ResultsPlus

edexcel

Examiners' Report
January 2013

GCE Chemistry 6CH07 01

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications come from Pearson, the world's leading learning company. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk for our BTEC qualifications.
Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

If you have any subject specific questions about this specification that require the help of a subject specialist, you can speak directly to the subject team at Pearson.
Their contact details can be found on this link: www.edexcel.com/teachingservices.

You can also use our online Ask the Expert service at www.edexcel.com/ask. You will need an Edexcel username and password to access this service. See the ResultsPlus section below on how to get these details if you don't have them already.

ResultsPlus

Giving you insight to inform next steps

ResultsPlus is Edexcel's free online service giving instant and detailed analysis of your students' exam results.

- See students' scores for every exam question.
- Understand how your students' performance compares with class and Edexcel national averages.
- Identify potential topics, skills and types of question where students may need to develop their learning further.

For more information on ResultsPlus, or to log in, visit www.edexcel.com/resultsplus. Your exams officer will be able to set up your ResultsPlus account in minutes via Edexcel Online.

Pearson: helping people progress, everywhere

Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for raising achievement through innovation in education.
Find out more about how we can help you and your students at: www.pearson.com/uk .

January 2013

Publications Code US034340

Introduction

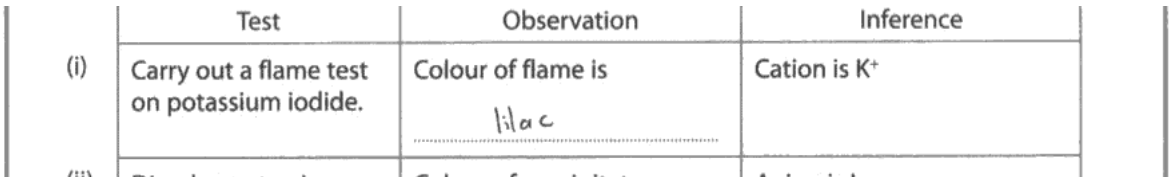
The standard and the layout of this exam paper were similar to that of previous series. All of the questions were accessible to at least some of the candidates and allowed all to achieve credit for the chemistry that they knew and understood. The questions provided scope for the whole ability range to be differentiated as it was intended. This was particularly evident in the numerical questions where the requirement for calculations discriminated effectively between candidates but did allow potential for all to gain at least some credit.

As has been mentioned previously the candidates often knew experimental procedures and the chemicals or apparatus but were rather unclear about why they were being used or what the reasons were behind them. This would be a good area for candidates to focus on in the future. There was little evidence of alternative answers being given for individual questions and so this advice given has been acted on which was pleasing to see.

In addition candidates should be reminded to double-check that their answers are addressing the task set. For example, there was evidence that the answer given was inappropriate for the question set but would have been suitable for any earlier step in the experimental procedure. Alternatively if there are multiple marks available for part of a question then the candidate needs to ensure that their answer includes multiple points.

Question 1 (a) (i)

This question was correctly answered with 'Lilac' by the vast majority of candidates. Alternative colours for lilac such as mauve, purple and violet, were allowed but rarely seen.



	Test	Observation	Inference
(i)	Carry out a flame test on potassium iodide.	Colour of flame is lilac	Cation is K^+

ResultsPlus
Examiner Comments

This type of question is very common and simply requires a one word answer as shown here.

ResultsPlus
Examiner Tip

If the flame colours are learnt well then more time can be spent on other questions which require more thought and consideration.

Question 1 (a) (ii)

A similar number of positive responses were seen as in part (i) which suggested that candidates knew the qualitative inorganic ion tests very well.

(ii)	Dissolve potassium iodide in water. Add dilute nitric acid followed by aqueous silver nitrate.	Colour of precipitate formed is yellow	Anion is I^-

ResultsPlus
Examiner Comments

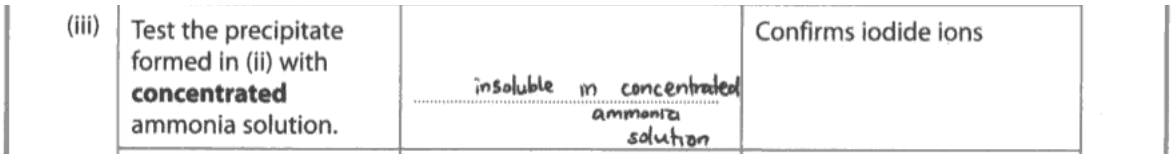
Only one word required and correctly given here.

ResultsPlus
Examiner Tip

The different colours of the silver halides are commonly examined and so in a similar way to the flame colours if these are well-learnt then more time can be better served on the more challenging questions.

Question 1 (a) (iii)

This was a slightly more testing question but the majority of candidates answered it correctly in a range of different ways as illustrated below.



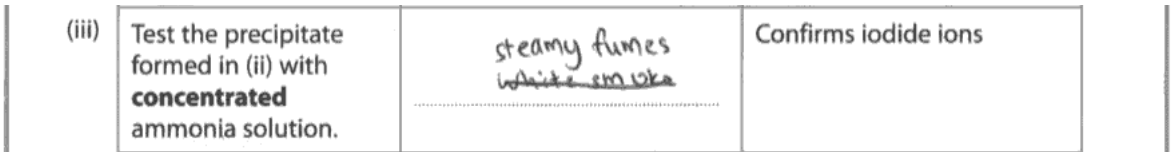
(iii)	Test the precipitate formed in (ii) with **concentrated** ammonia solution.	insoluble in concentrated ammonia solution	Confirms iodide ions

ResultsPlus
Examiner Comments

Just the word 'insoluble' would have been sufficient here as the single dotted line suggests.

ResultsPlus
Examiner Tip

Often the layout of the answer space gives good guidance as to the length of the answer required.



(iii)	Test the precipitate formed in (ii) with **concentrated** ammonia solution.	steamy fumes white smoke	Confirms iodide ions

ResultsPlus
Examiner Comments

This is clearly an incorrect answer as the candidate has written the observation for a different test.

ResultsPlus
Examiner Tip

Candidates should always double-check their answers to make sure that they are responding to the question set and not some other question.

Question 1 (a) (iv)

The two parts were marked independently in this question. Many correctly gave the colour of iodine in water and only a few gave the colour in an organic solvent. It was very rare to see the I_3^- species suggested as being responsible for the colour but I_2 was a very common answer, however, a minority appeared to have misread the question and gave the name rather than the formula as requested. A sizeable number suggested KCl as the coloured species which is a concern and is something that candidates should review since it is colourless in aqueous solution.

(iv)	Dissolve potassium iodide in water. Add 10 drops of aqueous chlorine solution.	Colour of solution formed is yellow	Formula of the coloured species is I_2

ResultsPlus
Examiner Comments

A good answer which scores both marks.

(iv)	Dissolve potassium iodide in water. Add 10 drops of aqueous chlorine solution.	Colour of solution formed is ~~pale yellow~~ purple ~~brown~~	Formula of the coloured species is ~~Cl~~ I_2

ResultsPlus
Examiner Comments

Unfortunately the colour of the solution formed is incorrect. The correct answer can be seen through the crossing-out but does not gain credit because it is replaced by an alternative answer which is incorrect. The formula of the coloured species is correct and since these responses are marked independently this candidate can be awarded one mark.

(iv)	Dissolve potassium iodide in water. Add 10 drops of aqueous chlorine solution.	Colour of solution formed is brown	Formula of the coloured species is iodine I_2

ResultsPlus
Examiner Comments

It is always important to answer the question asked. Here the candidate has placed a box around the requirement for a formula and presumably then crossed out the word 'iodine' and written the formula as requested. This will now gain the mark and with the correct colour results in both marks being awarded.

(iv)	Dissolve potassium iodide in water. Add 10 drops of aqueous chlorine solution.	Colour of solution formed is white .	Formula of the coloured species is

ResultsPlus
Examiner Comments

The colour of the solution is incorrect but no attempt is offered for the formula of the coloured species.

ResultsPlus
Examiner Tip

Candidates should always be encouraged to at least attempt all questions on the exam paper. There is no 'negative marking' and so an incorrect response here will not result in other marks being deducted.

