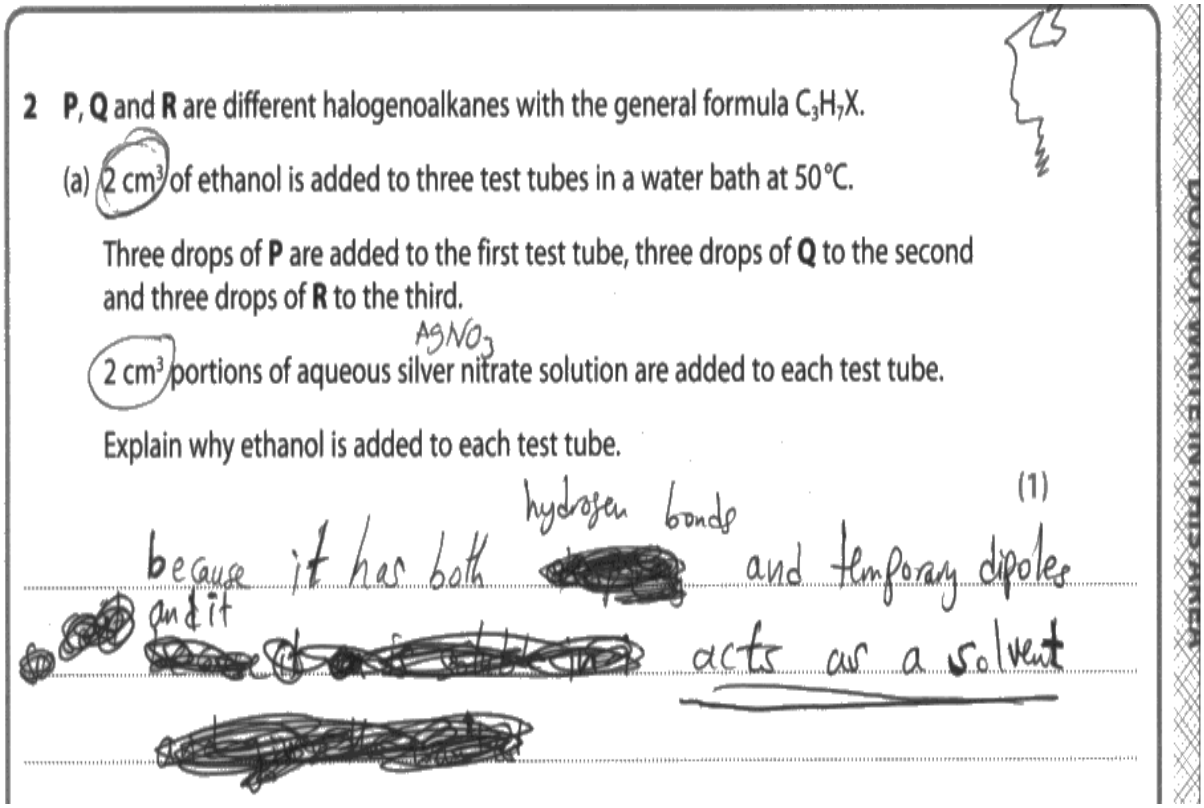
Item: QC0419000007316

Examiner Comment

This answer is just not sufficient. Had the answer referred to ethanol making hydrogen bonds with water and London forces with the halogenoalkane it would have been fine.

Examiner Tip

Always give as full an explanation as possible.



2 **P**, **Q** and **R** are different halogenoalkanes with the general formula C_3H_7X.

(a) 2 cm^3 of ethanol is added to three test tubes in a water bath at 50 °C.

Three drops of **P** are added to the first test tube, three drops of **Q** to the second and three drops of **R** to the third.

2 cm^3 portions of aqueous silver nitrate ($AgNO_3$) solution are added to each test tube.

Explain why ethanol is added to each test tube.

(1)

because it has both hydrogen bonds and temporary dipoles and it acts as a solvent

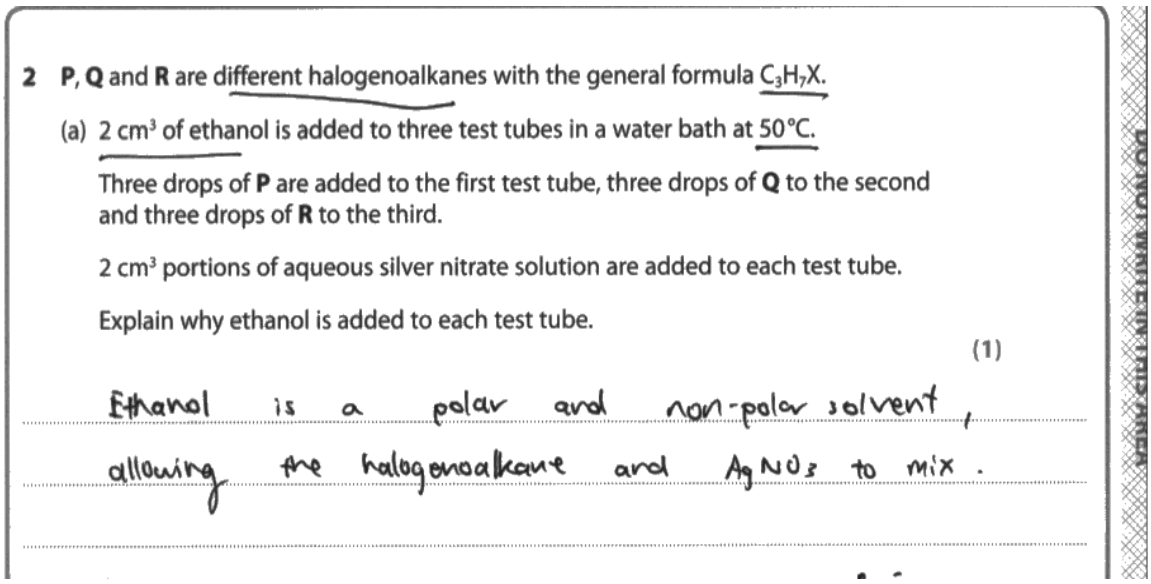
Item: QC0419000007313

Examiner Comment

This is a very thorough answer. Either the first or second line would have been sufficient.

Examiner Tip

In an explanation always give as much detail as you can when answering the question.



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2 cm^3 portions of aqueous silver nitrate solution are added to each test tube.

Explain why ethanol is added to each test tube.

(1)

Ethanol is a polar and non-polar solvent, allowing the halogenoalkane and $AgNO_3$ to mix.

DO NOT WRITE IN THIS AREA

WCH03_01_Q02b-cii

Question Introduction

There were elementary errors in (b) like writing ‘bromide’ and ‘iodide’. These ions are not present in halogenoalkanes.

Many candidates had little experience of identifying mass spectra fragments shown in responses to (c)(i). It is good to start from the twelve times table to get the number of carbons present!

Item: QC0419000007284

Examiner Comment

Parts (b) and (c)(i) are fine.

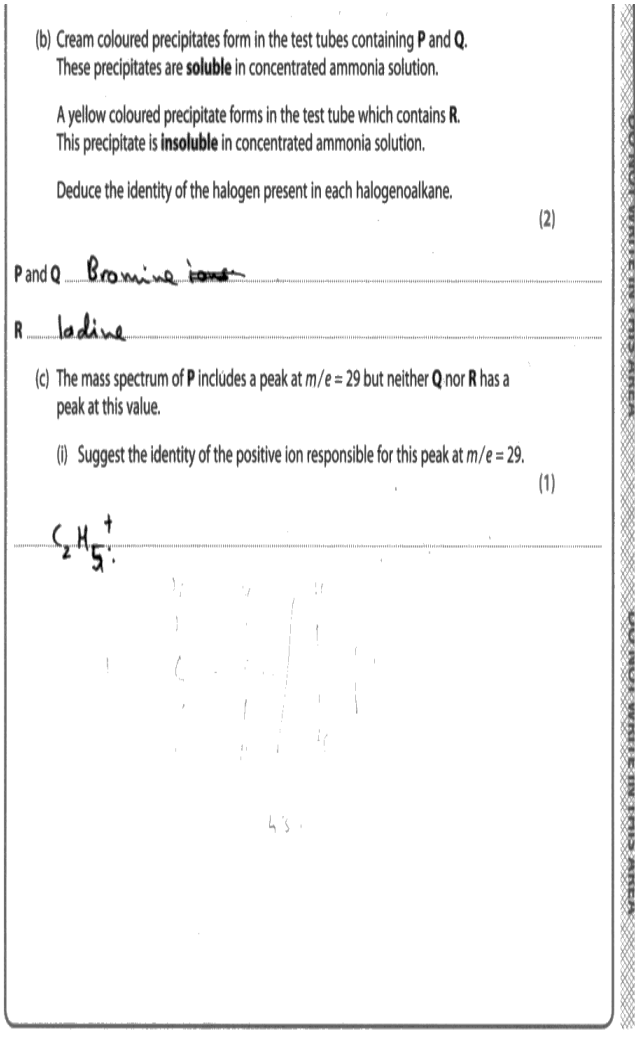
In (c)(ii) there are two errors. Skeletal structures have been attempted. This was not penalised on this occasion.

Each structure has an extra carbon.

Examiner Tip

Read the question twice! Underline instructional details like 'structural'.

Count carbon atoms in structures carefully (meth, eth, prop but etc.)



(b) Cream coloured precipitates form in the test tubes containing **P** and **Q**.
These precipitates are **soluble** in concentrated ammonia solution.

A yellow coloured precipitate forms in the test tube which contains **R**.
This precipitate is **insoluble** in concentrated ammonia solution.

Deduce the identity of the halogen present in each halogenoalkane.

(2)

P and **Q** Bromine ~~ion~~

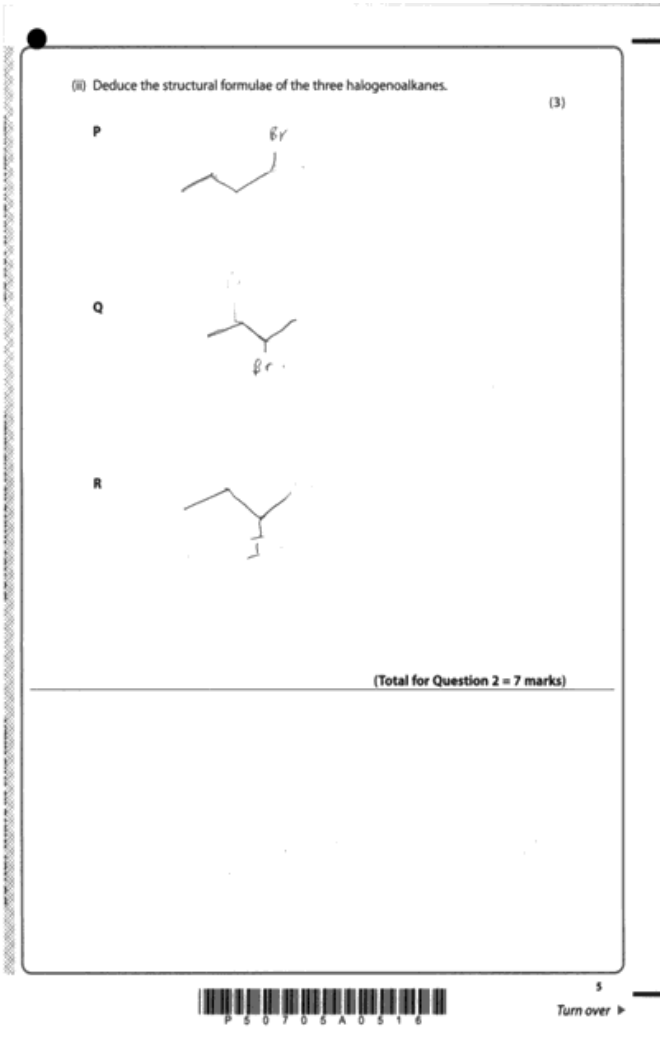
R Iodine

(c) The mass spectrum of **P** includes a peak at $m/e = 29$ but neither **Q** nor **R** has a peak at this value.

(i) Suggest the identity of the positive ion responsible for this peak at $m/e = 29$.

(1)

$C_2H_5^+$



(ii) Deduce the structural formulae of the three halogenoalkanes.

(3)

P Br

Q Br

R I

(Total for Question 2 = 7 marks)

Item: QC0419000007279

Examiner Comment

An interesting set of answers.

