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Examiners' Report
January 2011

GCE Chemistry 3 (INT) 6CH07 01

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Introduction

The style and standard of this paper was similar to previous series; all the questions proved accessible to well-prepared candidates and there were many excellent papers. While familiarity with past papers was an evident benefit, the best responses were informed by the laboratory context of the paper.

The standard of the numerical work was generally high although a substantial minority of candidates were unable to distinguish between significant figures and decimal places and many candidates persist in the practice of using rounded intermediate answers in a calculation sequence.

Similarly, a number of candidates proved unable to draw clear accurate diagrams of chemistry apparatus. In a number of questions, candidates had clearly failed to read the question with sufficient care and offered answers that were excluded by the terms of the question.

Question 1(a)(i)

This is a straightforward question assessing knowledge of the test for ammonium compounds.

	Test	Observation	Inference
(i)	Warm solid **X** with dilute Sodium hydroxide solution	A gas was evolved which turned damp red litmus paper blue.	Ammonia is formed so the ammonium ion is present.
(ii)	Add aqueous barium		**X** contains either

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Examiner Comments

The word ‘solution’ is not strictly necessary as it is implied by the use of ‘dilute’ in the question.

	Test	Observation	Inference
(i)	Warm solid **X** with dilute NaOH	A gas was evolved which turned damp red litmus paper blue.	Ammonia is formed so the ammonium ion is present.
(ii)	Add aqueous barium		**X** contains either

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Examiner Comments

This candidate has correctly answered the question using a formula.

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Examiner Tip

Any formulae used must be fully correct.

Question 1(a)(ii)

This question involves the use of barium chloride solution in the test for sulfate(VI), sulfate(IV) and carbonate. Candidates lost marks quite frequently by giving as their answer the ion already identified on the question paper.

(ii)	Add aqueous barium chloride to a solution of **X**.	white precipitate	**X** contains either sulfite (sulfate(IV)) or sulphate or carbonate
(iii)	Add dilute hydrochloric	A gas was evolved which	Sulfite (sulfate(IV))

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Examiner Comments

This is a fully correct answer although note the use of the obsolete spelling of sulfate.

(ii)	Add aqueous barium chloride to a solution of **X**.	A white ~~prep~~ precipitate observed	**X** contains either sulfite (sulfate(IV)) or SO_4^{2-} or SO_3^{2-}
(iii)	Add dilute hydrochloric	A gas was evolved which	Sulfite (sulfate(IV))

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Examiner Comments

The candidate has used correct formulae but given as one answer the information given on the question paper.

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Examiner Tip

Read the material provided carefully.

	solution...		
(ii)	Add aqueous barium chloride to a solution of **X**.	White precipitate	**X** contains either sulfite (sulfate(IV)) or Barium sulfibe or ~~Barium~~ Sulphate
(iii)	Add dilute hydrochloric	A gas was evolved which	Sulfite (sulfate(IV))

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Examiner Comments

Note the use of 'barium' here. The candidate has identified the precipitate rather than the ion present. While this error was not penalised on this occasion, it might well have been.

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Examiner Tip

Make sure that you answer the question that has been asked.

Question 1(a)(iii)

After the addition of barium chloride, hydrochloric acid is used to distinguish sulfate, sulfite and carbonate, all of which give white precipitates. When identifying a reagent, formulae or oxidation numbers must be correct.

		produced.	Carbonate
(iii)	Add dilute hydrochloric acid to the result of test (ii).	A gas was evolved which Sulphur dioxide	Sulfite (sulfate(IV)) confirmed.

$(NH_4)_2SO_4 + BaCl \rightarrow NH_4Cl + BaSO_4$

(iv) Describe a further **chemical** test, not involving indicators, that you could use to

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Examiner Comments

This paper is intended as a test of practical skills. An observation column must be completed using observations.

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Examiner Tip

The identity of the gas is an inference.

			oxide.
(iii)	Add dilute hydrochloric acid to the result of test (ii).	A gas was evolved which turns ~~the~~ ~~red~~ blue litmus paper red and then bleach the paper.	Sulfite (sulfate(IV)) confirmed.

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Examiner Comments

The inclusion of the 'bleach' observation negates the colour change of the litmus (an 'allow' in the mark scheme) as it indicates chlorine.

			[illegible]
(iii)	Add dilute hydrochloric acid to the result of test (ii).	A gas was evolved which turns potassium dichromate (VI) from orange to green.	Sulfite (sulfate(IV)) confirmed.

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Examiner Comments

A fully correct answer.

Question 1(a)(iv)

The best answers to this question demonstrated an appreciation of the need to describe the practical stages of a test, identify the reagent used and summarise precise laboratory observations.

(iv) Describe a further **chemical** test, not involving indicators, that you could use to confirm that ammonia is formed in part (i).

(2)

Test: Add hydrochloric acid

Result: White fumes can be seen. This shows the presence of NH_3.

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Examiner Comments

The reagent must be correctly used in this test and the lack of precision costs the first mark.

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Examiner Tip

How a reagent is used is significant as well as its identity.

(iv) Describe a further **chemical** test, not involving indicators, that you could use to confirm that ammonia is formed in part (i).

(2)

Test: Use damp ~~blue~~ red Litmus paper

Result: damp red Litmus paper turns blue.

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Examiner Comments

The question very specifically excludes the use of indicators as a valid response.

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Examiner Tip

Read the question carefully.

(iv) Describe a further **chemical** test, not involving indicators, that you could use to confirm that ammonia is formed in part (i).

(2)

Test Determine the smell by placing the mouth of the test tube near the nose.

Result A pungent smell is ~~produced~~ present.

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Examiner Comments

A chemical test is required. Smell will not do here.

(iv) Describe a further **chemical** test, not involving indicators, that you could use to confirm that ammonia is formed in part (i).

(2)

Test Aluminium foil, NaOH added and warm it.

Result White fumes formed.

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Examiner Comments

The nitrate test was a common error.

(iv) Describe a further **chemical** test, not involving indicators, that you could use to confirm that ammonia is formed in part (i).

(2)

Test ~~Use~~ Place a glass rod dipped in concentrated hydrochloric acid near the mouth of the test tube in contact with the gas.

Result steamy White fumes are formed.

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Examiner Comments

A clear and comprehensive correct answer.

Question 1(b)(i)

Identification of a cation from a flame test observation requires precise knowledge of the standard colours. Ideally the formula of the ion should be given but the charge must be correct.

	Test	Observation	Inference
(i)	Flame test	Brick red (yellow-red) flame.	The cation in **Y** is Ca^{+}
(ii)	Gently heat a sample of	Vapour turned cobalt	Water is produced

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Examiner Comments

Ideally the answer should be the formula of the calcium ion but it must be fully correct.