Question 1 (a) (v)

The fact that there were two marks available to be awarded for this response and that there were a number of available lines for writing should have suggested that there were at least two points required in any answer to this question.

The two marks were for (i) the observation of 2 layers and for (ii) the colour of the upper hydrocarbon layer being purple. These points could be obtained separately but if both colour and a reference to layers were seen, then it had to be clear that the upper layer was the purple one. This should have been evident from the statement given that it was 'less dense than water'. Occasionally reference to 3 layers was seen but this was not credited.

(v) A hydrocarbon solvent, which is less dense than water, was added to the solution formed in test (iv). What would you expect to see in the test tube after the solvent has been added, the contents of the test tube vigorously shaken and left to stand for a few minutes?

(2)

There will be two layers present. The top layer would be purple in colour due to iodine dissolving in it. The bottom layer is colourless (potassium chloride solution), remains at bottom due to greater density of water.

ResultsPlus
Examiner Comments

A high quality answer where the candidate clearly states the two observations required.

ResultsPlus
Examiner Tip

Care is needed if additional information is given because if incorrect then it can negate the credit that would have been given for a correct answer.

(v) A hydrocarbon solvent, which is less dense than water, was added to the solution formed in test (iv). What would you expect to see in the test tube after the solvent has been added, the contents of the test tube vigorously shaken and left to stand for a few minutes?

(2)

Layers would be formed because both the ~~hydrocarbon solvent and the~~ solvents are immiscible. The top layer would be in ~~yellow~~ colour pale yellow colour meanwhile the bottom layer ~~water are immiscible. Thus, the top layer would be the hydrocarbon solvent~~ would be in purple. ~~meanwhile water would be the bottom layer.~~

ResultsPlus
Examiner Comments

This is an example where the correct reference is made to layers and the correct colour is given but since the bottom layer is given as purple this response only gains one mark.

(v) A hydrocarbon solvent, which is less dense than water, was added to the solution formed in test (iv). What would you expect to see in the test tube after the solvent has been added, the contents of the test tube vigorously shaken and left to stand for a few minutes?

(2)

Two layer because it does not dissolve in hydrocarbon solvent

ResultsPlus
Examiner Comments

Only one point is being made here and so only one mark can be awarded.

(v) A hydrocarbon solvent, which is less dense than water, was added to the solution formed in test (iv). What would you expect to see in the test tube after the solvent has been added, the contents of the test tube vigorously shaken and left to stand for a few minutes?

(2)

Since the hydrocarbon solvent is immiscible with water, after left to stand for a few minutes, there would be 2 layers formed, the hydrocarbon solvent layer being above the layer of water. The colour of the hydrocarbon solvent layer would be purple while the water layer would be yellowish-brown.

ResultsPlus
Examiner Comments

This is a fine response with both marks being made and awarded.

ResultsPlus
Examiner Tip

The use of separate sentences for each point can be effective in making it very clear exactly what is being referred to.

Question 1 (b) (i)

This was very well known by most candidates and so a high-scoring question. A very small minority did not give an indicator even though one was requested. It was still possible for these to gain credit in b(ii).

(i) Name the indicator that is used in thiosulfate/iodine titrations. (1)

Starch

ResultsPlus
Examiner Comments

The minimum required to gain the mark for this question.

(i) Name the indicator that is used in thiosulfate/iodine titrations. (1)

starch solution

ResultsPlus
Examiner Comments

Either 'starch solution' or 'starch indicator' was a common response as seen here but neither was essential to gain credit.

(i) Name the indicator that is used in thiosulfate/iodine titrations. (1)

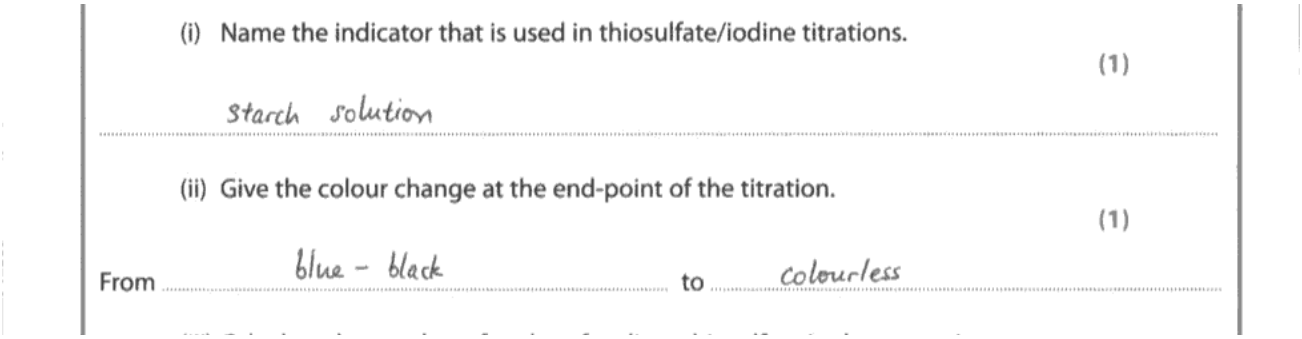
phenolphthalein.

ResultsPlus
Examiner Comments

This indicator is used for acid-base titrations and not for thiosulfate titrations. No credit could be awarded.

Question 1 (b) (ii)

The majority also got this question correct. It was pleasing to see that very few candidates used the word 'clear' which would have marked incorrect but rather correctly used the term 'colourless'. If no indicator was given in b(i) then the mark could be awarded for yellow/ brown to colourless but this was rarely seen.



(i) Name the indicator that is used in thiosulfate/iodine titrations. (1)

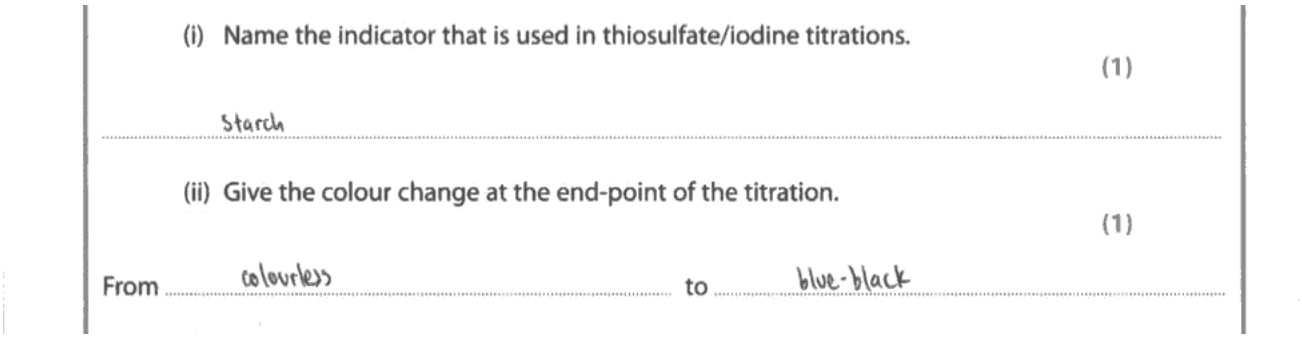
starch solution

(ii) Give the colour change at the end-point of the titration. (1)

From blue - black to colourless

ResultsPlus
Examiner Comments

Blue or black or a combination of the two, as seen here, which then goes colourless, was acceptable to gain the mark in this question.



(i) Name the indicator that is used in thiosulfate/iodine titrations. (1)

starch

(ii) Give the colour change at the end-point of the titration. (1)

From colourless to blue-black

ResultsPlus
Examiner Comments

Although these two colours are the correct ones, they are the wrong way round and so do not gain the mark.

ResultsPlus
Examiner Tip

Thiosulfate titrations are often described in exams and so the colour change with a starch indicator is well-worth remembering. Make sure you get absolutely clear which way round the colour change occurs.

Question 1 (b) (iii-vi)

This was the first calculation on the paper and generally provided a good spread of marks, thus allowing the more able to score highly and the less able to gain some credit. As in previous occasions the use of only 1 significant figure was penalised but any above that were credited. In addition, showing the working was not essential, and full marks could be gained simply from the correct answer alone. The errors seen in parts (iv) and (v) were those pertaining to the mole ratios. These are good areas for additional practice in exam preparation.