The significance of the cream rather than white precipitate soluble in concentrated ammonia solution has been missed in (b). So both Cl and Br have been given.

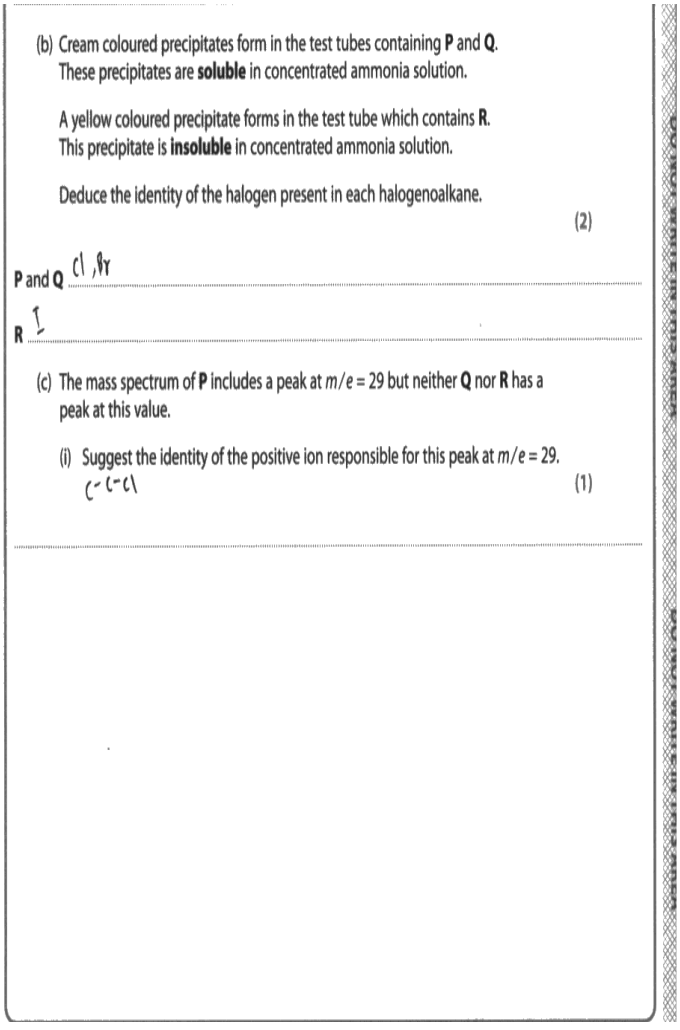
In (c)(i) the identity of the MS peak was unknown, though this fragment is straight from the specification.

In (c)(ii) there is a transferred error form both Cl and Br in (b).

Examiner Tip

The first error may be due to insufficient reading of the question but is more likely due to insufficient detailed knowledge of halogen chemistry, which needs to be thoroughly learned.

The second error could be limited by more practice is with mass spectra.



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A yellow coloured precipitate forms in the test tube which contains **R**.
This precipitate is **insoluble** in concentrated ammonia solution.

Deduce the identity of the halogen present in each halogenoalkane.

(2)

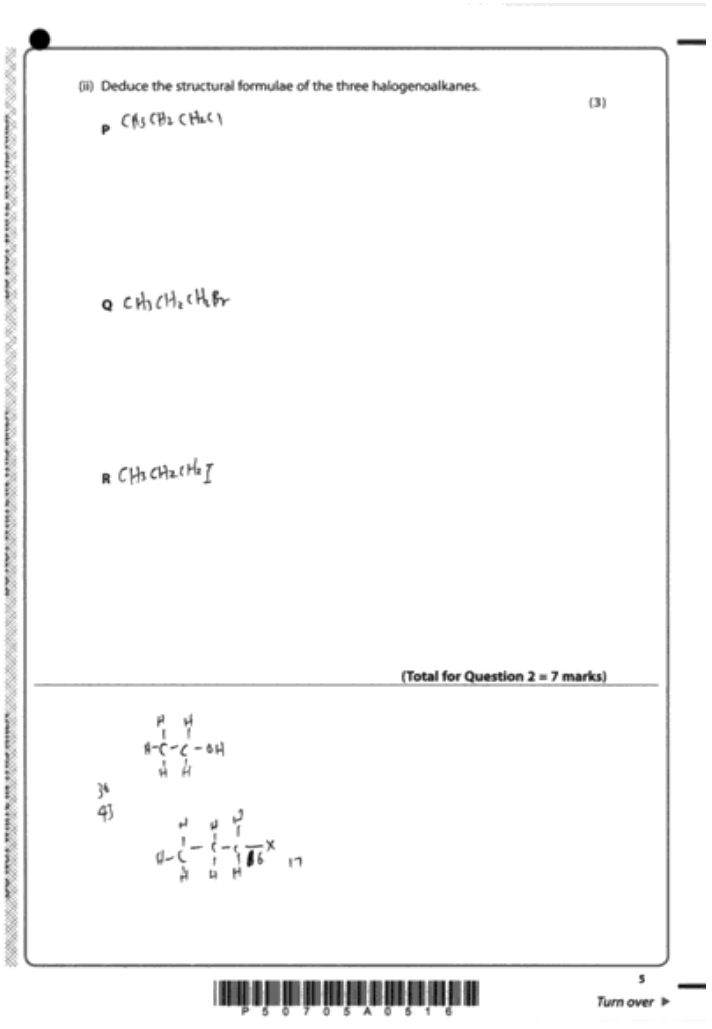
P and **Q** Cl, Br

R I

(c) The mass spectrum of **P** includes a peak at $m/e = 29$ but neither **Q** nor **R** has a peak at this value.

(i) Suggest the identity of the positive ion responsible for this peak at $m/e = 29$.

$C_2H_5^+$ (1)



(ii) Deduce the structural formulae of the three halogenoalkanes.

(3)

P $CH_3CH_2CH_2Cl$

Q $CH_3CH_2CH_2Br$

R $CH_3CH_2CH_2I$

(Total for Question 2 = 7 marks)

WCH03_01_Q03ai

Question Introduction

Many candidates struggled to find the indicator with the unusual context.
A surprising range of colour changes for starch were offered. The initial colour is definitely not purple.

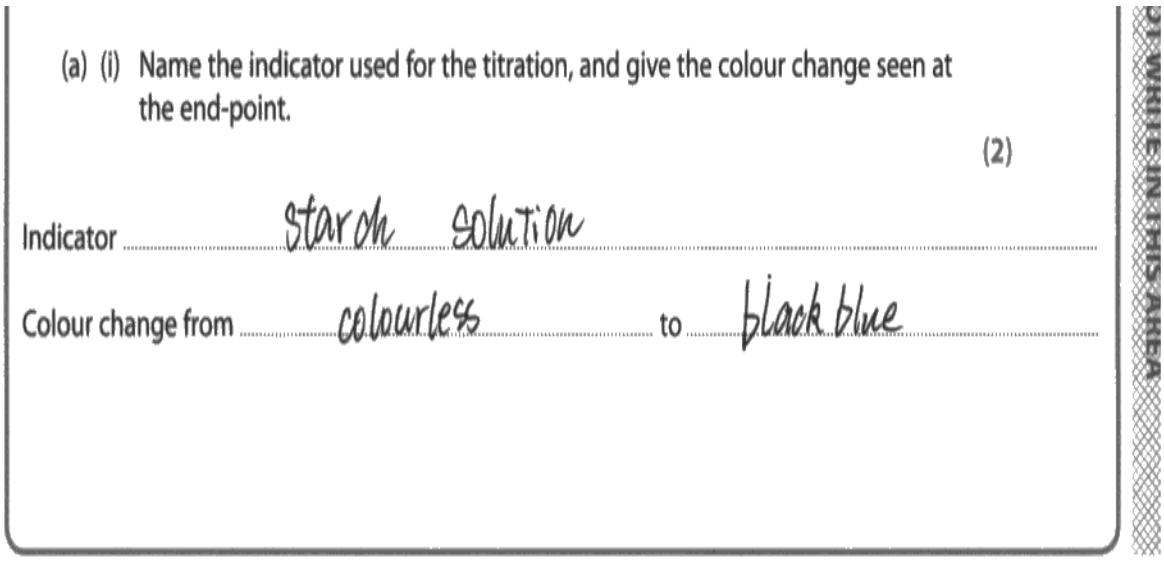
Item: QC0419000007290

Examiner Comment

This was the common error with the correct indicator here the colour change the wrong way round.

Examiner Tip

If titrating with thiosulfate, the initial colour is the blue colour of the starch iodine complex.



(a) (i) Name the indicator used for the titration, and give the colour change seen at the end-point.

(2)

Indicator starch solution

Colour change from colourless to black blue

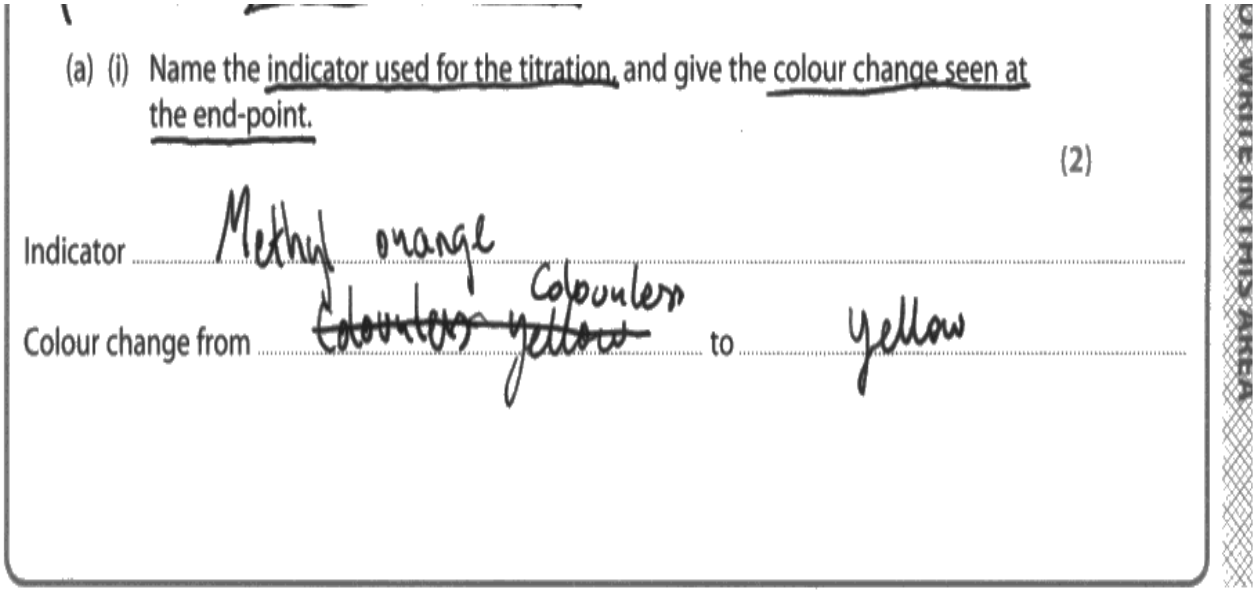
Item: QC0419000007315

Examiner Comment

An acid-alkali indicator was a very common incorrect response.

Examiner Tip

If iodine is involved, starch is the indicator.



(a) (i) Name the indicator used for the titration, and give the colour change seen at the end-point.

(2)

Indicator Methyl orange

Colour change from ~~Colourless yellow~~ Colourless to yellow

WCH03_01_Q03aii

Question Introduction

Item: QC0419000007274

Introduction

Though candidates may be observant when carrying out experiments, they seem unable to recall their observations.