	Test	Observation	Inference
(i)	Flame test	Brick red (yellow-red) flame.	The cation in **Y** is Calcium / Strontium
(ii)	Gently heat a sample of	Vapour turned cobalt	Water is produced

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Examiner Comments

Here and elsewhere in the paper alternative answers can only score if they are all correct.

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Examiner Tip

Multiple correct answers will score but do not offer two (or more) clearly different answers.

	Test	Observation	Inference
(i)	Flame test	Brick red (yellow-red) flame.	The cation in **Y** is Ca +2
(ii)	Gently heat a sample of	Vapour turned cobalt	Water is produced

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Examiner Comments

This answer scored the mark even though normally the number comes before the charge.

Question 1(b)(ii)

The test for water using cobalt chloride paper was not well known and a surprising number of candidates gave red rather than pink as the observation.

(ii)	Gently heat a sample of Y in a test tube, testing any vapours evolved with cobalt chloride paper.	Vapour turned cobalt chloride paper from blue to pink	Water is produced. Y contains water of crystallization.
(iii)	Heat the sample of Y in	Brown gas evolved.	Gas is

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Examiner Comments

Correct answer to a simple, factual question. Many candidates chose red, which was allowed.

Question 1(b)(iii)

The thermal decomposition of group II metal nitrates was well known; the common incorrect response was to identify the brown gas as bromine.

(iii)	Heat the sample of Y in the test tube.	Brown gas evolved.	Gas is NO_2
(iv)	Continue to heat the	Gas reignited a glowing	Gas is

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Examiner Comments

Again, name or formula are acceptable answers when identifying a substance.

Question 1(b)(iv)

Most candidates knew the test for oxygen.

(iv)	Continue to heat the sample of **Y**.	Gas reignited a glowing splint.	Gas is O_2

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Examiner Comments

A typical correct answer. Note the use of the formula; the name would also score.

Question 1(b)(v)

The majority of candidates knew that nitrate was indicated by the preceding tests although not all knew the formula of the ion.

(v) Identify, by name or formula, the anion in **Y**. (1)

Nitrate (NO_3^{2-})

(vi) Give the formula of **Y** (one mole of **Y** contains one mole of water of

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Examiner Comments

Either name or formula would do to score the mark here.

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Examiner Tip

If name and formula are used, both must be correct.

Question 1(b)(vi)

A number of candidates seemed unfamiliar with the representation of water of crystallization in a formula.

(v) Identify, by name or formula, the anion in **Y**.

(1)

NO_3^-

(vi) Give the formula of **Y** (one mole of **Y** contains one mole of water of crystallization).

(2)

$Ca(NO_3)_2$

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Examiner Comments

This was a common response; the candidate ignores the mention of water (of crystallization) in the question.

(v) Identify, by name or formula, the anion in **Y**.

(1)

nitrate ion.

(vi) Give the formula of **Y** (one mole of **Y** contains one mole of water of crystallization).

(2)

$Ca(NO_3)_2 \cdot H_2O$

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Examiner Comments

A fully correct answer.

Question 2(a)

Most candidates knew that the standard test for alcohols involved the use of PCl_5 but some spoiled their answer by using solutions. The most common error was the use of oxidizing agents, which would react with other functional groups.

2 (a) The organic compounds propan-1-ol and propan-2-ol are isomers. Propan-1-ol has the structure $CH_3CH_2CH_2OH$ and propan-2-ol has the structure $(CH_3)_2CHOH$.

Describe a test and its expected result to confirm the presence of the –OH group in propan-1-ol or propan-2-ol.

(2)

Test Add PCl_5

Result White fumes which turn damp litmus paper red. (blue)

(b) When propan-1-ol or propan-2-ol is heated to 170 °C with concentrated sulfuric acid,

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Examiner Comments

A fully correct response. Note the additional correct but non-scoring information which does not affect the mark.

2 (a) The organic compounds propan-1-ol and propan-2-ol are isomers. Propan-1-ol has the structure $CH_3CH_2CH_2OH$ and propan-2-ol has the structure $(CH_3)_2CHOH$.

Describe a test and its expected result to confirm the presence of the –OH group in propan-1-ol or propan-2-ol.

(2)

Test Add. PCl_5.

Result A Chloropropane would be obtained in both of the reactions

(b) When propan-1-ol or propan-2-ol is heated to 170 °C with concentrated sulfuric acid,

ResultsPlus
Examiner Comments

The test reagent is correct but the question requires the result to be described.

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Examiner Tip

Keep in mind the laboratory context of this paper.

2 (a) The organic compounds propan-1-ol and propan-2-ol are isomers. Propan-1-ol has the structure $CH_3CH_2CH_2OH$ and propan-2-ol has the structure $(CH_3)_2CHOH$.

Describe a test and its expected result to confirm the presence of the –OH group in propan-1-ol or propan-2-ol.

(2)

Test: Add acidified $K_2Cr_2O_7$ to propanol

Result: orange color changes to green due to presence of –OH group.

(b) When propan-1-ol or propan-2-ol is heated to 170 °C with concentrated sulfuric acid,

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Examiner Comments

This response is chemically correct but, because other groups give the same reaction, it cannot score full marks.

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Examiner Tip

A test must be specific to the group involved.

Question 2(b)

Most candidates were able to describe a suitable test (and its result) for an alkene. Many were unable to identify the type of reaction involved in its formation from an alcohol.

(b) When propan-1-ol or propan-2-ol is heated to 170 °C with concentrated sulfuric acid, propene is formed.

Name the type of reaction that has occurred in the reaction with sulfuric acid. Describe a test and its positive result to show the presence of the C=C bond in propene.

(3)

Type of reaction: Condensation reaction

Test: Add acidified potassium permanganate.

Result: A diol is produced

ResultsPlus
Examiner Comments

The reagent is correct but, instead of an observation, the type of compound formed has been identified.

(b) When propan-1-ol or propan-2-ol is heated to 170 °C with concentrated sulfuric acid, propene is formed.

Name the type of reaction that has occurred in the reaction with sulfuric acid. Describe a test and its positive result to show the presence of the C=C bond in propene.