(iii) Calculate the number of moles of sodium thiosulfate in the mean titre.

(1)

45 cm^3 = 0.045 dm^3.

Number of mol = (0.100 mol dm^{-3})(0.045 dm^3)

= 0.0045 mol

(iv) Hence deduce the number of moles of iodine, I_2, which reacted with the number of moles of sodium thiosulfate calculated in (b)(iii).

(1)

$\frac{0.045 \text{ mol}}{2}$ = 0.0225 mol.

(v) How many moles of hydrogen ions, H^+, are required to produce the number of moles of iodine stated in (b)(iv)?

$$IO_3^-(aq) + 5I^-(aq) + 6H^+(aq) \rightarrow 3I_2(aq) + 3H_2O(l)$$

(1)

0.0225 mol × 2 = 0.045 mol.

(vi) Use your answer to (b)(v) to calculate the concentration of the hydrochloric acid in mol dm^{-3}.

(1)

30 cm^3 = 0.03 dm^3

Concentration = $\frac{\text{mol}}{dm^3}$

= $\frac{0.045 \text{ mol}}{0.03 \text{ } dm^3}$

= 1.5 mol dm^{-3}

ResultsPlus
Examiner Comments

Unfortunately the candidate has omitted a zero in their transferring of the answer from (iii) to (iv). This has resulted in a loss of one mark but the remaining marks can be awarded because the correct processing has been done. Hence this response scores 3 out of 4 for this question.

ResultsPlus
Examiner Tip

Candidates should always check and double-check their answers, particularly mathematical ones, as here a mark lost could easily have been avoided.

(iii) Calculate the number of moles of sodium thiosulfate in the mean titre. (1)

number of moles of sodium thiosulfate = $\frac{MV}{1000}$

= $\frac{(0.100)(45.00)}{1000}$

= 0.0045 moles.

(iv) Hence deduce the number of moles of iodine, I_2, which reacted with the number of moles of sodium thiosulfate calculated in (b)(iii). (1)

$I_{2(aq)} + 2S_2O_3^{2-}{}_{(aq)} \longrightarrow 2I^-{}_{(aq)} + S_4O_6^{2-}{}_{(aq)}$

2 moles $S_2O_3^{2-}$ = 1 mole I_2

0.0045 moles $S_2O_3^{2-}$ = $\frac{1}{2} \times 0.0045$

= 0.0025 moles I_2

(v) How many moles of hydrogen ions, H^+, are required to produce the number of moles of iodine stated in (b)(iv)? (1)

$IO_3^-(aq) + 5I^-(aq) + 6H^+(aq) \rightarrow 3I_2(aq) + 3H_2O(l)$

3 moles I_2 = 6 moles H^+

0.0025 moles I_2 = $\frac{6}{3} \times 0.0025$

= 0.005 moles H^+

(vi) Use your answer to (b)(v) to calculate the concentration of the hydrochloric acid in mol dm^{-3}. (1)

30 cm^3 hydrochloric acid –

ResultsPlus
Examiner Comments

This candidate has omitted a figure '2' from their answer as half of 0.0045 is 0.00225 and so one mark is lost. The mark for (v) was awarded for transferred error since the correct manipulation was carried out. No real attempt is made at (vi) and so 2 marks out of 4 were gained by this candidate.

ResultsPlus
Examiner Tip

Another reminder to illustrate the need to even triple-check calculations!

(iii) Calculate the number of moles of sodium thiosulfate in the mean titre.

(1)

$\frac{45.00}{1000} \times 0.100 \text{ mol} = 4.5 \times 10^{-3} \text{ moles of sodium thiosulfate}$

(iv) Hence deduce the number of moles of iodine, I_2, which reacted with the number of moles of sodium thiosulfate calculated in (b)(iii).

(1)

mole ratio of $I_2 : S_2O_3^{2-} = 1 : 2$

so $\frac{1}{2} \times 4.5 \times 10^{-3}$ moles $= 2.25 \times 10^{-3}$ moles of I_2.

(v) How many moles of hydrogen ions, H^+, are required to produce the number of moles of iodine stated in (b)(iv)?

$$IO_3^-(aq) + 5I^-(aq) + 6H^+(aq) \rightarrow 3I_2(aq) + 3H_2O(l)$$

(1)

mole ratio of $H^+ : I_2 = 6 : 3 = 2 : 1$

$2 \times 2.25 \times 10^{-3}$ moles $= 4.5 \times 10^{-3}$ moles of H^+

(vi) Use your answer to (b)(v) to calculate the concentration of the hydrochloric acid in mol dm^{-3}.

(1)

$\frac{4.5 \times 10^{-3} \text{ mol}}{30 \times 10^{-3} \text{ dm}^3} = 0.15 \text{ mol dm}^{-3}$

ResultsPlus

Examiner Comments

This is a fine example of how to answer a question of this type, with all of the working clearly shown and coherent.

Question 1 (c)

Many candidates struggled with this question and a wide range of possible answers were suggested. It could have been balanced either by the use of oxidation numbers or by a consideration of charge.

(c) Complete the half-equation showing the reduction of iodate(V) ions in acidic solution.

(1)

$IO_3^-(aq) + 6H^+(aq) + \underline{5}\,e^- \rightarrow \frac{1}{2} I_2(aq) + 3H_2O(l)$

(Total for Question 1 = 14 marks)

ResultsPlus
Examiner Comments

This is all that is required and one mark awarded.

(c) Complete the half-equation showing the reduction of iodate(V) ions in acidic solution.

(1)

$\overset{+5}{IO_3^-}(aq) + 6H^+(aq) + \underline{5}\,e^- \rightarrow \frac{1}{2} \overset{0}{I_2}(aq) + 3H_2O(l)$

(Total for Question 1 = 14 marks)

ResultsPlus
Examiner Comments

This candidate has used oxidation numbers to determine the number of electrons required. Clearly the iodine oxidation number is shown to go from +5 to 0 and so the correct answer of 5 electrons is deduced.

ResultsPlus
Examiner Tip

Working is not essential and in a question like this where there is only one mark available it will not gain any credit. However in longer questions it can be beneficial to shown working in case the final answer is incorrect and then some credit can be awarded for the working.

Question 2 (a) (i)

This question simply required the candidate to make use of the information given to them above. It was a high scoring question and the vast majority were able to correctly state a suitable wavenumber range for the OH group.

(a) (i) Give the wavenumber range of the absorption in the infrared spectrum that shows that compound **S** is an alcohol.

(1)

3500 - 3200 cm^{-1}

ResultsPlus
Examiner Comments

A correct range is given here within the full range that is possible and that would have gained credit.

(a) (i) Give the wavenumber range of the absorption in the infrared spectrum that shows that compound **S** is an alcohol.

(1)

~~3750 - 3200~~ ~~3200 - 3100~~ 3650 - 3100

ResultsPlus
Examiner Comments

This range does not gain any credit because it goes beyond the acceptable range of 3750 - 3200. All parts of the range given must be within the quoted range that was given above in the question.

(a) (i) Give the wavenumber range of the absorption in the infrared spectrum that shows that compound **S** is an alcohol.

(1)

3750 - 3200 cm^{-1}

ResultsPlus
Examiner Comments

Units were not required for the mark to be awarded but it was pleasing to see them correctly given as here.

Question 2 (a) (ii)

Candidates are reminded to make sure that they read the question carefully because a sizeable number of candidates wrote the name of the specific molecule, instead of giving the **type** of organic molecule as requested.

(ii) Identify the type of organic compound formed in the reaction of **S** with phosphorus(V) chloride, PCl_5.

(1)

2-chloropropane .

ResultsPlus
Examiner Comments

This answer gives the organic compound formed and not the **type** of organic compound and hence does not score the mark.

ResultsPlus
Examiner Tip

Make sure that the question answered is the one asked.

(ii) Identify the type of organic compound formed in the reaction of **S** with phosphorus(V) chloride, PCl_5.

(1)

~~2-Chloropropane~~
~~Chloroalkane~~ , ~~C_3H_7Cl~~ Chloroalkane, 2-chloropropane

ResultsPlus
Examiner Comments

Fortunately this candidate has given the **type** of organic molecule as well as the actual organic molecule. In this case the type is given and so gains the mark.