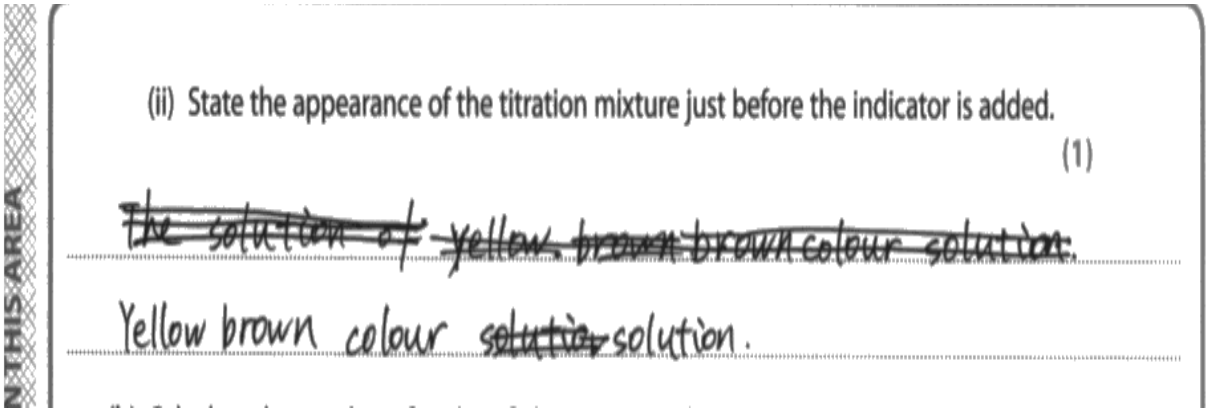
Here the freshly prepared starch solution is added when the colour of the mixture is very pale yellow.

Examiner Comment

This is almost correct, had it been 'pale yellow-brown' it would have been allowed.

Examiner Tip

When carrying out experiments, note all colour changes seen.



Item: QC0419000007276

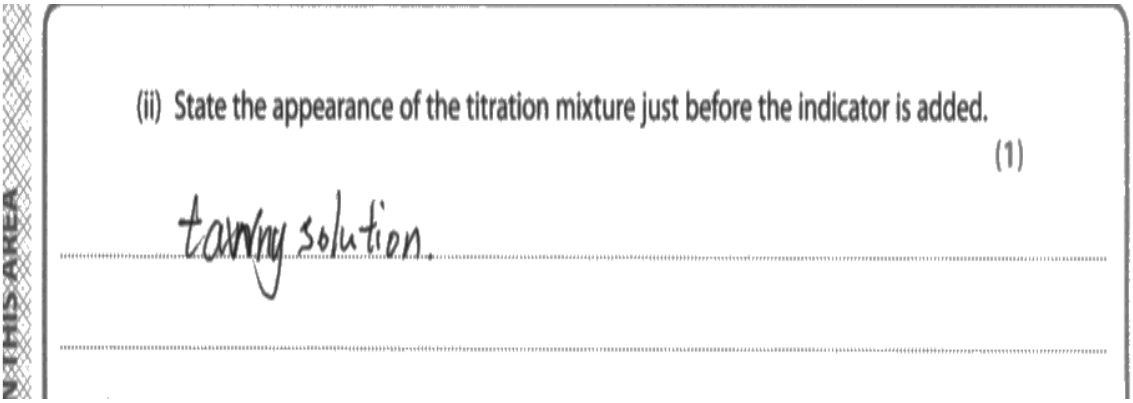
Introduction

Examiner Comment

The solution is not tawny.

Examiner Tip

Slowly dilute a solution of iodine until it becomes very pale yellow.



WCH03_01_Q03b-dii

Question Introduction

3b There were only a few candidates who failed to convert minutes to seconds in this calculation.

ci There were a surprising number of calculator errors here.

ii Only grade A candidates were able to eliminate both titrations 1 and 3 with the correct reason, that they were not concordant.

iii Very few candidates did not manage to find the mean of their titres.

iv Some very weak candidates multiplied the volume by omitted to divide by 1000.

v There was much confusion here in handling the dilution factor.

Many began a fresh calculation starting from 10 cm of sodium thiosulfate solution.

di This was very challenging. Candidates need more practice in balancing equations involving change in oxidation number.

ii Grade A candidates were able to recognise that the number of moles of thiosulfate ion was the same as the number of moles of electrons transferred (to form iodine).

Item: QC0419000007316

Introduction

These are a moderate candidate's responses.

Parts (b), (c)(i), (ii), and (iii) are fine.

In part (iv) the factor of 1000 has been omitted.

In part (v) the volume of 10 cm^3 has been used.

In part (d)(i) there has been some attempt to calculate oxidation numbers, but no sign of the change in oxidation number which would have led to the correct electron transfer.

In Part (d)(ii) the amount of thiosulfate has not been linked to the number of moles of electrons.

Examiner Tip

Practice titration calculations.

(b) Calculate the number of moles of electrons transferred from the iodide ions to form iodine in the experiment. Use the expression

$$\text{number of moles of electrons} = \frac{\text{current (A)} \times \text{time (s)}}{96\,500}$$

(1)

$= \frac{0.200 \times 900}{96500}$

$= 1.865 \times 10^{-3}$ mol.

(c) The total volume of solution in the volumetric flask is 100 cm³.

10.0 cm³ portions of the mixture are titrated with 0.0100 mol dm⁻³ sodium thiosulfate solution.

The results are given in the table below.

Titration number	1	2	3	4
Second reading / cm³	19.45	38.05	19.05	38.25
First reading / cm³	0.00	19.45	0.00	19.55
Titre / cm³	[illegible]	[illegible]	[illegible]	[illegible]
	19.45	18.6	19.05	18.7

(i) Complete the table.

(1)

(ii) Which result(s) should be discarded? Give a reason for your answer.

(2)

[illegible] titrate number 1 and 3 because they are not in concordant results

(iii) Calculate the mean titre for the remaining values.

(1)

$\frac{18.6 + 18.7}{2} = 18.65$ cm³

(iv) Calculate the number of moles of thiosulfate ions in this mean titre.

(1)

$n = cv$

$= 0.0100 \times 18.65$

$= 0.1865$ mol

(v) Calculate the number of moles of thiosulfate ions needed to react with the total amount of iodine in the 100 cm³ of solution in the flask.

(1)

[illegible] $n = cv = 0.0100 \times \frac{100}{1000} = 1 \times 10^{-3}$ mol

(d) (i) Complete the ionic half-equations for the oxidation of thiosulfate ions and the oxidation of iodide ions.

(2)

$2S_2O_3^{2-}(aq) + 2e^- \rightarrow S_4O_6^{2-}(aq)$

$2I^-(aq) + e^- \rightarrow I_2(aq)$

(ii) In part (b), you calculated the number of moles of electrons lost when the iodide ions are oxidised to form the amount of iodine in the flask.

In part (c)(v), you calculated the number of moles of thiosulfate ions required to reduce this iodine back to iodide ions.

Show that the results calculated from the two experiments are consistent with your ionic half-equations.

(1)

[illegible] have the same number of moles of thiosulfate ions.

Item: QC0419000007277

Examiner Comment

This is a fairly typical response from a good candidate.

The errors are in (c)(ii) where only the first titration is discarded with a valid reason.

Notice how transferred error marks are awarded in parts (iii) to (v).

In (d)(i) the second equation is correct. There is no sign that oxidation numbers have been calculated in order to find the change in oxidation number and hence the number of electrons transferred in the first equation.

dii is fine.

Examiner Tip

1 Only concordant titration values are included in a mean titre calculation

2 Write down oxidation numbers, calculate the total change in oxidation number, and then write down the number of electrons transferred to balance redox equations.

(b) Calculate the number of moles of electrons transferred from the iodide ions to form iodine in the experiment. Use the expression

$$\text{number of moles of electrons} = \frac{\text{current (A)} \times \text{time (s)}}{96\,500}$$

(1)

$$= \frac{0.200 \times (15 \times 60)}{96500} =$$

$$1.865 \times 10^{-3} \approx 1.87 \times 10^{-3} \text{ mol}$$

(c) The total volume of solution in the volumetric flask is 100 cm³.

10.0 cm³ portions of the mixture are titrated with 0.0100 mol dm⁻³ sodium thiosulfate solution.

The results are given in the table below.

Titration number	1	2	3	4
Second reading / cm³	19.45	38.05	19.05	38.25
First reading / cm³	0.00	19.45	0.00	19.55
Titre / cm³	19.45	18.60	19.05	18.70

(i) Complete the table.

(1)

(ii) Which result(s) should be discarded? Give a reason for your answer.

(2)

The first one (Titration number 1) 19.45 because it's a rough titration, it's done only to know the end point and when to add drop by drop. (and the difference between it and other values is more than 0.2)

(iii) Calculate the mean titre for the remaining values.

(1)

$$\frac{18.60 + 19.05 + 18.70}{3} = 18.78 \text{ cm}^3$$

(iv) Calculate the number of moles of thiosulfate ions in this mean titre.

(1)

number of moles = volume in dm^3 × concentration

$$\frac{18.78}{1000} \times 0.01 = 1.878 \times 10^{-4} \text{ mol}$$

(v) Calculate the number of moles of thiosulfate ions needed to react with the total amount of iodine in the 100 cm³ of solution in the flask.

(1)

$$(1.878 \times 10^{-4}) \times 10 = 1.878 \times 10^{-3} \text{ mol.}$$

(d) (i) Complete the ionic half-equations for the oxidation of thiosulfate ions and the oxidation of iodide ions.

(2)

~~+5e⁻~~ ~~2e⁻~~

$2S_2O_3^{2-}(aq) + \cancel{2e^-} \rightarrow S_4O_6^{2-}(aq)$

$1.5e^-$

$2I^-(aq) \pm 2 \rightarrow I_2(aq) + 2e^-$

(ii) In part (b), you calculated the number of moles of electrons lost when the iodide ions are oxidised to form the amount of iodine in the flask.

In part (c)(v), you calculated the number of moles of thiosulfate ions required to reduce this iodine back to iodide ions.

Show that the results calculated from the two experiments are consistent with your ionic half-equations.

(1)

The mole of ~~number~~ electrons lost is equal to the amount of thiosulfate ion needed to react with iodine, so same number of electrons accepted by the iodine to form iodide ions. $2e^-$ lost when $2I^-$ for I_2 and $2e^-$ is accepted by $2S_2O_3^{2-}$ to form $S_4O_6^{2-}$.

WCH03_01_Q03ei

Question Introduction

Two straightforward calculations, yet the modal mark was only one out of two. The common errors are shown in the examples.

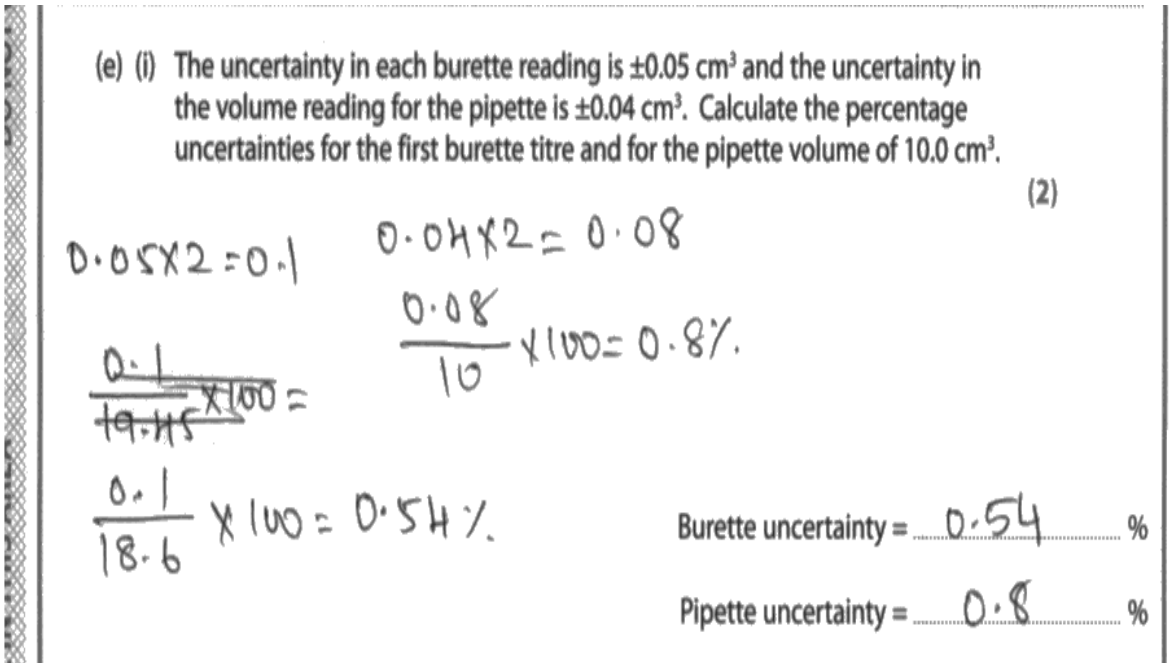
Item: QC0419000007286

Examiner Comment

This is an example of a calculator transcription error in the burette value, the working is correct, but 0.514 has been written as 0.54. This is followed by a common error; the pipette uncertainty has been doubled.