(3)

Type of reaction ~~Dehydration~~ ~~Dehydrogenation~~ Elimination

Test Add bromine water

Result The brown solution will become colourless

ResultsPlus
Examiner Comments

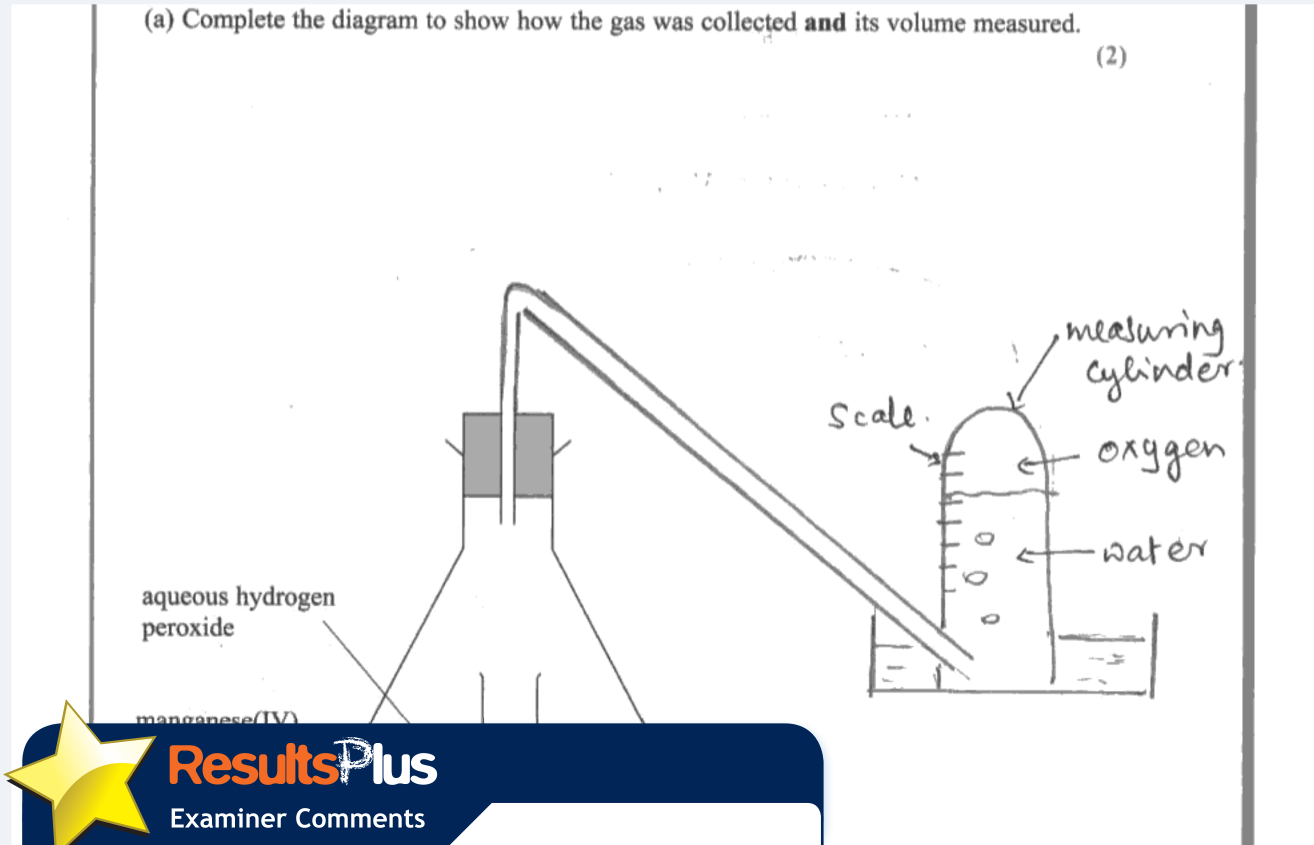
A fully correct answer.

ResultsPlus
Examiner Tip

When describing a colour change, it is good practice to give the start and finish colours.

Question 3(a)

There were many excellent diagrams. Drawings do need to show working apparatus so care does need to be taken to show the parts of the apparatus (e.g. the barrel and plunger of the syringe as separate parts) and to avoid representations that could not possibly work in practice such as a delivery tube passing through the wall of a container, syringe plungers too short to fit the barrels gaps in a gas-tight system or blocked systems.



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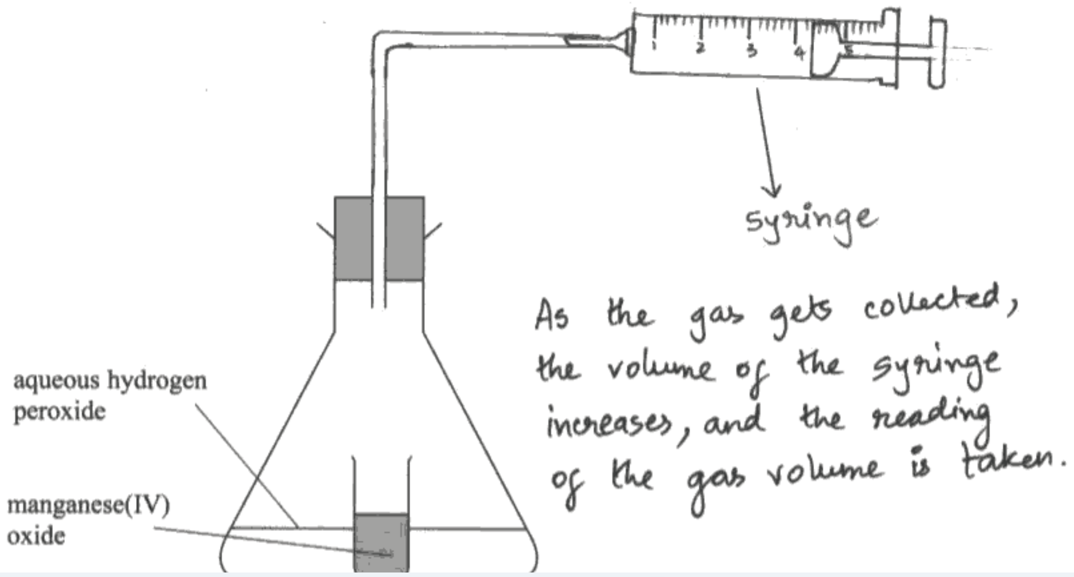
Examiner Comments

An example of a delivery tube passing through a container wall.

(a) Complete the diagram to show how the gas was collected **and** its volume measured.
(2)



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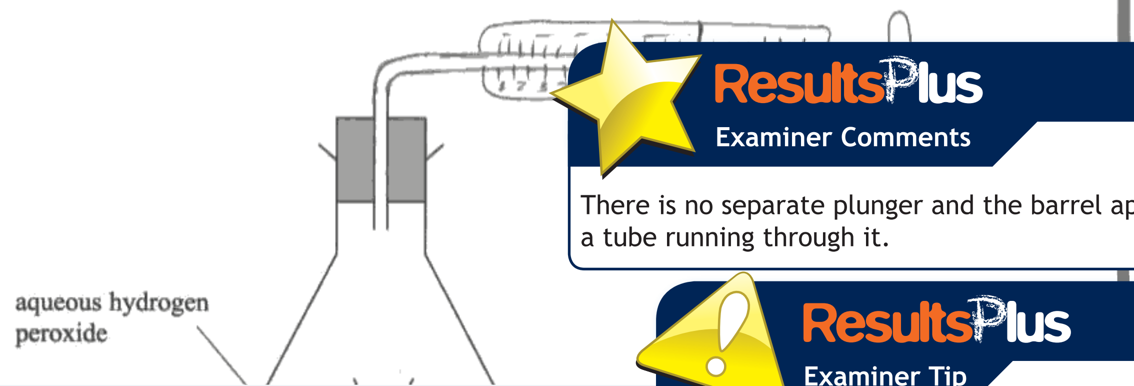
The right-hand end of this syringe is closed by the vertical line.