ResultsPlus
Examiner Tip

Remember if you give more information in your answer, such as above, it must also be correct.

Question 2 (b)

Similar to part (a) above in that the wording of the question must be carefully noted in order to gain credit.

This particular question stated 'from this information **alone**' and notice that the word '**alone**' was in bold for emphasis. Hence credit was given for the candidate responses which only used the information given in this part of the question as illustrated below.

(b) Compound **T** does not produce carbon dioxide when added to a solution of sodium carbonate.

From this information **alone**, what can you deduce about compound **T**?

(1)

It is not an acid.

ResultsPlus
Examiner Comments

This is the minimum required to gain the mark.

(b) Compound **T** does not produce carbon dioxide when added to a solution of sodium carbonate.

From this information **alone**, what can you deduce about compound **T**?

(1)

Compound T do not react with sodium carbonate.

ResultsPlus
Examiner Comments

While this is technically correct it is not going far enough to gain any credit. It does not address the reason why compound T does not react with sodium carbonate.

(b) Compound **T** does not produce carbon dioxide when added to a solution of sodium carbonate.

From this information **alone**, what can you deduce about compound **T**?

(1)

Compound T is a ketone and cannot be oxidised any further.

ResultsPlus
Examiner Comments

This is an example where the candidate is using information given in other parts of the question to deduce about the chemical nature of compound T and so does not score.

ResultsPlus
Examiner Tip

Make sure that the answer given only uses the particular information provided.

Question 2 (c) (i)

This question was similar to Q2a(i) in that a wavenumber range was requested and a large proportion of candidates also got their answer correct. Although a range was asked for in the question if a single wavenumber was given, as long as the value was within the acceptable answer then the mark was awarded.

(i) Give the wavenumber range of the absorption in the infrared spectrum that shows that compound **T** is formed from a **secondary** alcohol.

(1)

1680 – 1720 cm^{-1}

ResultsPlus
Examiner Comments

The range could be given either way round. In this example the lower wavenumber was given first. The range is an acceptable answer and so scores the mark.

(i) Give the wavenumber range of the absorption in the infrared spectrum that shows that compound **T** is formed from a **secondary** alcohol.

(1)

1720 - 1680

ResultsPlus
Examiner Comments

As stated for Q2a(i) the wavenumber range for Q2c(i) did not require units and so this answer was awarded the mark.

(i) Give the wavenumber range of the absorption in the infrared spectrum that shows that compound **T** is formed from a **secondary** alcohol.

(1)

1720 - 1700 cm^{-1}

ResultsPlus
Examiner Comments

The quoted information in the question gave the expected wavenumber range as 1720 - 1680 but any values within this range were acceptable. Hence this answer was acceptable and scored the mark.

(i) Give the wavenumber range of the absorption in the infrared spectrum that shows that compound **T** is formed from a **secondary** alcohol.

(1)

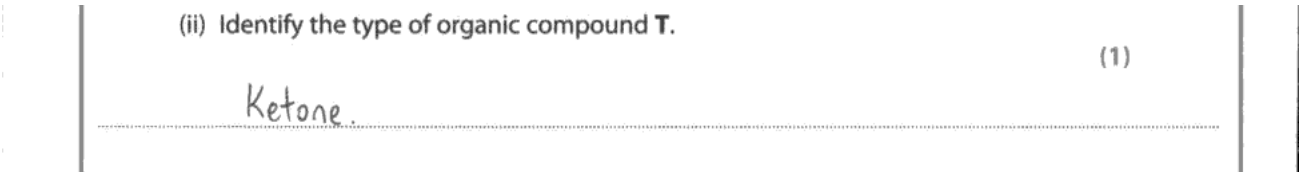
~~1720 cm^{-1}~~ 1710 cm^{-1}

ResultsPlus
Examiner Comments

This is an example of an answer where a single value was given and because the value was within the acceptable range the mark could be awarded.

Question 2 (c) (ii)

Many candidates successfully answered this question and stated the type of organic molecule of compound T. It was rare to see the actual molecule, propanone, given for this question and if it was the only answer then no mark would have been awarded. If the type of molecule had been given as well then the mark could be gained.


(ii) Identify the type of organic compound **T**.

(1)

Ketone.

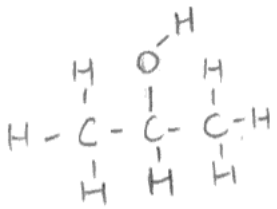
ResultsPlus
Examiner Comments

An example of a clearly written correct answer.

Question 2 (c) (iii)

This question was a good discriminator for the more able since they could correctly answer this question. A wide range of formulae were given as some candidates struggled with skeletal formulae. It was fairly common to see the OH group incorrectly placed at the end of the carbon chain.

(iii) Draw the **skeletal** formula for **S**. (1)



ResultsPlus
Examiner Comments

This is a formula for compound S but the displayed formula and the question specifically asks for the skeletal formula. Hence this does not score.

(iii) Draw the **skeletal** formula for **S**. (1)

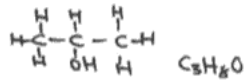
ResultsPlus
Examiner Comments

This is a clear and correct skeletal formula for compound S. Note that the bond to the OH group is to the oxygen as it should be. It would be good if all candidates had taken more care with this.

(iii) Draw the **skeletal** formula for **S**. secondary alcohol

(1)

structural:



C_5H_8O

Skeletal:

ResultsPlus
Examiner Comments

Any displayed or structural formulae were ignored and viewed as 'workings' if the skeletal formula was correctly given.

ResultsPlus
Examiner Tip

Take care to clearly label your answer. In this example the skeletal formula is correctly given as requested.

Question 2 (d) (i)

The majority of candidates correctly answered this question and seemed to know well how to associate the colour of the precipitate formed with silver nitrate, to the correct silver halide.

(d) Liquid **X** gives a white precipitate, **R**, on warming with an aqueous ethanolic solution of silver nitrate.

(i) Identify **R** by name or formula.

(1)

AgCl.

ResultsPlus
Examiner Comments

The formula alone was a suitable response as correctly given here.

(d) Liquid **X** gives a white precipitate, **R**, on warming with an aqueous ethanolic solution of silver nitrate.

(i) Identify **R** by name or formula.

(1)

Silver chloride.

ResultsPlus
Examiner Comments

Alternatively the name could be given as correctly stated here.

(d) Liquid **X** gives a white precipitate, **R**, on warming with an aqueous ethanolic solution of silver nitrate.

(i) Identify **R** by name or formula.

(1)

silver chloride / AgCl (s)

ResultsPlus
Examiner Comments

If two answers are given then both must be correct for the mark to be awarded. Fortunately for this candidate both answers are correct and the mark was given.

Question 2 (d) (ii)

It would seem that this question addressed one of the less well-known aspects of the specification and so only the more able correctly knew the observation. There were some candidates who had some idea of the darkening due to the formation of silver but instead of clearly referring to the precipitate actually stated that the solution changed colour which did not gain credit. Also there were a number of answers that referred to the decomposition of the silver iodide but the question required what would be **seen**.

(ii) Describe what you would see if precipitate **R** was left in sunlight.

(1)

precipitate R darkens

ResultsPlus
Examiner Comments

This was the minimum that was required to gain the mark

(ii) Describe what you would see if precipitate **R** was left in sunlight.

(1)

White precipitate turns grey.

ResultsPlus
Examiner Comments

A correct observation which states the original colour and then the colour change that would be seen over time in sunlight. A good answer.

Question 2 (d) (iii)

This proved to be a challenging question with only a minority being able to correctly refer to the ethanol as being a better solvent for the X than water alone. A sizeable number of candidates either simply stated that ethanol acted as a solvent without any comparison or that ethanol allowed them to mix better without stating why. Neither of these alternatives were detailed enough to gain credit.

(iii) Suggest why an aqueous ethanolic solution of silver nitrate gives a better result in this test than would be obtained by aqueous silver nitrate.

(1)

More soluble with compard.

ResultsPlus
Examiner Comments

This is clearly an insufficient response which may have some merit because of the reference to more soluble but it is not expressed correctly. The compound is soluble in the solvent and not the other way round which is suggested here.

(iii) Suggest why an aqueous ethanolic solution of silver nitrate gives a better result in this test than would be obtained by aqueous silver nitrate.