Examiner Tip

There is only one reading in using a pipette.



(e) (i) The uncertainty in each burette reading is ±0.05 cm^3 and the uncertainty in the volume reading for the pipette is ±0.04 cm^3. Calculate the percentage uncertainties for the first burette titre and for the pipette volume of 10.0 cm^3.

(2)

0.05X2 = 0.1

0.04X2 = 0.08

$\frac{0.1}{19.45} \times 100 =$

$\frac{0.08}{10} \times 100 = 0.8\%$

$\frac{0.1}{18.6} \times 100 = 0.54\%$

Burette uncertainty = 0.54 %

Pipette uncertainty = 0.8 %

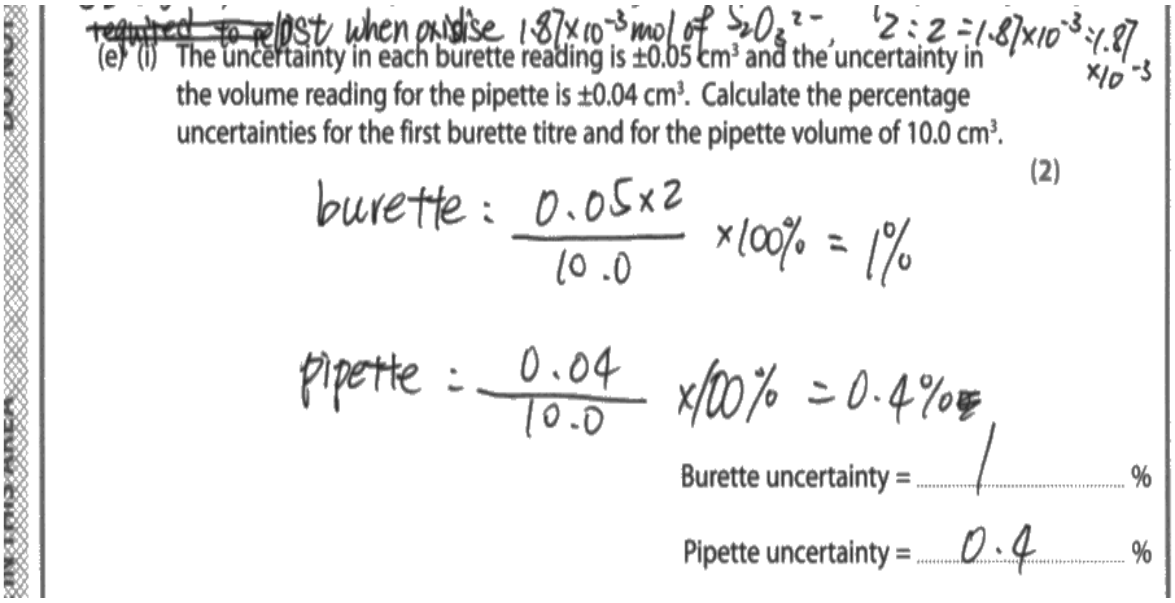
Item: QC0419000007290

Examiner Comment

Another common error is shown here; the burette reading is not 10 cm^3.

Examiner Tip

Read the question carefully, the 10 cm^3 refers to the pipette reading.



WCH03_01_Q03eii

Question Introduction

Though an unfamiliar question, better candidates successfully recognised that only a whole number ratio was needed so a tolerance of anything up to 10% was acceptable.

Item: QC0419000007315

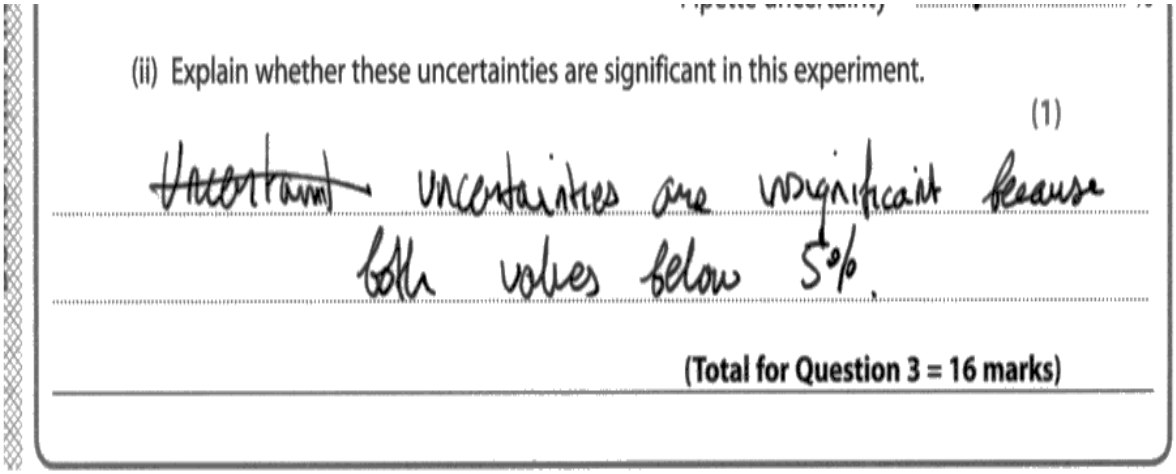
Examiner Comment

This answer is just allowed, it lacks development but is just sufficient.

Because a ratio is required there is quite a high tolerance for uncertainty.

Examiner Tip

Do not be afraid to offer your answer if you are not sure it is correct.



(ii) Explain whether these uncertainties are significant in this experiment.

(1)

~~Uncertainty~~ uncertainties are insignificant because both values below 5%.

(Total for Question 3 = 16 marks)

WCH03_01_Q04ai

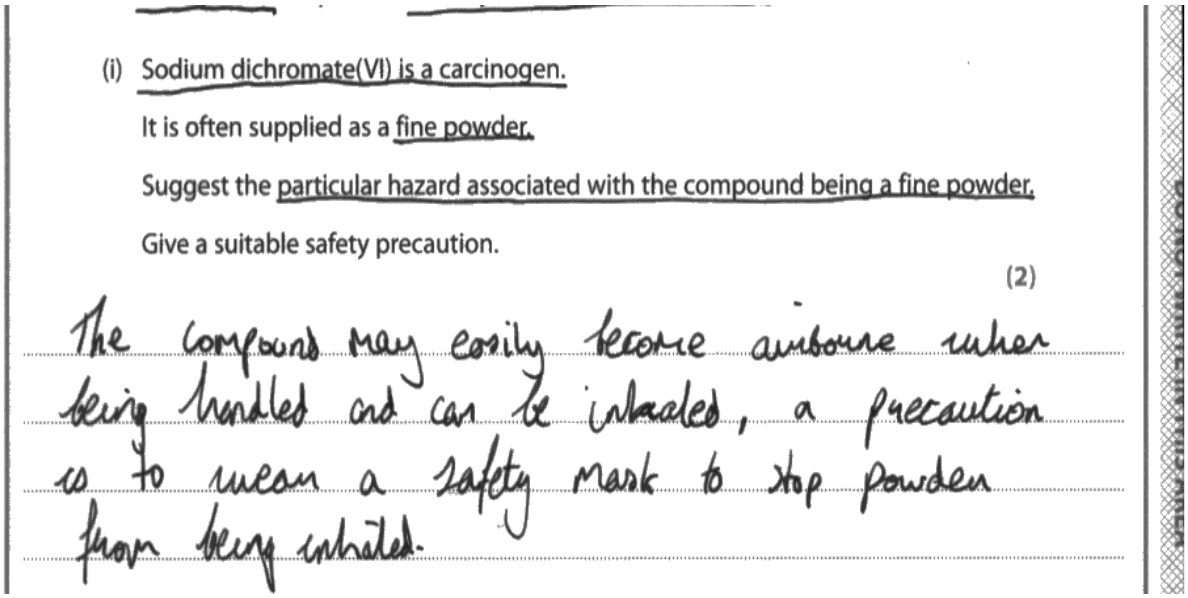
Question Introduction

Few candidates failed to say that a breathing mask was required.
Less realised that this was to prevent inhalation of the powder.

Item: QC0419000007315

Examiner Comment

This is a model answer to this question.



(i) Sodium dichromate(VI) is a carcinogen.

It is often supplied as a fine powder.

Suggest the particular hazard associated with the compound being a fine powder.

Give a suitable safety precaution.

(2)

The compound may easily become airborne when being handled and can be inhaled, a precaution is to wear a safety mask to stop powder from being inhaled.

WCH03_01_Q04aii

Question Introduction

This was an unfamiliar question which few candidates seemed to have considered.

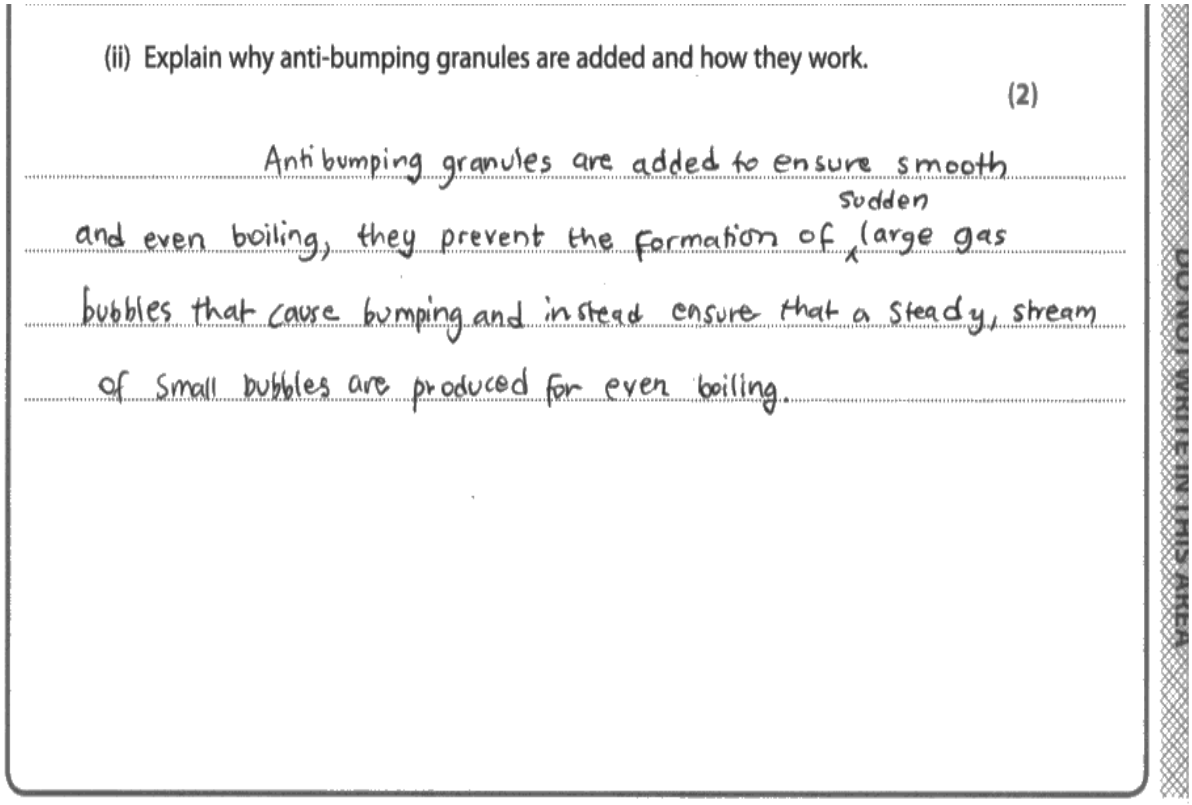
Organic mixtures bump because glassware is too smooth and clean! There are no fine scratches or dust particles present to assist small bubble formation, so there is a risk that a large bubble will form.

The anti-bump granules provide the rough surface needed to encourage small bubbles to form.

Item: QC0419000007617

Examiner Comment

An example of a good candidate's answer.



(ii) Explain why anti-bumping granules are added and how they work.

(2)

Anti bumping granules are added to ensure smooth and even boiling, they prevent the formation of ~~large~~ sudden large gas bubbles that cause bumping and instead ensure that a steady, stream of small bubbles are produced for even boiling.