ResultsPlus Examiner Tip

Practise drawing cross-sectional diagrams.

(a) Complete the diagram to show how the gas was collected **and** its volume measured.

(2)



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Examiner Comments

There is no separate plunger and the barrel appears to have a tube running through it.

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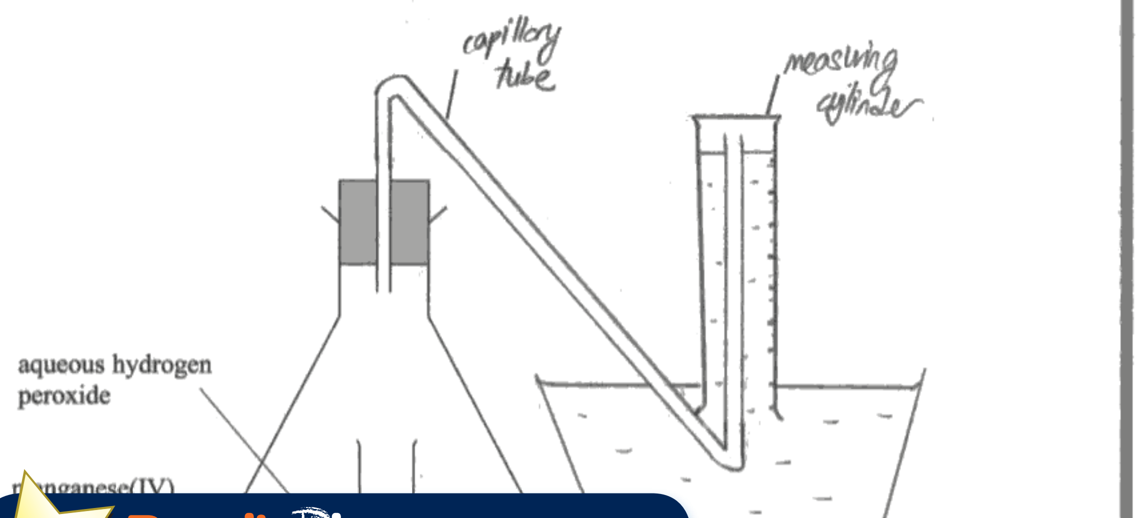
Examiner Tip

Think about how the apparatus you draw would work.

(a) Complete the diagram to show how the gas was collected **and** its volume measured.

(2)



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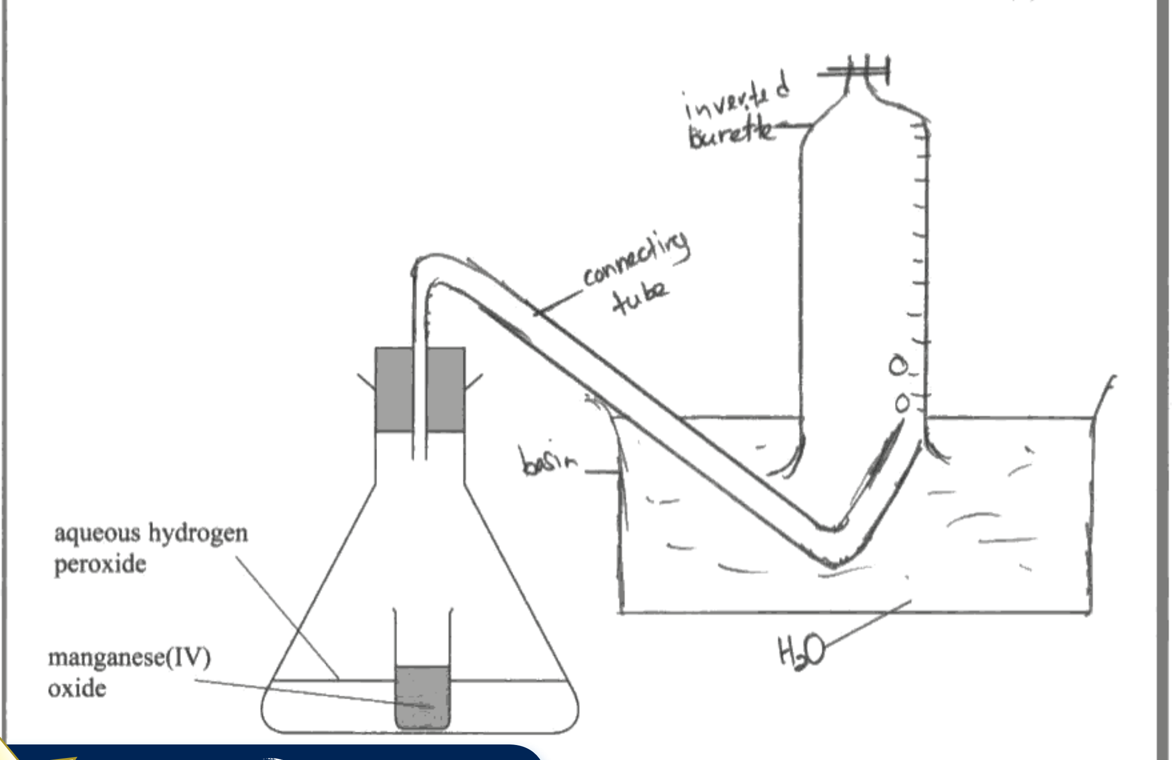
Examiner Comments

There is no separate plunger and the barrel appears to have a tube running through it.

(a) Complete the diagram to show how the gas was collected **and** its volume measured.

(2)



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Examiner Comments

A very good example of collection over water.