(1)

The ethanol will dissolve the liquid x which is a halogenoalkane.

ResultsPlus
Examiner Comments

In this response a comparison is not seen and so does not score.

ResultsPlus
Examiner Tip

If the question is referring to a comparison between two things, in this example two solvents, then the answer should also be comparative. Hence the adjectives used must convey the difference, i.e. more soluble or dissolves better.

Question 2 (e) (i)

The use of bromine water or solution was by far the most common response to the request for a test for an alkene and the associated decolourisation was almost universally given correctly. This is clearly a well-known chemical identification test.

(e) If **X** is heated with a concentrated ethanolic solution of potassium hydroxide, a gas **Q** is produced.

(i) Describe a test and its expected result to show that this gas is an alkene.

(2)

Test: react with acidified potassium manganate (VII)

Result: Turns Purple to colourless

ResultsPlus
Examiner Comments

The use of acidified potassium manganate(VII) to test for an alkene was rarely seen but perfectly correct and as seen here both marks awarded.

(e) If **X** is heated with a concentrated ethanolic solution of potassium hydroxide, a gas **Q** is produced.

(i) Describe a test and its expected result to show that this gas is an alkene.

(2)

Test: Shake a test tube of the gas with some Bromine water. (stoppered test tube)

Result: The brown Bromine water turns colourless.

ResultsPlus
Examiner Comments

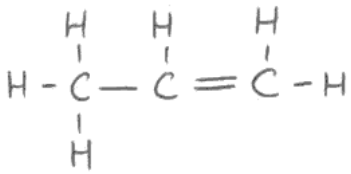
Here is a good example of one of the many correct answers that were seen.

Question 2 (e) (ii)

This question was generally answered correctly but there were some common mistakes which are illustrated below that could be easily remedied by checking or by greater understanding of the mechanism of the elimination of HX and H_2O by the use of hot, alcoholic hydroxide ions.

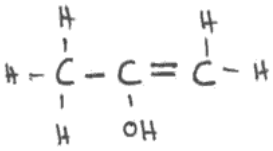
(ii) Give the displayed formula of the alkene **Q**.

(1)



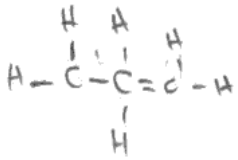
ResultsPlus
Examiner Comments

A correct answer which clearly shows the displayed formula of the alkene Q.



ResultsPlus
Examiner Comments

It was surprisingly common to see either an OH or a Cl in the alkene displayed formula, as illustrated in this example. It would seem that some of the candidates did not fully understand how the alkene Q was formed by elimination.



ResultsPlus
Examiner Comments

In this example the carbon to the far left only has 3 bonds while the central carbon has 5 bonds. Clearly this is an incorrect displayed formula for alkene Q.

ResultsPlus
Examiner Tip

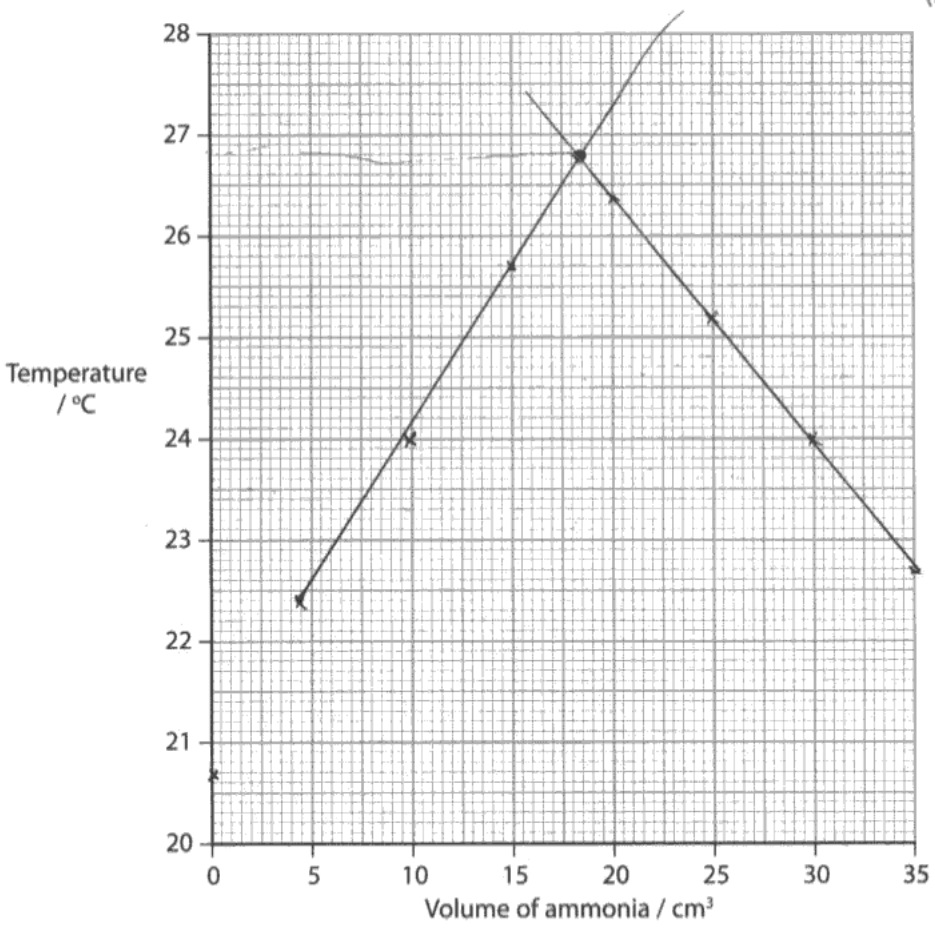
Always check and double-check displayed formula by counting the number of bonds that each carbon has. It should only be four.

Question 3 (a) (i-iii)

The vast majority of graphs were correctly plotted and straight lines drawn connecting all of the points. The tolerance for part (ii) was widened to allow a reading error of 17.0 cm^3 to score one mark out of two. Although not common it was seen in a sizeable number of scripts and so the reading of graph scales could be an area for candidates to practice. Part (iii) was rather straight-forward and was generally an easily obtainable mark for many.

(a) (i) Plot these data on the axes below. Draw **two straight** lines through the points on your graph. Extrapolate the lines until they intersect, to enable you to determine the end-point volume.

(2)



(ii) State the volume of the ammonia solution at the end-point.

(2)

26.8

(iii) Explain why the temperature rises until the end-point is reached.

(1)

because ~~water~~ molecules vibrate and move away from each other

ResultsPlus
Examiner Comments

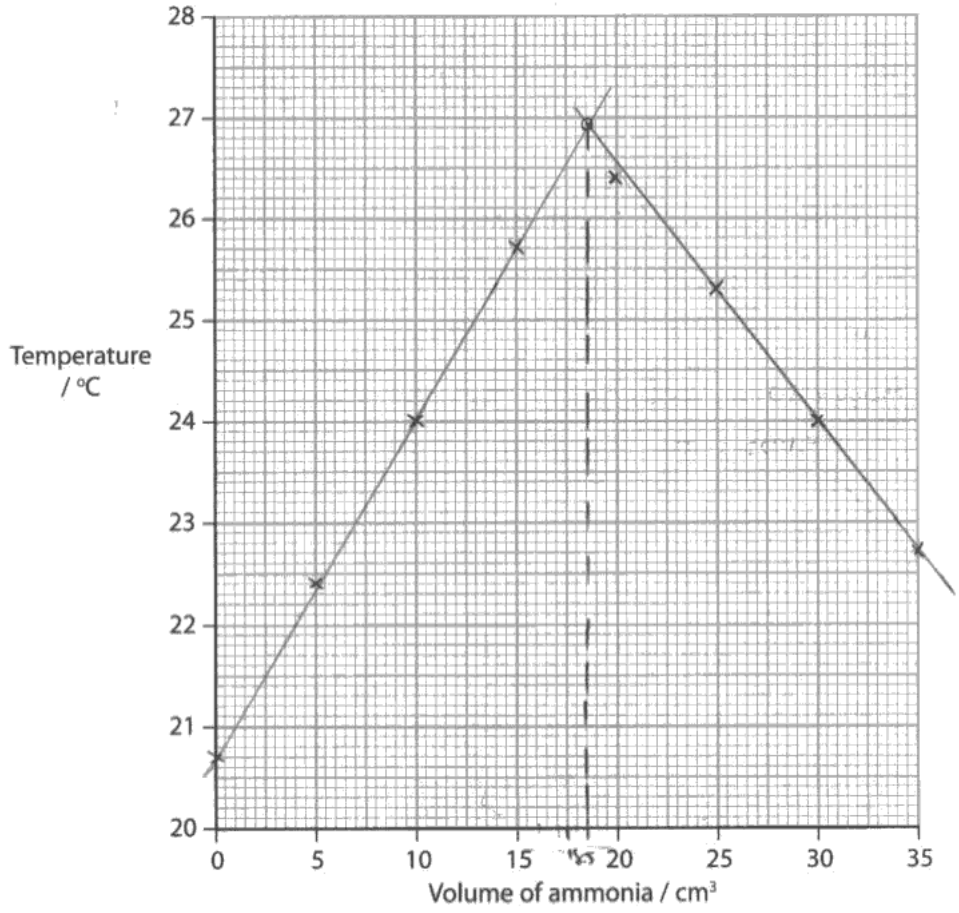
In part (i) the point at volume 0 is plotted suitably but is not connected with the straight line and so one mark was lost for this omission. The answer given in part (ii) is outside of the tolerance acceptable and so does not score any marks. Likewise the answer for part (iii) is clearly incorrect.