DO NOT WRITE IN THIS AREA

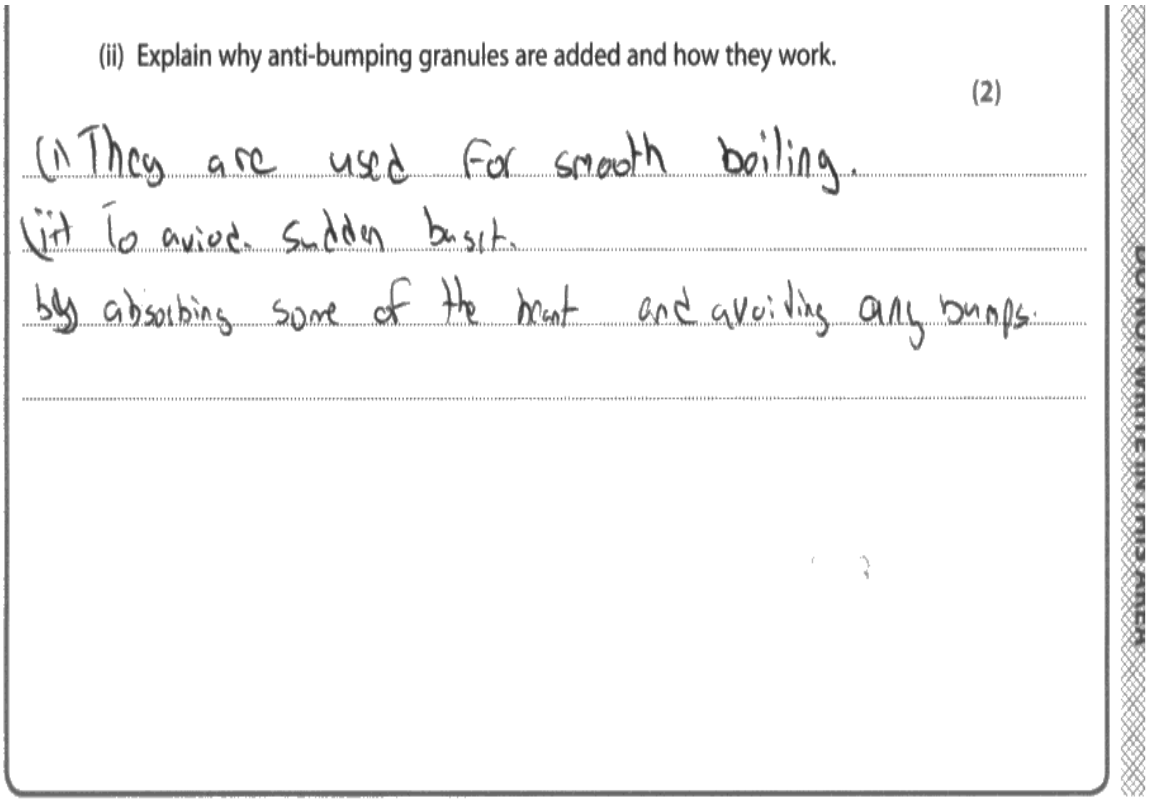
Item: QC0419000007317

Examiner Comment

The first point is just acceptable whilst the second is not sufficiently clear.

Examiner Tip

When carrying out practical work always try to answer the questions, 'why am I doing this?' and 'How does this work?'



(ii) Explain why anti-bumping granules are added and how they work.

(2)

(1) They are used for smooth boiling.

(1) to avoid sudden burst.

by absorbing some of the heat and avoiding any bumps.

WCH03_01_Q04aiii

Question Introduction

This is the first time this had been asked, replacing the usual 'draw a diagram…' It proved well beyond most of the candidates with a modal mark of zero out of three.

Yet, the question is perfectly reasonable as this is a technique the candidates will have used, if not with 'Quick-fit' apparatus, with similar apparatus with corks.

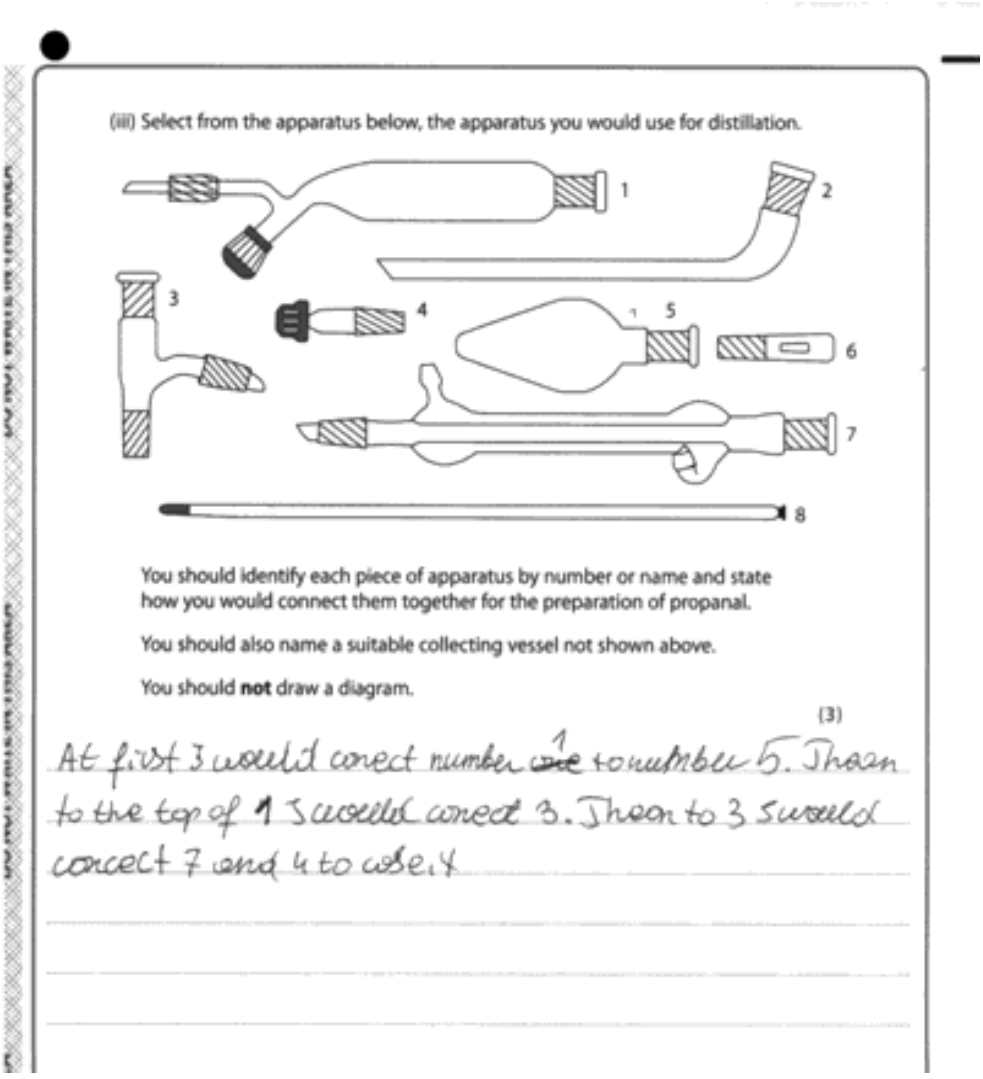
Item: QC0419000007270

Examiner Comment

This is a fairly typical response, gaining no credit. The connections do not make any sense.

Examiner Tip

Though a diagram was not required, a quick sketch of this set up would have been a useful check to see if it would work.



(iii) Select from the apparatus below, the apparatus you would use for distillation.

You should identify each piece of apparatus by number or name and state how you would connect them together for the preparation of propanal.

You should also name a suitable collecting vessel not shown above.

You should **not** draw a diagram.

(3)

At first I would corect number ~~one~~ 1 to number 5. Then to the top of 1 I would corect 3. Then to 3 I would corect 7 and 4 to use.4

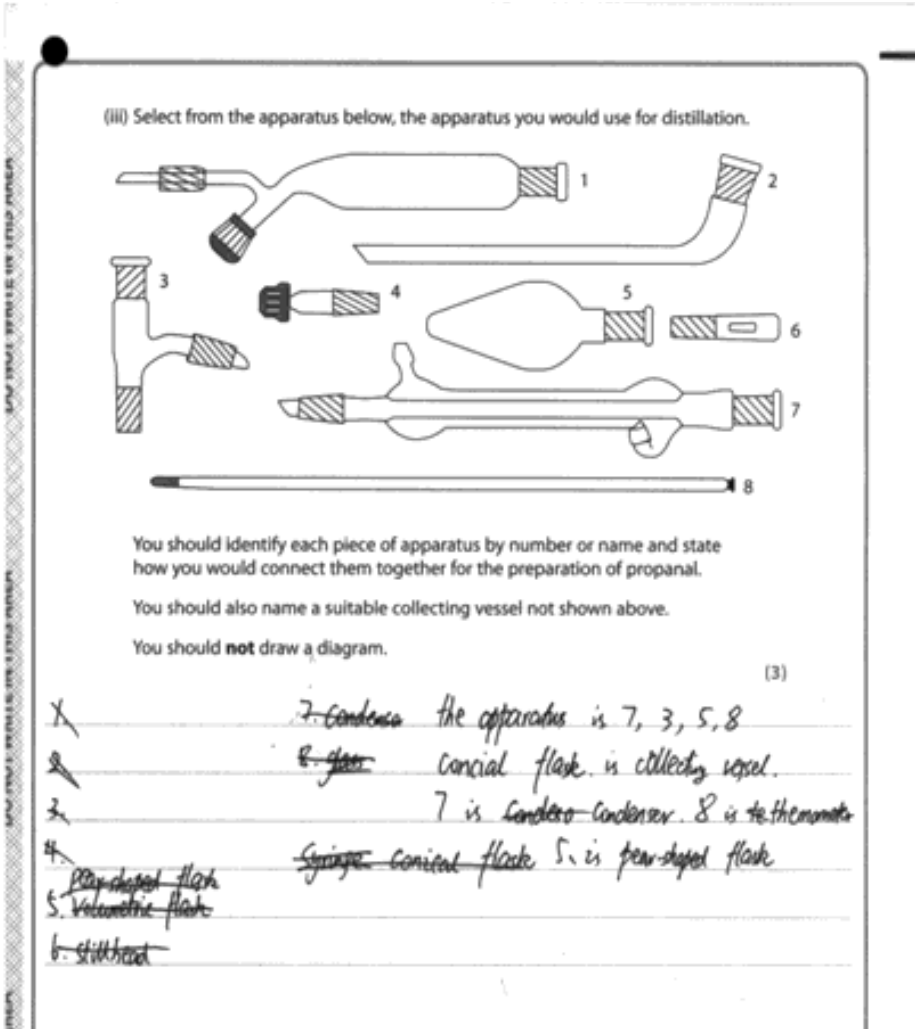
Item: QC0419000007296

Examiner Comment

This candidate has made the correct selection with the small omission of the thermometer holder. On this occasion this was allowed for one mark because of the unfamiliarity of the question type.

Examiner Tip

Always think about apparatus you are using and how items need to be connected.



(iii) Select from the apparatus below, the apparatus you would use for distillation.

You should identify each piece of apparatus by number or name and state how you would connect them together for the preparation of propanal.

You should also name a suitable collecting vessel not shown above.

You should **not** draw a diagram.

(3)

X 7. ~~Condenser~~ the apparatus is 7, 3, 5, 8
~~8. flask~~ conical flask is collecting vessel.
3 7 is ~~Condenser~~ Condenser. 8 is ~~the thermometer~~
4. ~~Syringe~~ ~~conical flask~~ 5. is ~~pear-shaped flask~~
~~pear-shaped flask~~
5. ~~Volumetric flask~~
6. ~~stillhead~~

WCH03_01_Q04bi

Question Introduction

Another less familiar question on the detail of a preparation in the specification.

Again the modal mark was zero.

Twice as much sodium dichromate(VI) is used and the acid is more concentrated to give stronger oxidizing conditions.