Question 3(b)(i-iv)

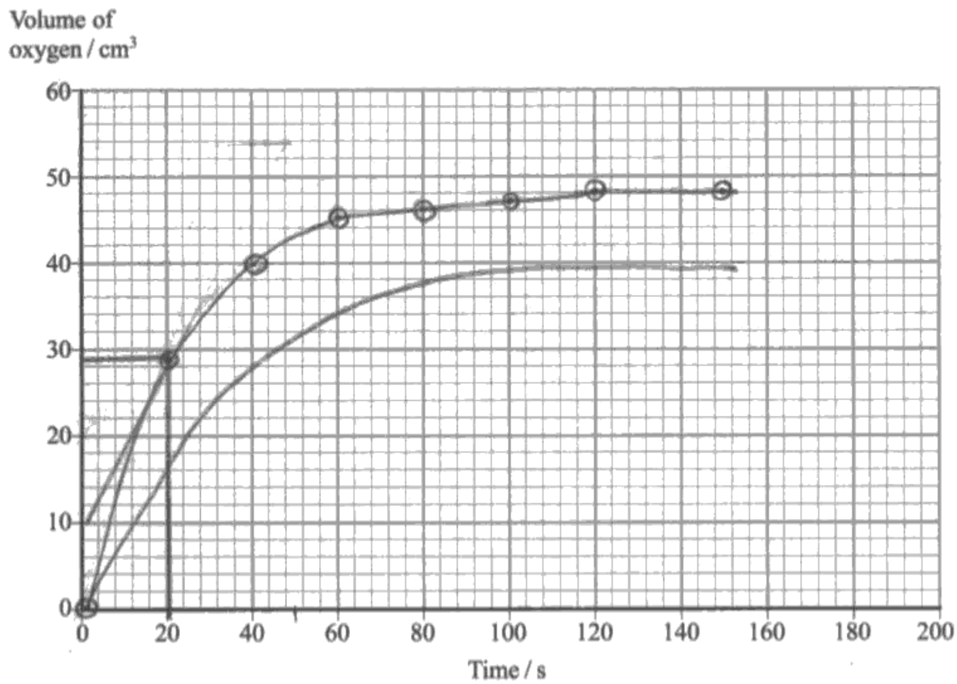
Almost all candidates were able to plot the points on the graph correctly but these were not always clear once the best fit line was drawn. The use of circles or crosses to help identify the points is a good idea. A best fit curve should be a smooth line passing through all points except anomalies.

The rate calculation proved straightforward but many candidates gave their answer to two decimal places (1.45) rather than two significant figures. A few candidates rounded their answer but still gave it to three significant figures (1.50).

The responses on the similarities and differences between the two experiments often omitted any explanation of the fact that the volume of gas was the same in both cases.

(i) Plot these results on the grid below and draw a best fit line through the points.

(3)



(ii) The rate of reaction may be assumed to be approximately constant up to the first volume measurement (20.0 seconds in this experiment) and is called the initial rate. Use this approximation to calculate the initial rate of this reaction, giving your answer to **two** significant figures and stating the units.

(2)

Rate = Change in concentration/Volume / time

~~= 53 =~~

$\frac{29 cm^3}{20 s}$

= 1.45 cm^3/s

(iii) In a second experiment, the manganese(IV) oxide granules were replaced by the same mass of the compound as a fine powder. The volume and concentration of the aqueous hydrogen peroxide were kept the same.
On the grid in (b)(i), draw the line that you would expect to obtain in this experiment.

(2)

(iv) Explain any similarities in the lines you have drawn on the grid.
Use the collision theory of reaction rates to explain any differences between the shapes of the lines.

(3)

As fine powders of manganese (IV) oxide the rate of reaction increases, as there surface area is greater more effective collisions take place, thereby increasing the rate.

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Examiner Comments

The graph is well drawn and the explanation of the change in rate is a model of clarity and conciseness although it contradicts the appearance of the sketched line. The calculated rate is given to three significant figures.

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Examiner Tip

Make sure that graphs are plotted clearly and that the distinction between significant figures and decimal places is understood.

(iii) In a second experiment, the manganese(IV) oxide granules were replaced by the same mass of the compound as a fine powder. The volume and concentration of the aqueous hydrogen peroxide were kept the same.
On the grid in (b)(i), draw the line that you would expect to obtain in this experiment.

(2)

(iv) Explain any similarities in the lines you have drawn on the grid.
Use the collision theory of reaction rates to explain any differences between the shapes of the lines.

(3)

The general trend of the graphs are the same, where the lines are both steep in the beginning and becomes less steep ~~and~~ as time passes and levels off at ~~a~~ volume of oxygen 48 cm^3. The line of second experiment is steeper than first experiment and levels off at 48cm^3 faster than first experiment, as fine manganes (IV) oxide powder is used. Powder form has larger surface area and provides more site of reaction for H_2O_2 to ~~[illegible]~~ bind to, the rate of reaction increases and line becomes steeper. At Oxygen volume 48 cm^3, all H_2O_2 is used up and graph levels off. This line levels off faster as H_2O_2 is used up faster.

(c) Catalysts are not used up during a reaction. Outline an experiment to demonstrate

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Examiner Comments

The explanation in this example of 3(b)(iv) is over-long and repetitive.

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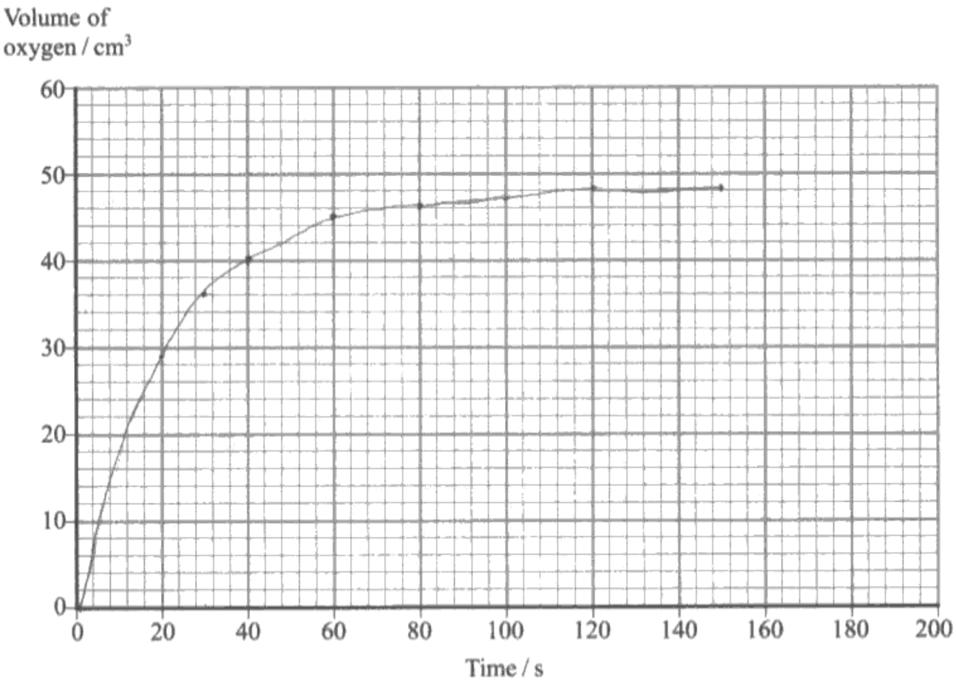
Examiner Tip

Aim to write concisely. The space provided for the answer gives an indication of the length of the required answer and does allow additional space.

(i) Plot these results on the grid below and draw a best fit line through the points.