ResultsPlus
Examiner Tip

Make sure that **all** of the points in the graph are included in the drawing of straight lines; unless they are clearly anomalous and then this should be clearly indicated on the graph.

(a) (i) Plot these data on the axes below. Draw **two straight** lines through the points on your graph. Extrapolate the lines until they intersect, to enable you to determine the end-point volume.

(2)



(ii) State the volume of the ammonia solution at the end-point.

(2)

18.5 cm^3

(iii) Explain why the temperature rises until the end-point is reached.

(1)

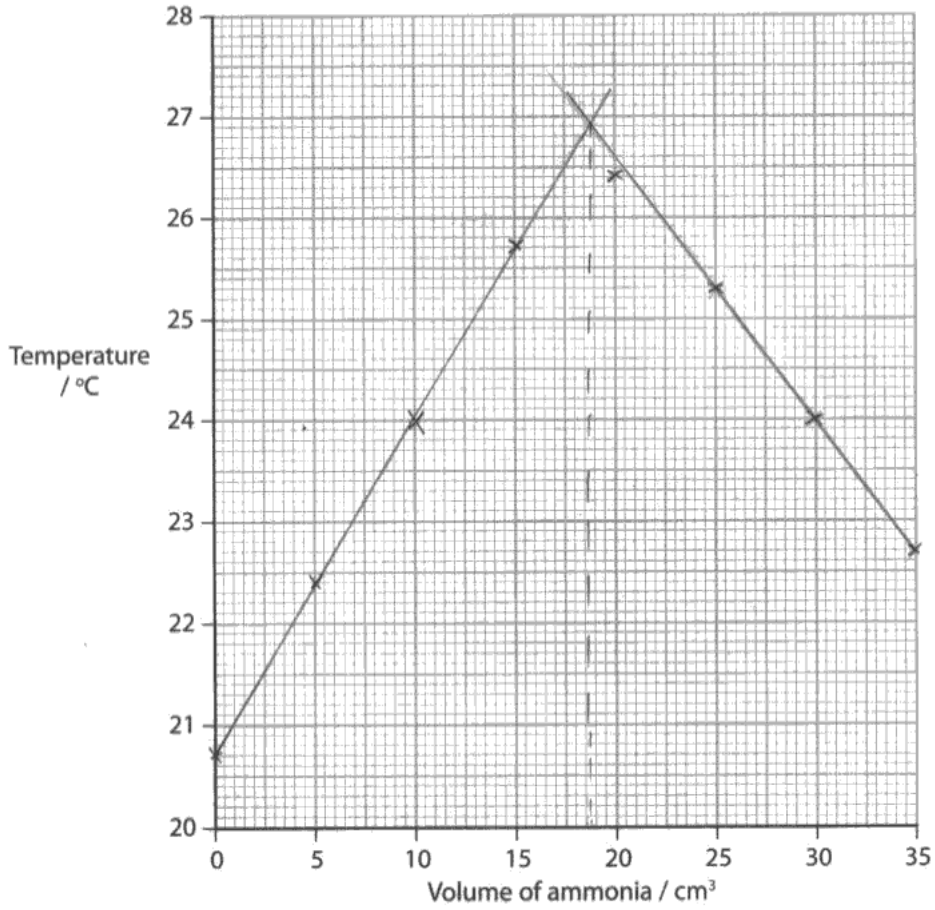
The reaction is exothermic, heat is given out.

ResultsPlus
Examiner Comments

This is a fine example where all the marks were awarded for parts (i) to (iii).

(a) (i) Plot these data on the axes below. Draw **two straight** lines through the points on your graph. Extrapolate the lines until they intersect, to enable you to determine the end-point volume.

(2)



(ii) State the volume of the ammonia solution at the end-point.

(2)

18.7 cm³

(iii) Explain why the temperature rises until the end-point is reached.

(1)

reactant still reacting

ResultsPlus
Examiner Comments

The graph is suitable and scores both marks in part (i) and the end-point volume in part (ii) is within the tolerance for 2 marks. However part (iii) does not score.

Question 3 (a) (iv)

This question served as a good discriminator since only the more able were able to correctly explain why the temperature falls after the end-point. Many candidates stated that it was due to heat loss to the surroundings but this would not be correct under the conditions of this type of experiment. The addition of extra ammonia solution at room temperature (cooler) would be the correct response and this was known by the better candidates.

However there was one mark readily available for the reference to the fact that there would be no further reaction after the end-point as all of the ethanoic acid was used up. This was appreciated by the majority of candidates.

(iv) Explain why the temperature falls when more ammonia solution is added after the end-point.

(2)

The heat released is used to break the bonds in ammonia because it is a weak base so it only partially dissociates.

ResultsPlus
Examiner Comments

This response shows a complete misunderstanding of the experiment. It suggests that the chemistry involved in the experiment has not been properly grasped.

ResultsPlus
Examiner Tip

Ensure that the chemistry of all experiments is fully understood so that it is not just a series of actions without appreciation for their meaning.

(iv) Explain why the temperature falls when more ammonia solution is added after the end-point.

(2)

Because ethanoic acid has all been used up.
cooling process occurs.

ResultsPlus
Examiner Comments

This is an example of where the candidate has correctly grasped that at the end-point all of the acid has been used up but does not understand that under the time frame of a practical of this type the loss of heat to the surroundings is not the reason why the temperature drops.

(iv) Explain why the temperature falls when more ammonia solution is added after the end-point.

(2)

When reaction is complete, more ammonia solution which is at room temperature is added to a higher temperature solution which cause ~~it to~~ the temperature to decrease back to room temperature to reach thermal equilibrium with surrounding.

ResultsPlus
Examiner Comments

An example of a high quality answer which clearly demonstrates understanding of the chemistry involved.

Question 3 (b) (i)

This calculation was very well answered with the vast majority scoring both marks. There was the rare occasion when a mass of only 25g was used but this was still able to score one mark. In the clear layout of the question there is no requirement for significant figures nor for conversion to kilojoules but a few candidates did do this. It is worth reminding candidates that this is fine but if alternative answers are given then they must all be correct if the marks are to be awarded.

(b) In a similar experiment, 25.0 cm^3 of ethanoic acid of concentration 2.00 mol dm^{-3} was reacted with 25.0 cm^3 of 2.00 mol dm^{-3} aqueous ammonia. The initial temperature was 20.6 °C and the temperature at the end-point was 29.8 °C.

(i) Use the expression below to calculate the heat energy evolved in this reaction. (Assume that the density of the reaction mixture is 1.00 g cm^{-3} and that the specific heat capacity of the mixture is 4.18 J g^{-1} $°C^{-1}$.)

energy transferred = mass × specific heat capacity × temperature change
in joules

(2)

Energy ~~transfred~~ transferred = 50 × 4.18 × 9.2
= 1923 J.