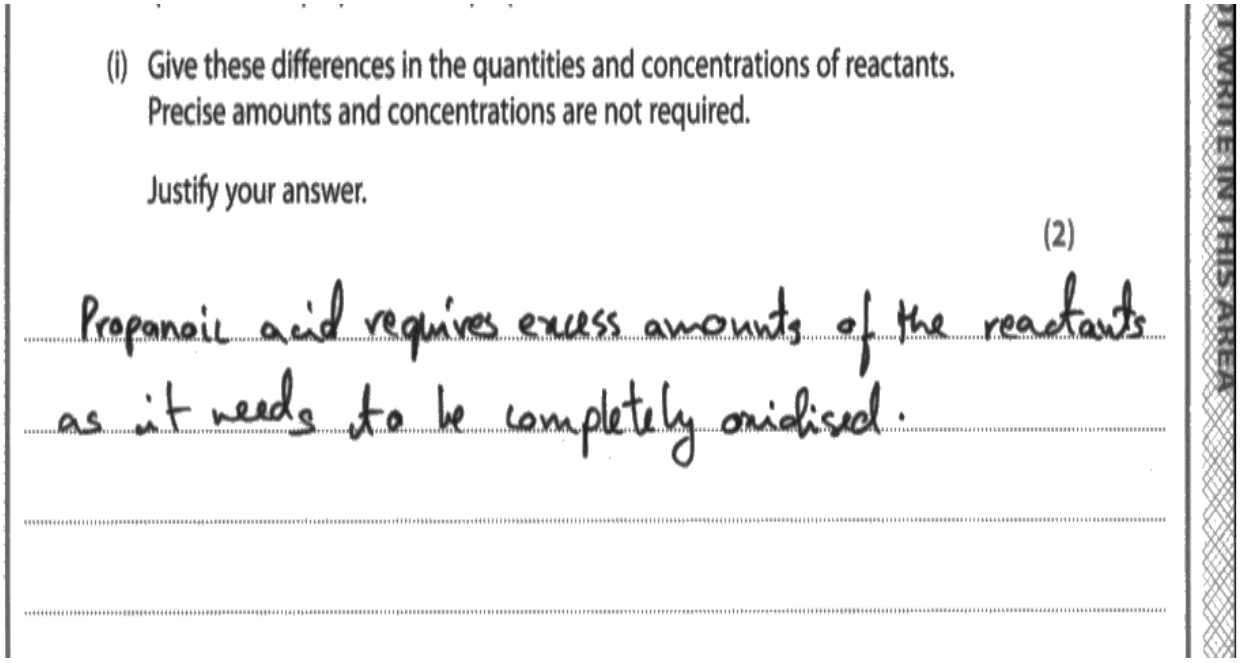
Item: QC0419000007284

Examiner Comment

This was a common error. An excess of all reactants misses the point. There must not be more of the alcohol.

Examiner Tip

Always consider which amounts are varied in reactions and the reasons for this.



(i) Give these differences in the quantities and concentrations of reactants.
Precise amounts and concentrations are not required.

Justify your answer.

(2)

Propanoic acid requires excess amounts of the reactants as it needs to be completely oxidised.

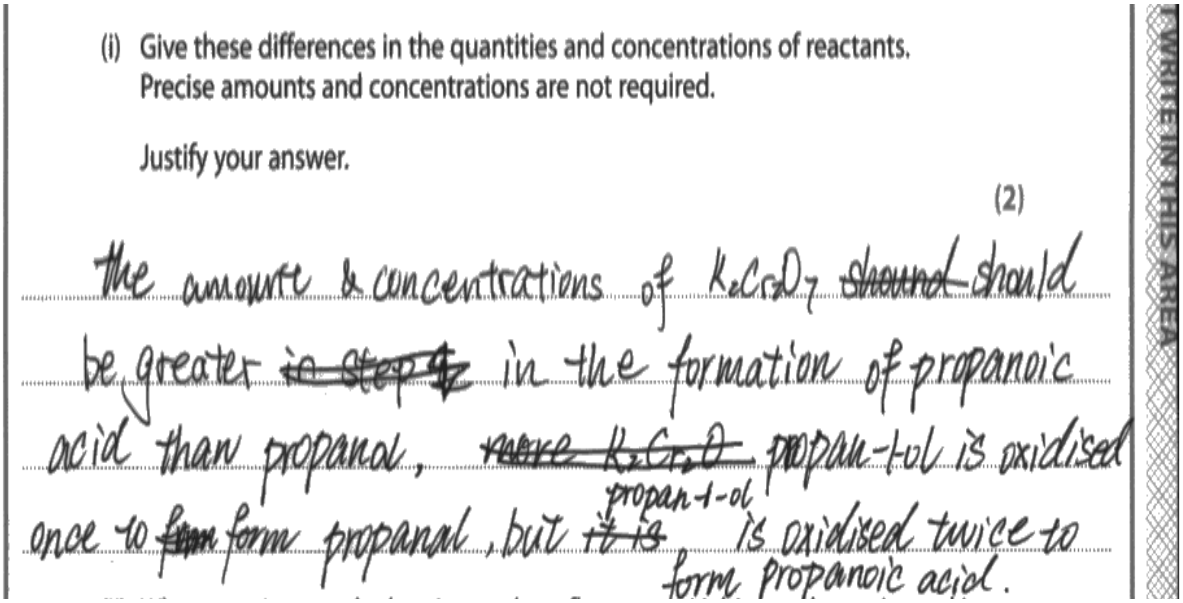
Item: QC0419000007290

Examiner Comment

The statement, about potassium dichromate(VI) are fine, but no mention is made of the sulfuric acid.

Examiner Tip

The concentration of the acid is more significant than the dichromate(VI) ion concentration because there are far more hydrogen ions in the ionic equation for this oxidation.



(i) Give these differences in the quantities and concentrations of reactants.
Precise amounts and concentrations are not required.

Justify your answer.

(2)

The amount & concentrations of $K_2Cr_2O_7$ ~~should~~ should be greater ~~in step 4~~ in the formation of propanoic acid than propanal, ~~more $K_2Cr_2O_7$~~ propan-1-ol is oxidised once to ~~form~~ form propanal, but ~~it is~~ propan-1-ol is oxidised twice to form propanoic acid.

WRITE IN THIS AREA

WCH03_01_Q04bii

Question Introduction

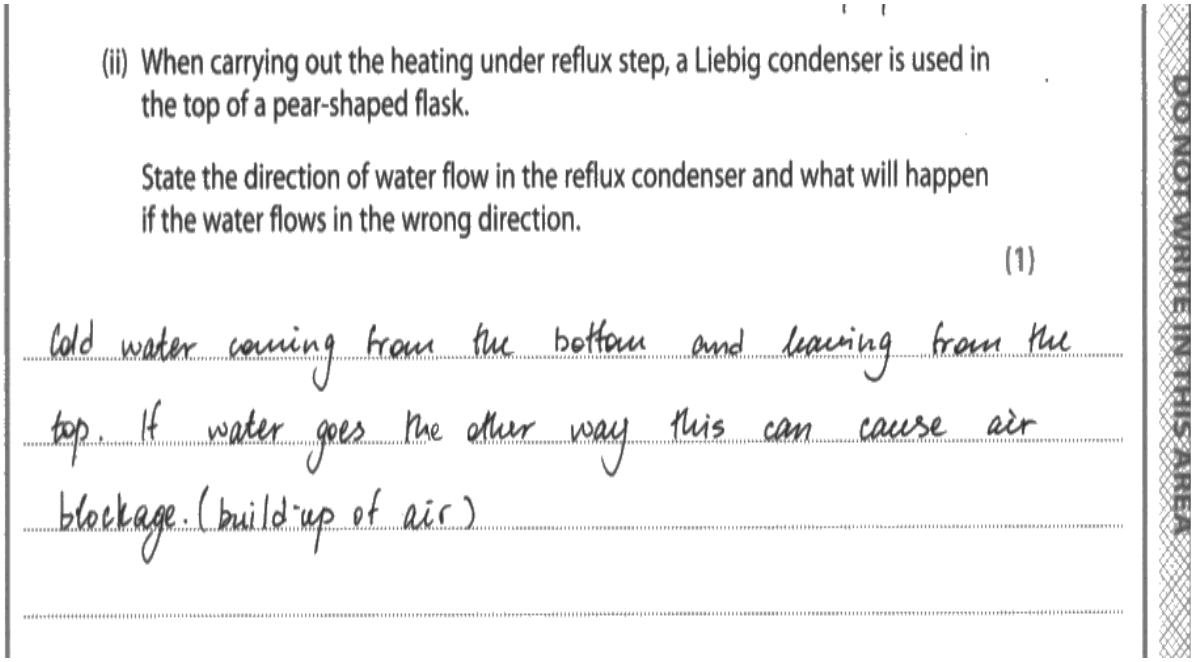
Though the direction of water flow was usually correct, the effect of wrong direction flow was often not known.

Some candidates gave the correct description of what would happen if the flow was incorrect but omitted to answer the question of which direction was correct.

Item: QC0419000007314

Examiner Comment

This was just sufficient detail to gain the mark.



(ii) When carrying out the heating under reflux step, a Liebig condenser is used in the top of a pear-shaped flask.

State the direction of water flow in the reflux condenser and what will happen if the water flows in the wrong direction.

(1)

Cold water coming from the bottom and leaving from the top. If water goes the other way this can cause air blockage. (build up of air)

DO NOT WRITE IN THIS AREA

WCH03_01_Q04biii

Question Introduction

This question had been asked before and was answered well by better candidates. The reason for using the condenser was more likely to be answered correctly.

Explaining how a condenser works was more demanding. The key was to state that the hot vapour was cooled by the cold surface and so condensed to a liquid and returned to the reaction flask.

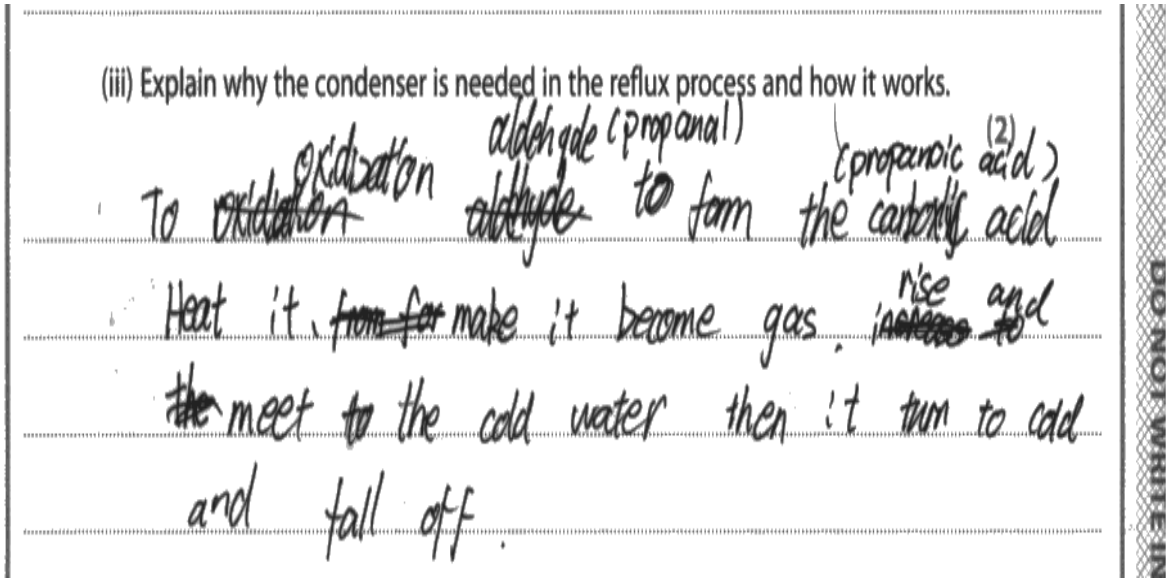
Item: QC0419000007283

Examiner Comment

This illustrates a common problem with many of the explanation answers in this paper. It is difficult to understand the candidates written English.

Examiner Tip

Practice writing explanations of why processes are used and how they work.