(3)



(ii) The rate of reaction may be assumed to be approximately constant up to the first volume measurement (20.0 seconds in this experiment) and is called the initial rate. Use this approximation to calculate the initial rate of this reaction, giving your answer to **two** significant figures and stating the units.

(2)

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Examiner Comments

The points in this example are only just visible.

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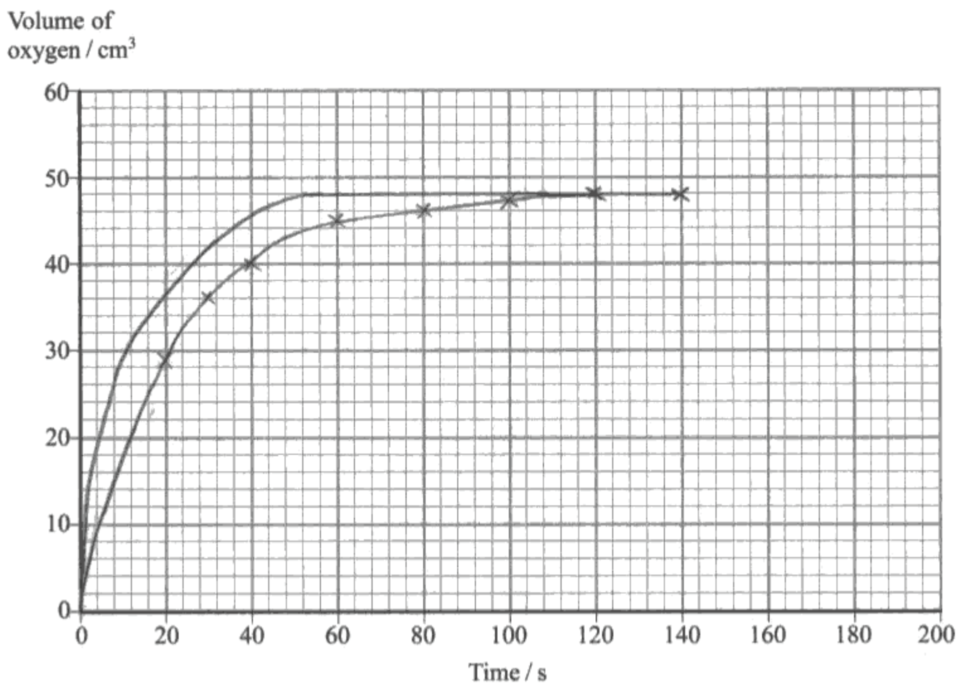
Examiner Tip

Use circles or crosses to clearly identify the points.

(i) Plot these results on the grid below and draw a best fit line through the points.

(3)



(ii) The rate of reaction may be assumed to be approximately constant up to the first volume measurement (20.0 seconds in this experiment) and is called the initial rate. Use this approximation to calculate the initial rate of this reaction, giving your answer to **two** significant figures and stating the units.

(2)

Initial rate of reaction = Gradient of graph

$= \frac{29}{20.0}$

$= 1.5\ cm^3\ s^{-1}$

(iii) In a second experiment, the manganese(IV) oxide granules were replaced by the same mass of the compound as a fine powder. The volume and concentration of the aqueous hydrogen peroxide were kept the same.
On the grid in (b)(i), draw the line that you would expect to obtain in this experiment.

(2)

(iv) Explain any similarities in the lines you have drawn on the grid.
Use the collision theory of reaction rates to explain any differences between the shapes of the lines.

(3)

One of the similarities of the graph is the ~~final~~ total volume of oxygen collected, which is 48cm^3. Since the same number of moles of hydrogen peroxide were used, the volume of oxygen collected would be similar. In the second experiment, since fine powder was used, the total surface area of manganese (IV) oxide is higher. Frequency of collision of molecules increases. A greater proportion of collision are successful. Hence, initial rate of reaction is higher. Therefore, gradient of line at t=0s in steeper.

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Examiner Comments

This is a generally very high standard of answer. Note that in 3(b)(iv) the candidate states that the 'proportion of successful collisions increases' as well as the number. This is incorrect; it is the same proportion of a larger number of collisions that result in reaction, so rate increases.

Question 3(c)

There were many excellent answers to this question and many more who appreciated that the key point of the answer was to demonstrate that the mass of catalyst was unchanged at the end of the reaction. The typical errors arose from a failure to appreciate the practical dimension of the question and the need to enumerate the essential stages required. Some went to the other extreme and, despite clear guidance in the question, insisted on giving extensive practical details of the process.

(c) Catalysts are not used up during a reaction. Outline an experiment to demonstrate that the manganese(IV) oxide is not used up in the decomposition of hydrogen peroxide (practical details of the experiment are **not** required).

(4)

The hydrogen peroxide Solution containing manganese (IV) oxide powder be heated and bring the Solution to less than half. Let the solution to cool off and evaporate. Filter the solution and collect the filterate. Let the filterate to dry and weigh its mass. The mass of dry fillrate = to the mass of manganese (IV) oxide powder used.

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Examiner Comments

Despite the unnecessary volume reduction, this is a well-structured answer covering all the essential points with appropriate conciseness.

(c) Catalysts are not used up during a reaction. Outline an experiment to demonstrate that the manganese(IV) oxide is not used up in the decomposition of hydrogen peroxide (practical details of the experiment are **not** required).

(4)

– Boil solution

~~Boil the so~~ of the manganese(IV) oxide and the aqueous hydrogen peroxide.

– This will quickly evaporate the decomposition of hydrogen peroxide and only leave the catalyst behind as a solid.

– ~~Dry the~~ Place contents of the beaker onto ~~the~~ a filter paper – allow to dry and weigh the filter paper.

– Solid manganese(IV) should have the same mass as before of 0.25g.

(Total for Question 3 = 16 marks)

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Examiner Comments

While evaporation rather than filtration is not ideal the inclusion of a viable separation method was deemed sufficient to gain that mark in the context of a very good answer.

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Examiner Tip

This is a practical paper so do think about the practical implications of your answer. Evaporation will be more difficult to implement than filtration.

(c) Catalysts are not used up during a reaction. Outline an experiment to demonstrate that the manganese(IV) oxide is not used up in the decomposition of hydrogen peroxide (practical details of the experiment are **not** required).

(4)

~~The manganese (IV) oxide is reacted with ethene. The purple~~
Nickel is used as catalyst for alkanes to undergo dehydrogenation ~~and~~ to become alkenes. The mass of the nickel is weighed before and after the experiment and is to be found that the mass is constant and does not change. Thus demonstrating that manganese (IV) oxide is not used up in the decomposition of hydrogen peroxide

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Examiner Comments

A small number of candidates referred to a completely different catalyst system in their answer despite the very specific requirements of the question.

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Examiner Tip

Answer the question asked.

(c) Catalysts are not used up during a reaction. Outline an experiment to demonstrate that the manganese(IV) oxide is not used up in the decomposition of hydrogen peroxide (practical details of the experiment are **not** required).