ResultsPlus
Examiner Comments

Simple, straight-forward and correct for 2 marks.

(b) In a similar experiment, 25.0 cm^3 of ethanoic acid of concentration 2.00 mol dm^{-3} was reacted with 25.0 cm^3 of 2.00 mol dm^{-3} aqueous ammonia. The initial temperature was 20.6 °C and the temperature at the end-point was 29.8 °C. temp increase

(i) Use the expression below to calculate the heat energy evolved in this reaction. (Assume that the density of the reaction mixture is 1.00 g cm^{-3} and that the specific heat capacity of the mixture is 4.18 J g^{-1} $°C^{-1}$.)

energy transferred = mass × specific heat capacity × temperature change
in joules

(2)

ΔT = 29.8 − 20.6
= 9.2 °C

energy transferred = (50)(4.18)(9.2)

= 1922.8 J

$\frac{1922.8}{1000}$ kJ = 1.92 kJ.

ResultsPlus
Examiner Comments

This response shows a clearly laid-out answer with all of the calculation steps organised. There was no need to convert to kilojoules or to three significant figures but this has been correctly done.

Question 3 (b) (ii)

This was a straight-forward question with the vast majority of candidates gaining the mark. This was the only question on the paper where an answer to 1 significant figure was acceptable.

(ii) Calculate the number of moles of ethanoic acid used in this reaction. (1)

moles = $\frac{2.00}{1000}$ = 0.002 mol

ResultsPlus
Examiner Comments

This was one of the few incorrect responses that were seen. Clearly the volume of 25 is missing from the calculation of n = c x V and so does not score.

(ii) Calculate the number of moles of ethanoic acid used in this reaction. (1)

No. of moles of ethanoic acid

= $2.00 \times \frac{25.0}{1000}$

= 0.0500 (cor. to 3 sig. Fig.)

ResultsPlus
Examiner Comments

A clearly laid-out answer which illustrated good understanding.

ResultsPlus
Examiner Tip

Most chemical calculations are best done to 3 significant figures, as in this case, unless specified otherwise.

Question 3 (b) (iii)

This proved to be an effective question for discriminating between the different ability candidates.

There were in effect three requirements for the calculation and one mark was awarded for each. The first was a correct division of the value for q by the number of moles. The second was for the use of 3 significant figures as requested and the third for the correct sign and units, also as requested in the question. These resulted in a spread of marks according to candidate ability.

Candidates could be well-reminded that 3 significant figures are not the same as 3 decimal places.

(iii) The reaction that occurs is

$$CH_3COOH(aq) + NH_3(aq) \rightarrow CH_3COONH_4(aq)$$

Use your values from (b)(i) and (ii) to calculate the enthalpy change per mole for this reaction. Include a sign and units in your answer. Give your answer to **three** significant figures.

(3)

0.05 mol — 1922.8 J
— 1.9228 kJ
1 mol — 38.456 kJ

− 38.5 kJ mol^{-1}

ResultsPlus
Examiner Comments

With most mathematical calculations there are multiple ways to arrive at the final answer. This example shows a less common approach but an equally valid one and that gained all 3 marks for a correct final answer.

(iii) The reaction that occurs is

$$CH_3COOH(aq) + NH_3(aq) \rightarrow CH_3COONH_4(aq)$$

Use your values from (b)(i) and (ii) to calculate the enthalpy change per mole for this reaction. Include a sign and units in your answer. Give your answer to **three** significant figures.

(3)

$$-\frac{1922.8}{0.05} = -38456\ J\,mol^{-1}$$

$$\approx -38kJ\,mol^{-1}$$

ResultsPlus
Examiner Comments

In this example the candidate has not given their final answer to **three** significant figures as requested and so only scores 2 marks.

ResultsPlus
Examiner Tip

Note the parts of the question that are in bold as they will be essential to address if full marks are to be achieved.

(iii) The reaction that occurs is

$$CH_3COOH(aq) + NH_3(aq) \rightarrow CH_3COONH_4(aq)$$

Use your values from (b)(i) and (ii) to calculate the enthalpy change per mole for this reaction. Include a sign and units in your answer. Give your answer to **three** significant figures.

(3)

energy transferred = 1922.8 J

number of moles ~~used~~ ethanoic acid used = 50 000

$$\Delta H = \frac{1922.8}{50\,000}$$

$$= -0.0385\ J\,mol^{-1}$$

ResultsPlus
Examiner Comments

This response illustrates the common approach to marking numerical questions because there is a single error in the number of moles, otherwise all is correct. This means that there is only a single mark lost and so 2 marks were awarded.

(iii) The reaction that occurs is

0.05 0.05

$$CH_3COOH(aq) + NH_3(aq) \rightarrow CH_3COONH_4(aq)$$

Use your values from (b)(i) and (ii) to calculate the enthalpy change per mole for this reaction. Include a sign and units in your answer. Give your answer to **three** significant figures.

(3)

~~enthalpy = $\frac{1922.8 \times 10^3 \text{ kJ}}{0.05 \text{ mol}}$~~

=

enthalpy = $\frac{1922.8 \div 10^3 \text{ kJ}}{0.05 \text{ mol}}$

= 38.456 kJ mol^{-1}

= 38.5 (3SF) kJmol^{-1}

ResultsPlus
Examiner Comments

This answer is missing the required sign as stated in the question and so scores 2 out of the 3 available marks.

ResultsPlus
Examiner Tip

Re-read the instructions in the question to make sure that the final answer meets all of the requirements of the question.

Question 4 (a) (i)

The specification clearly refers to the need for diluted sulfuric acid and not concentrated in the production of the HBr needed for the formation of the bromoalkane but this was not always appreciated by the candidates. An alternative response which would have gained credit was the protonation of the alcohol so that the bromide ion could then attack but this was never seen.

(a) (i) Explain why sodium bromide and sulfuric acid are required in **step 2**.

(1)

The sodium bromide reacts with the sulfuric acid to produce hydrogen bromide. The hydrogen bromide will subsequently react with the butan-1-ol to produce 1-bromobutane later.

ResultsPlus
Examiner Comments

A good example of the type of answer expected and that was able to be awarded both marks.

(a) (i) Explain why sodium bromide and sulfuric acid are required in **step 2**.

(1)

To enable sulfuric acid to dissolve sodium bromide.

ResultsPlus
Examiner Comments

This is an example of where the chemical basis for various experimental activity appears not to be correctly grasped.

ResultsPlus
Examiner Tip

Always make sure that candidates are fully aware of the reasons behind all steps of an experimental procedure.

(a) (i) Explain why sodium bromide and sulfuric acid are required in **step 2**.

(1)

Sodium bromide needed to provide the bromide ion, the sulfuric acid is to oxidise the butan-1-ol

ResultsPlus
Examiner Comments

This illustrates the lack of understanding shown by a sizeable number of candidates for this experimental method. The sulfuric acid would not oxidize the alcohol but rather could dehydrate the alcohol.

(a) (i) Explain why sodium bromide and sulfuric acid are required in **step 2**.

(1)

To obtain the fraction of crude 1-bromobutane, so that the sodium bromide and H_2SO_4 can react with each other.

ResultsPlus
Examiner Comments

There is no real explanation given here and so did not score.

Question 4 (a) (ii)

Candidates would be well-advised to remind themselves regularly to check on the number of marks available for each question and to ensure that their answer meets this number of marks. The reason for this reminder is because very few answers were seen that addressed both aspects of the answer required. The question asked for 'the effect' and then to 'justify your answer'. The tendency was for candidates to justify their answers by often stating that the bromide ions would be oxidized to bromine. This was fine.

It was much less common to see the effect stated which was the lower yield of the product, 1-bromobutane. A statement that 'no 1-bromobutane formed' was allowed since this conveyed the idea although not technically correct. An alternative effect of the formation of an alkene would have been acceptable but this was hardly ever seen.

(ii) What would be the effect on this preparation if concentrated sulfuric acid was added in **step 2 without** water having been added in **step 1**? Justify your answer.

(2)

Bromine would be formed instead of hydrogen bromide.

Bromine will not react with butan-1-ol to form 1-bromobutane.