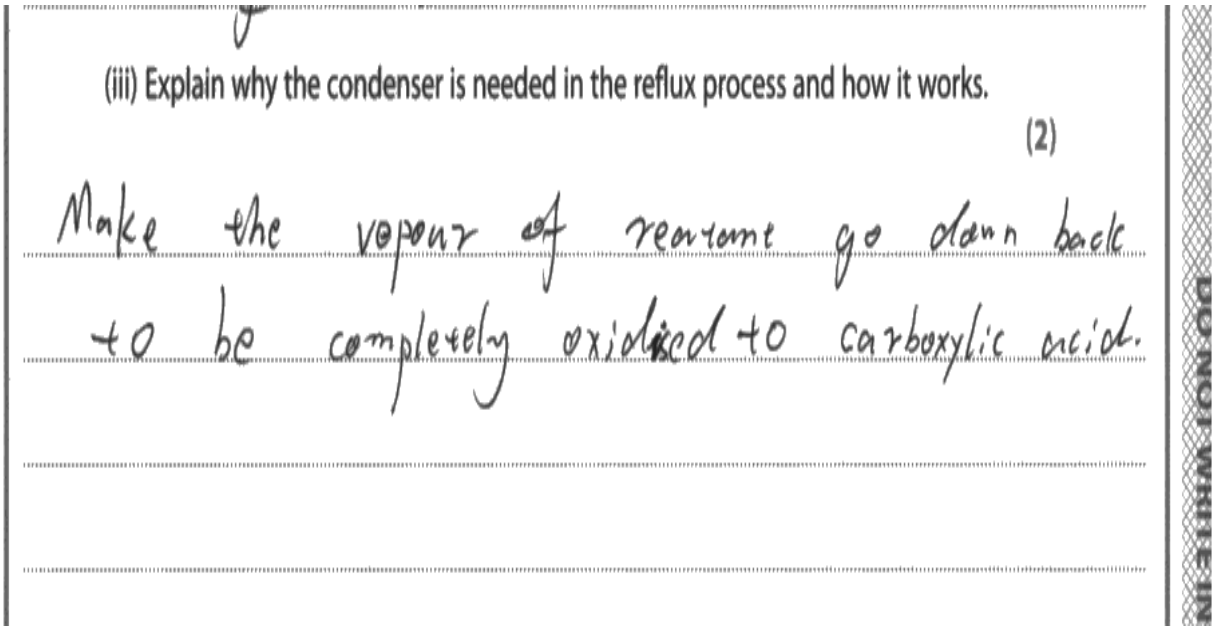
Item: QC0419000007291

Examiner Comment

This answer is on the limit of acceptability for the second mark only, though it really is a mixture of both points.

Examiner Tip

When a question contains two commands 'Why it is used' and 'How it works' both points need to be covered.



WCH03_01_Q04ci

Question Introduction

This seemed an unchallenging question when the paper was written but most candidates found it extremely difficult. Various colours were given. Some gave just 'clear liquid'.

WCH03_01_Q04cii

Question Introduction

It would seem to be standard practice to test the products of reactions in the specification in order to confirm their chemical identities.

But this element of practical work seems to be neglected by the candidates. The modal mark for this question was zero out of four.

Item: QC0419000007314

Examiner Comment

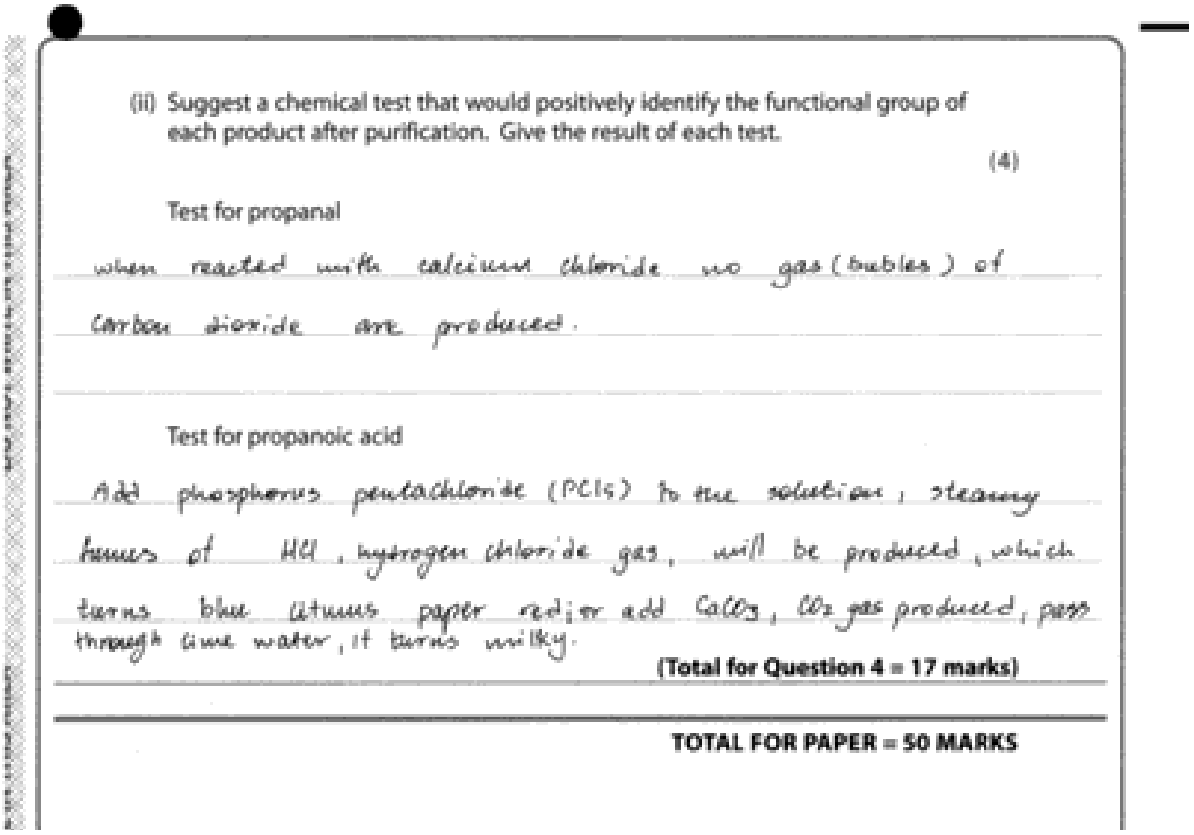
This an instructive answer.

The first test is incorrect; even if calcium carbonate had been used, rather than chloride, this is not a positive test for an aldehyde.

The general test for an O-H group would have gained one mark, because it is not specific to a carboxylic acid. However, the candidate then saves it with the correct test.

Examiner Tip

A positive test means a unique test for a functional group.



(ii) Suggest a chemical test that would positively identify the functional group of each product after purification. Give the result of each test.

(4)

Test for propanal

when reacted with calcium chloride no gas (bubles) of carbon dioxide are produced.

Test for propanoic acid

Add phosphorus pentachloride (PCl_5) to the solution, steamy fumes of HCl, hydrogen chloride gas, will be produced, which turns blue litmus paper red; or add $CaCO_3$, CO_2 gas produced, pass through lime water, it turns milky.

(Total for Question 4 = 17 marks)

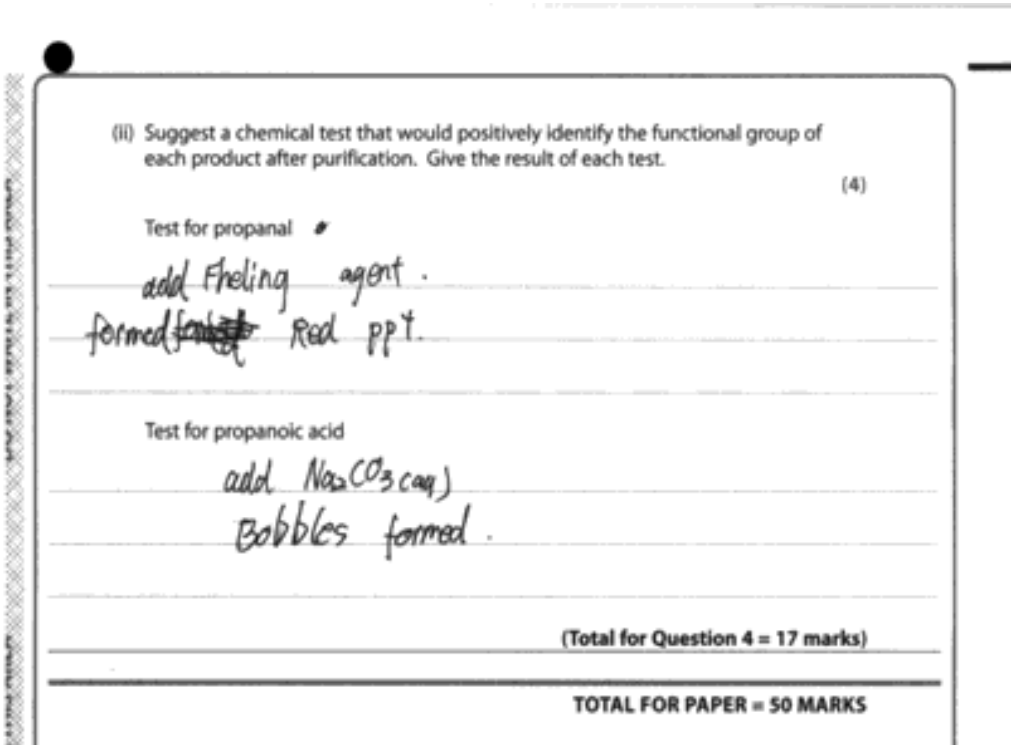
TOTAL FOR PAPER = 50 MARKS

Item: QC0419000007283

Examiner Comment

This candidate has covered the essential points, though the spelling of Fehling's is incorrect it is recognisable and this was not penalised on this occasion.

With practical work remember to learn a chemical test for each organic product or functional group.



(ii) Suggest a chemical test that would positively identify the functional group of each product after purification. Give the result of each test.

(4)

Test for propanal

add Fheling agent.

formed ~~[illegible]~~ Red ppt.

Test for propanoic acid

add Na_2CO_3 (aq)

Bobbles formed.

(Total for Question 4 = 17 marks)

TOTAL FOR PAPER = 50 MARKS

WCH03_01_Q1aiii-d

Question Introduction

The first two marks were easy for those who knew their flame colours.

The phrase 'some of it dissolved' in the stem implies the substance is partially soluble. As it forms a solution alkaline to phenolphthalein and contains two or more elements in the negative ion, it must be a hydroxide.

In (b)(i) and (c)(i) inclusion of spectator ions was penalised.

State symbol were required in (c)(ii).

Many candidates gave barium sulfate in (c)(i).

Surprisingly, many candidates gave the formula as SrOH/BaOH/CaOH in (d).

Some candidates need more practice writing formulae and equations.

Item: QC0419000007316

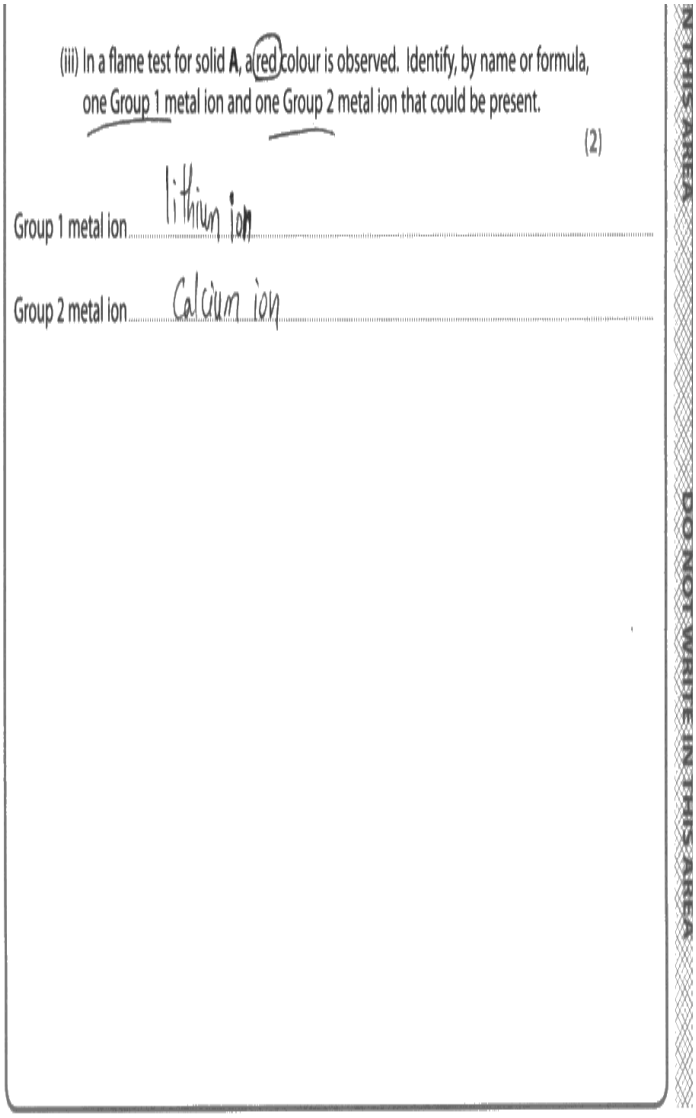
Examiner Comment

Li^+ is fine for the first mark. The second colour is not **brick** red, so this is not a calcium salt.