(4)

Weigh the manganese (IV) oxide using the weighing balance and record the mass and volume. Then, it is placed in a glass container. Add 50 cm^3 of 0.08 mol dm^{-3} of hydrogen peroxide into the conical flask with stopper connected to a graduated syringe. Place the glass container containing the manganese (VI) oxide into the conical flask and activate the stopwatch immediately. Record the volume of O_2 collected every 10 seconds, when the reaction stops, ~~remove the set up apparatus and remove~~ remove the glass container from the conical flask using forcep. Then, reweigh the mass of the manganese (IV) oxide using the weighing balance. The volume of MnO_4 can be measured by transferring it into a measuring cylinder. Record the mass and volume and compare. If there is no change in mass and volume, ~~this proves that~~ of manganese (IV) oxide, ~~this proves that~~ before and after the reaction, this proves that manganese (IV) oxide is not used up in the decomposition of hydrogen peroxide.

(Total for Question 3 = 16 marks)

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Examiner Comments

In this example, exhaustive experimental detail is included while key steps are omitted.

Question 4(a)

Most candidates appreciated that the degree of accuracy specified could only be provided by volumetric glassware. It is extremely useful for candidates to know the tolerances associated with the glassware used in the laboratory.

(a) Suggest the apparatus most suitable for measuring the volume of ethanol to an accuracy of ± 0.1 cm^3 (step 1).

(1)

~~burette~~ pipette

(b) Explain why it is necessary to pre-cool the bromine (step 3)

ResultsPlus

Examiner Comments

Volumetric glassware provides the required accuracy.

(a) Suggest the apparatus most suitable for measuring the volume of ethanol to an accuracy of ± 0.1 cm^3 (step 1).

(1)

Measuring Cylinder

(b) Explain why it is necessary to pre-cool the bromine (step 3)

ResultsPlus

Examiner Comments

A measuring cylinder is insufficiently accurate.

Question 4(b)

While most candidates appreciated that pre-cooling a reagent was necessary due to its volatility, answers in terms of the thermicity of the reaction were still quite common. Candidates often regarded the answers of 4(b) and 4(c) as inter-changeable.

(b) Explain why it is necessary to pre-cool the bromine (step 3).

(1)

Because it is a volatile liquid that can turn into gas very ~~easy~~ easaly, and at a low tempreture.

ResultsPlus
Examiner Comments

A satisfactory answer but note the repetition.

ResultsPlus
Examiner Tip

Avoid spending time reiterating the same point.

(b) Explain why it is necessary to pre-cool the bromine (step 3).

(1)

To keep it in the liquid state.

ResultsPlus
Examiner Comments

This is a perfectly acceptable formulation of the correct answer.

(b) Explain why it is necessary to pre-cool the bromine (step 3).

(1)

Reaction is too vigorous. Pre-cool the bromine to prevent the reaction to be too vigorous

ResultsPlus

Examiner Comments

This candidate focuses on the subsequent stage of the process, ignoring the 'cooling on mixing' which is the subject of the next question.

ResultsPlus

Examiner Tip

Glance through the parts of a question to ensure that your answer is in the appropriate place.

Question 4(c)

While most candidates gave straightforward, correct answers to this question on the need to cool the reagents on mixing, there were still some who were evidently not considering the practical sequence when framing their answer.

(c) Suggest why it is also necessary to cool the mixture while adding the bromine (step 3).

(1)

The reactions may be exothermic, causing the temperature of the flask to rise if not cooled.

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture

ResultsPlus

Examiner Comments

A good answer covering the essential points.

(c) Suggest why it is also necessary to cool the mixture while adding the bromine (step 3).

(1)

Bromine can react vigorously.

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture

ResultsPlus

Examiner Comments

Vigorous is an imprecise word which just gains the mark.

(c) Suggest why it is also necessary to cool the mixture while adding the bromine (step 3).

(1)

So that it isnt as exothermic.

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture

ResultsPlus

Examiner Comments

The meaning of exothermic has been misunderstood by this candidate. The thermicity of a reaction is fixed and the purpose of the cooling is to control the temperature.

(c) Suggest why it is also necessary to cool the mixture while adding the bromine (step 3).

(1)

These are exothermic.

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture

ResultsPlus

Examiner Comments

The use of the word ‘exothermic’ is unclear.

ResultsPlus

Examiner Tip

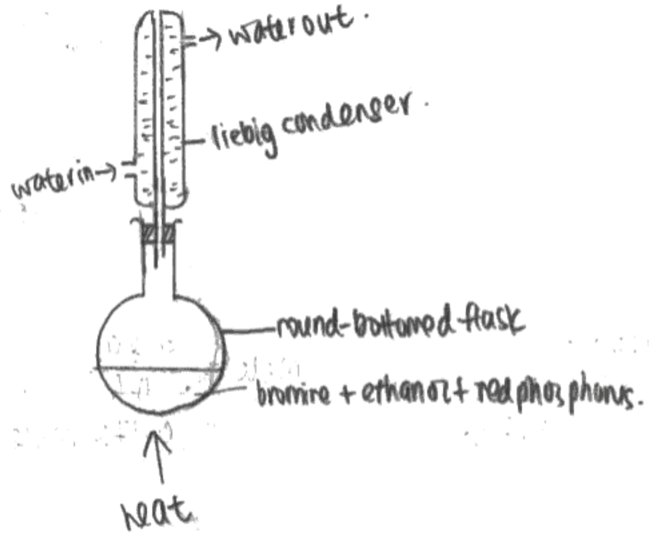
Try to make sure that the answer you write expresses what you want to say. **Reactions** are exothermic or endothermic.

Question 4(d)

Drawing a reflux condenser is a standard question but still one that causes considerable difficulty. Candidates need to be able to draw accurate cross-sectional diagrams of a workable apparatus.

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture under reflux (step 4).

(3)



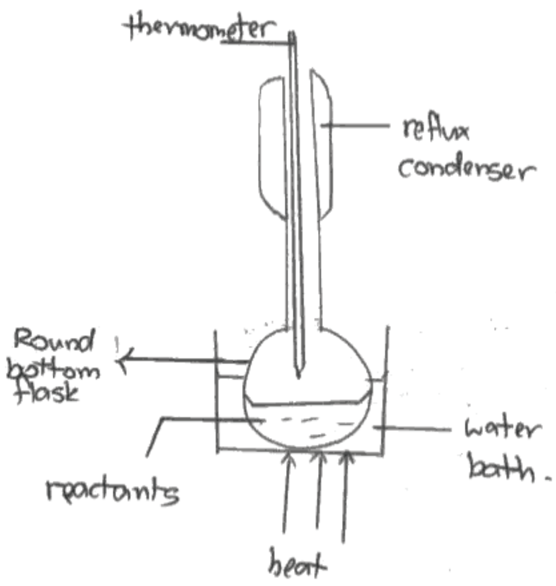
ResultsPlus

Examiner Comments

A good quality, well-labelled diagram which includes all the essential features of a working reflux.