ResultsPlus
Examiner Comments

Two points clearly made on separate lines. The first was easy to award and the second was given for no 1-bromobutane formed, although as stated it is likely that some 1-bromobutane would be made.

(ii) What would be the effect on this preparation if concentrated sulfuric acid was added in **step 2 without** water having been added in **step 1**? Justify your answer.

(2)

The reaction would be very ~~vigorou~~ vigorous. Bromine, sulfur dioxide and water would be produced.

ResultsPlus
Examiner Comments

Here one mark can be awarded for the statement that bromine would be produced, instead of the required HBr, but there is no justification given.

(ii) What would be the effect on this preparation if concentrated sulfuric acid was added in **step 2 without** water having been added in **step 1**? Justify your answer.

(2)

The apparatus may be broken because the pressure is very high without water added in.

ResultsPlus
Examiner Comments

Although this type of experiment is clearly on the specification this answer suggests that the candidate has not done or seen this experiment.

ResultsPlus
Examiner Tip

Experimental methods are a crucial part of this chemistry specification and should always be carried out and discussed fully to ensure good understanding.

Question 4 (b)

This was a very poorly-answered question and if the mark scheme had not been widened to allow less precise answers then there would have been very few marks awarded which suggests that teachers should spend more time making sure that their students grasp the chemistry behind this type of question. The correct response was that the reaction between the concentrated sulfuric acid and the water would have been highly exothermic and so considerable heat would be released. However many candidates wrote vague answers about an exothermic reaction without specifying what the reaction was that they were referring to. As long as an 'exothermic reaction' or 'heat was given out' was included in the answer then credit was given.

Alternatively reference could have been made to the loss of volatile organic molecules because of the heat generated. Although this was very rare it was pleasing to see that some candidates do have an in-depth understanding of what is actually occurring in the experimental procedure.

(b) Explain why the acid must be added slowly and with cooling in **step 2**.

(1)

Because the reaction is very exothermic

ResultsPlus
Examiner Comments

An example of just how vague some of the answers were that were given.

ResultsPlus
Examiner Tip

Rather than be vague and refer to 'the reaction', be specific in the reaction that an answer is addressing.

Question 4 (c)

The standard of drawing was quite high in comparison to some other examination sessions which was good to see. There were fewer drawings that were difficult to work out exactly what the apparatus was. The result of this was that many candidates scored all 4 marks. The common errors were:

A completely closed system with the potential to explode.

The omission of heat or a source of heat to the round-bottomed flask.

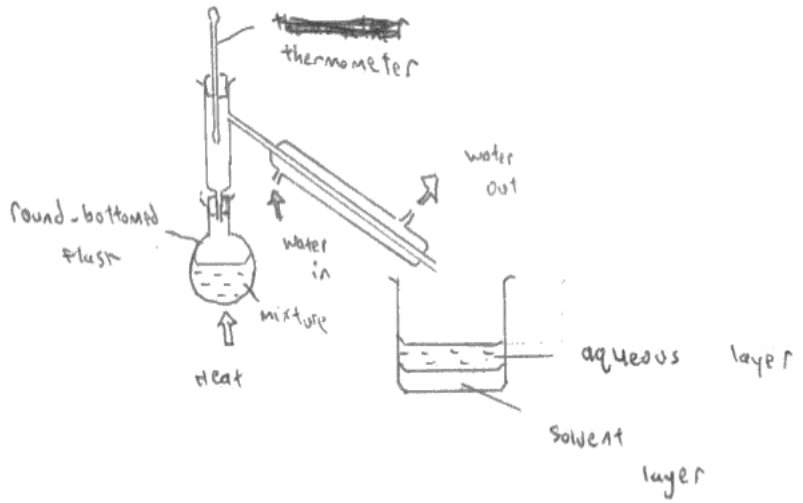
A conical flask rather than the round-bottomed flask as stated in the question.

The incorrect placement of the thermometer.

An incorrect flow of the water in the condenser.

(c) Draw a labelled diagram of the apparatus that could be used to carry out the distillation in **step 4**.

(4)



ResultsPlus
Examiner Comments

In this example one mark is lost for the incorrect flow of water in the condenser and another lost for the incorrect placement of the thermometer.

ResultsPlus
Examiner Tip

Check the flow of water in any condenser. It should always flow upwards or the condenser will only half-fill.

Also check that the thermometer is opposite the condenser opening because in this way the temperature of the gas entering the condenser and condensing is accurately noted.

Question 4 (d)

This was generally answered very well, with many candidates understanding that a carbonate is used to remove acid. In practice it is likely to remove the unreacted acidic HBr but this was not enforced and the removal of any acid was accepted. However there were a few rather bizarre responses which are a concern if they truly reflect the chemical understanding of some candidates as illustrated below.

(d) Explain why the 1-bromobutane is shaken with sodium carbonate solution in **step 5**.

(1)

to clean the water

ResultsPlus
Examiner Comments

A novel suggestion for the use of sodium carbonate but which no relation to the required answer and is a cause for concern for some of the candidate views on the uses of certain chemicals.

Question 4 (e)

The answers to this question showed that there is a need to make sure that candidates clearly know the difference between a drying agent and a dehydrating agent. The latter is the removal of water from the structure of a molecule as in the formation of an alkene from an alcohol. However a drying agent is the removal of trace water molecules from within a sample of a product.

(e) What is the purpose of the calcium chloride in **step 6**?

(1)

As a drying agent to remove water.

ResultsPlus

Examiner Comments

A suitable answer which states and explains the purpose of calcium chloride.

Question 4 (f)

This question was not answered well by many candidates as a wide range of possible suggestions were given that varied from the plausible and the understandable to the doubtful and the absurd. This question was addressing the need often experienced in organic preparations to purify the product by means of re-distillation. If this technique is given then the required boiling point should be over a narrower range than the 95-105 °C quoted in the question. There were some high quality responses that did exactly this and it was very pleasing to see. However as stated these were rather rare.

(f) Suggest how you would obtain pure 1-bromobutane after **step 7**.

(1)

Distill the 1-bromobutane to obtain pure 1-bromobutane.

(Total for Question 4 = 11 marks)

ResultsPlus
Examiner Comments

A suitable answer as the need for 're' before distillation was not demanded.

(f) Suggest how you would obtain pure 1-bromobutane after **step 7**.

(1)

filter using filter funnel and filter paper.

ResultsPlus
Examiner Comments

It would appear that this candidate is thinking that there is a need to remove the solid drying agent but this has already been done by the 'decanting' in step 7. The question clearly asks for 'after step 7'. Hence another good reminder to re-read the question to make sure that the answer given is addressing the question asked.

(f) Suggest how you would obtain pure 1-bromobutane after **step 7**.

(1)

~~Ref~~ Heat the mixture under reflux.

(Total for Question 4 = 11 marks)

ResultsPlus
Examiner Comments

This example illustrates how some candidates seemed to be making random guesses with various experimental techniques that they had either carried out or seen. Heat under reflux is the normal arrangement for the oxidation of primary alcohols to carboxylic acids and not for the purification of an organic product.

(f) Suggest how you would obtain pure 1-bromobutane after **step 7**.

(1)

Leave it to cool and crystalize.

(Total for Question 4 = 11 marks)

ResultsPlus
Examiner Comments

This is another example of an unusual answer where the candidate is clearly getting confused with other experiments. This response did not score.

Paper Summary

Based on their performance on the paper, candidates are offered the following advice:

- Make sure you are familiar with the Edexcel User Guide.
- Pay particular attention to the analytical tests and descriptions of the colours/colour changes expected in tests.
- Focus on learning and understanding the chemistry behind experimental procedures.
- Make sure you understand which chemicals are used in procedures and why.
- In longer calculation questions it can be beneficial to show working in case the final answer is incorrect and then some credit can be awarded for the working.
- Check all you answers to make sure you have answered the question actually set on the paper.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

Further copies of this publication are available from
Edexcel Publications, Adamsway, Mansfield, Notts, NG18 4FN

Telephone 01623 467467
Fax 01623 450481
Email publication.orders@edexcel.com
Order Code US034340 January 2013

For more information on Edexcel qualifications, please visit
www.edexcel.com/quals

Pearson Education Limited. Registered company number 872828
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE

Ofqual

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Rewarding Learning