Full transferred error marks were still available, and were gained in (c)(i) and (ii). The rest is incorrect.

Examiner Tip

Learn the flame colours and test for ions thoroughly.



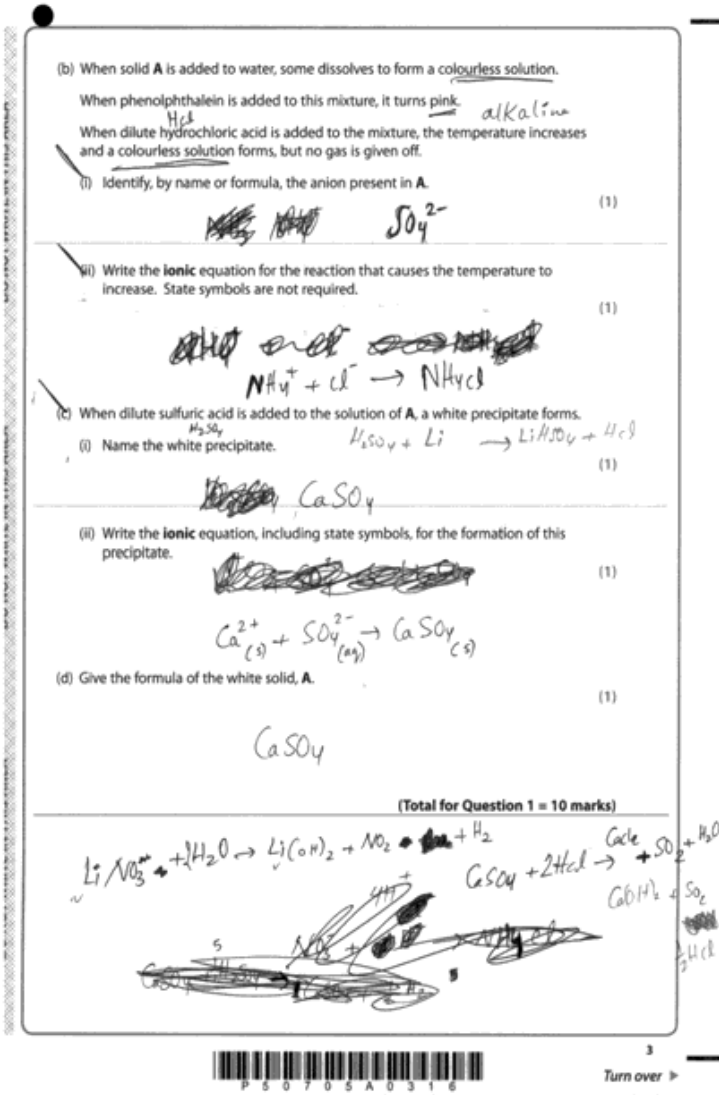
(iii) In a flame test for solid **A**, a red colour is observed. Identify, by name or formula, one Group 1 metal ion and one Group 2 metal ion that could be present.

(2)

Group 1 metal ion lithium ion

Group 2 metal ion Calcium ion

DO NOT WRITE IN THIS AREA



(b) When solid **A** is added to water, some dissolves to form a colourless solution.

When phenolphthalein is added to this mixture, it turns pink. alkaline

When dilute hydrochloric acid is added to the mixture, the temperature increases and a colourless solution forms, but no gas is given off.

(i) Identify, by name or formula, the anion present in **A**.

(1)

SO_4^{2-}

(ii) Write the **ionic** equation for the reaction that causes the temperature to increase. State symbols are not required.

(1)

$NH_4^+ + Cl^- \rightarrow NH_4Cl$

(c) When dilute sulfuric acid is added to the solution of **A**, a white precipitate forms.

(i) Name the white precipitate.

(1)

$CaSO_4$

(ii) Write the **ionic** equation, including state symbols, for the formation of this precipitate.

(1)

$Ca^{2+}_{(s)} + SO_4^{2-}_{(aq)} \rightarrow CaSO_{4(s)}$

(d) Give the formula of the white solid, **A**.

(1)

$CaSO_4$

(Total for Question 1 = 10 marks)

$Li^+ + H_2O \rightarrow Li(OH)_2 + NO_2 + H_2$

$CaSO_4 + 2HCl \rightarrow$

Item: QC0419000007314

Examiner Comment

The answer starts correctly with lithium and strontium, with the correct formulae for the ions.

Notice that if the formulae had been incorrect, this additional information would have been penalised.

Hydrogencarbonate ion is incorrect in (b)(i) for only some of **A** dissolves in water and hydrogen Carbonates are soluble.

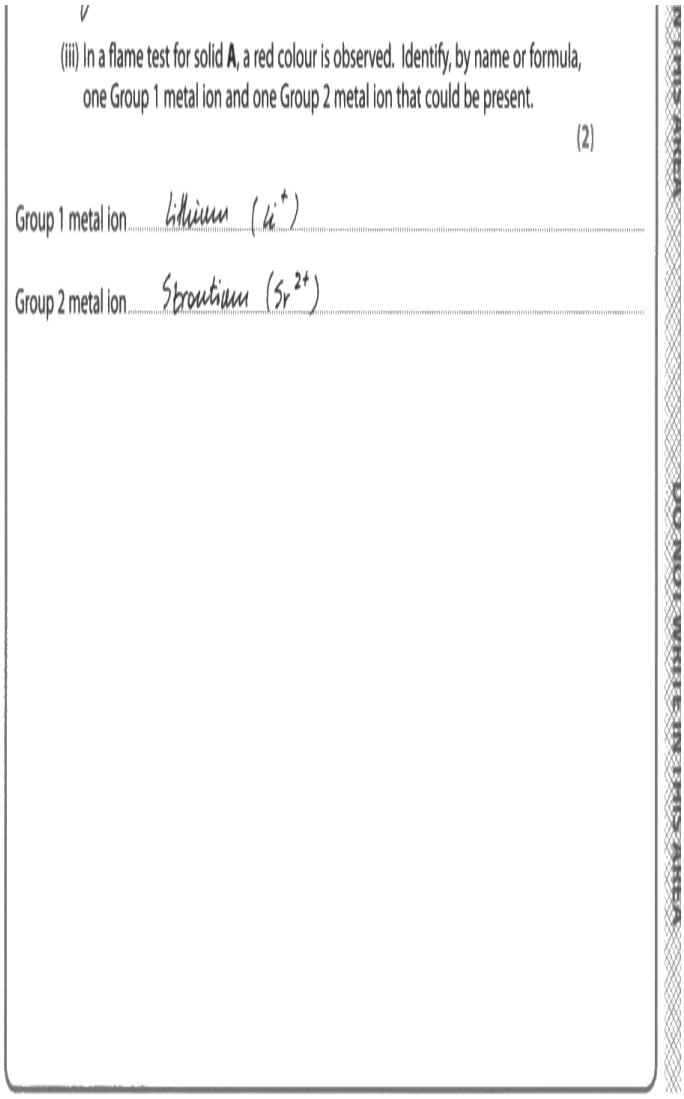
A transferred error mark was available in (b)(ii), but this is not given here as the carbonic acid would decompose in acid to give carbon dioxide.

(c)(i) is incorrect as the answer is strontium sulfate, but a transferred error is given for the correct equation for this ionic precipitationin (c)(ii).

A transferred error mark is not gained in (c)(iii) where $Ba(HCO_3)_2$ would have been allowed.

Examiner Tip

Always persevere with parts of a question, even if you thunk you may have made a mistake.

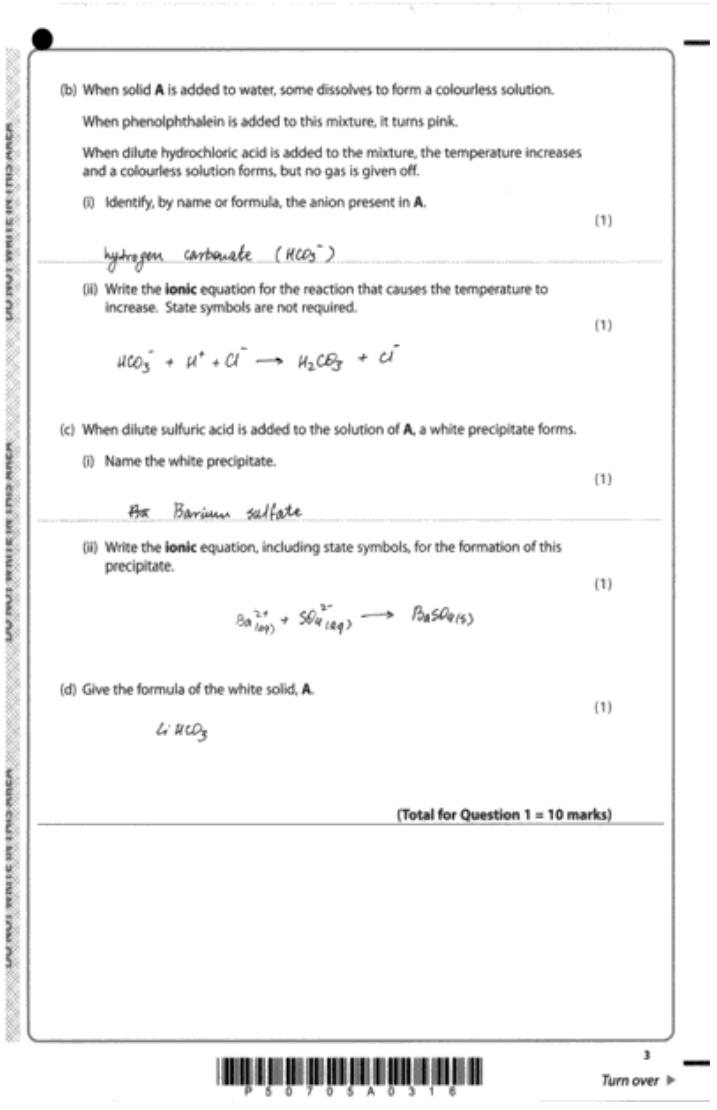


(iii) In a flame test for solid **A**, a red colour is observed. Identify, by name or formula, one Group 1 metal ion and one Group 2 metal ion that could be present.

(2)

Group 1 metal ion: Lithium (Li^+)

Group 2 metal ion: Strontium (Sr^{2+})



(b) When solid **A** is added to water, some dissolves to form a colourless solution.

When phenolphthalein is added to this mixture, it turns pink.

When dilute hydrochloric acid is added to the mixture, the temperature increases and a colourless solution forms, but no gas is given off.

(i) Identify, by name or formula, the anion present in **A**.

(1)

hydrogen carbonate (HCO_3^-)

(ii) Write the **ionic** equation for the reaction that causes the temperature to increase. State symbols are not required.

(1)

$HCO_3^- + H^+ + Cl^- \longrightarrow H_2CO_3 + Cl^-$

(c) When dilute sulfuric acid is added to the solution of **A**, a white precipitate forms.

(i) Name the white precipitate.

(1)

~~Ba~~ Barium sulfate

(ii) Write the **ionic** equation, including state symbols, for the formation of this precipitate.

(1)

$Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \longrightarrow BaSO_{4(s)}$

(d) Give the formula of the white solid, **A**.

(1)

Li_2HCO_3

(Total for Question 1 = 10 marks)

P 5 0 7 0 5 A 0 3 1 6

3

Turn over ▶

Paper Summary

To improve their performance candidates should learn:

- Details of chemicals and apparatus used
- Reasons for chemicals and apparatus used both why they are used and how they work.

For organic reactions candidates should learn:

- Names and formulae (all types – displayed, structural and skeletal) of all reactants and products
- Conditions for reactions and why they are needed
- Chemical tests for organic products
- Appropriate spectroscopic tests for functional groups.

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