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture under reflux (step 4).

(3)



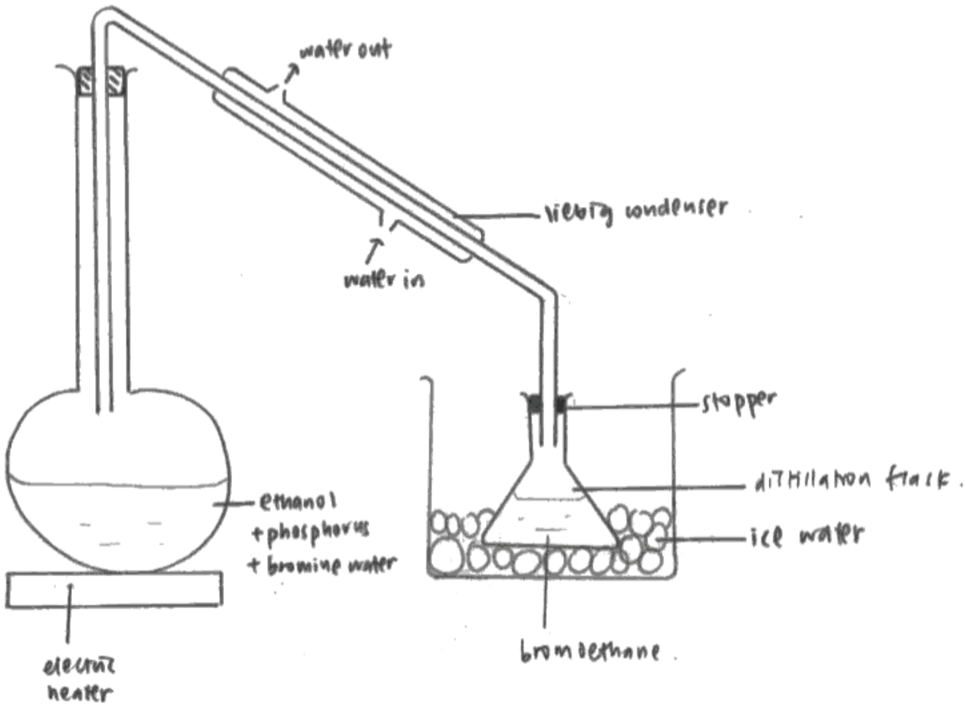
ResultsPlus

Examiner Comments

This candidate clearly understands what is meant by the term 'reflux' and has spent some time on the diagram. However, the condenser has no provision for the circulation of water and flask and condenser are shown as a single piece of apparatus. The thermometer is superfluous.

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture under reflux (step 4).

(3)



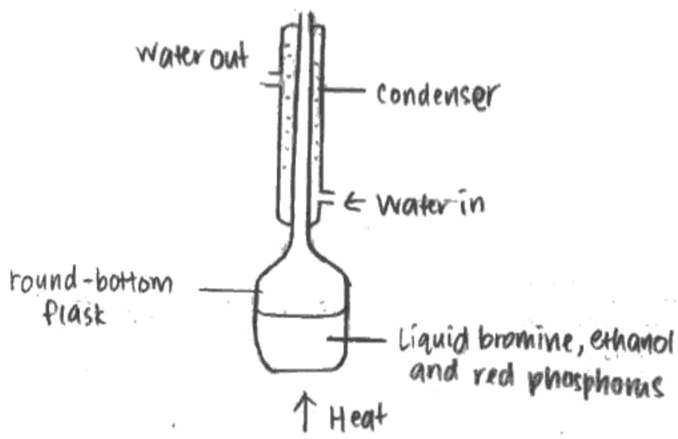
ResultsPlus

Examiner Comments

This is distillation not reflux and, to compound the error, the system is sealed.

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture under reflux (step 4).

(3)



ResultsPlus

Examiner Comments

The flask is labelled correctly but drawn incorrectly.

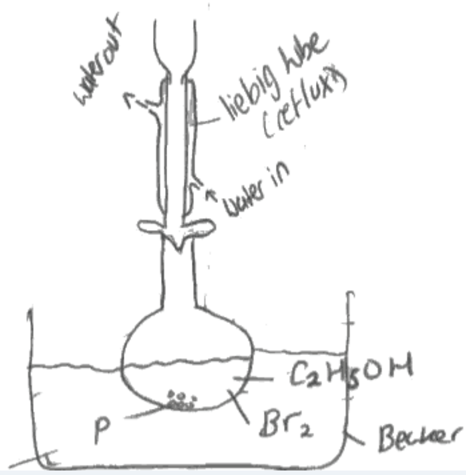
ResultsPlus

Examiner Tip

Be consistent in your answers.

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture under reflux (step 4).

(3)

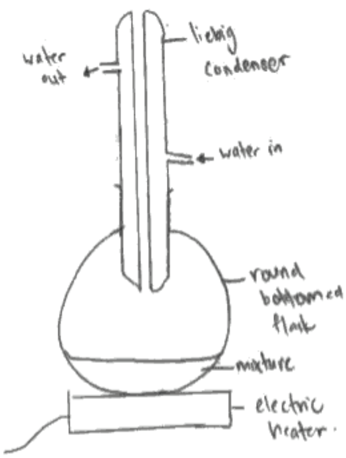


ResultsPlus
Examiner Comments

The apparatus is closed by the drawing at the neck of the flask.

(d) Draw a labelled diagram of the apparatus that you would use to heat the mixture under reflux (step 4).

(3)



ResultsPlus
Examiner Comments

This type of drawing in which the jacket of the condenser is inserted in the neck of the flask was not uncommon.

Question 4(e)

A frequent error in answers to 4(e) implied that cooling the receiver was necessary to condense the vapour. This is, of course, the function of the condenser.

(e) Suggest why, in both the distillations, the receiver is immersed in ice-cold water (steps 5 and 9).

(1)

Because bromoethane ~~eva~~ Boilis at 38.4°C, So use ice to cool the mixture and ensure you don't lose any of the product.

ResultsPlus
Examiner Comments

This answer is a bit wordy but makes the key points.

(e) Suggest why, in both the distillations, the receiver is immersed in ice-cold water (steps 5 and 9).

(1)

To keep the collected bromoethane at a suitable temprature so that it wont affected by external temperature

ResultsPlus
Examiner Comments

This answer fails to address the question or attempt to explain what is a 'suitable' temperature.

ResultsPlus
Examiner Tip

Do read your answers critically.

(e) Suggest why, in both the distillations, the receiver is immersed in ice-cold water (steps 5 and 9).

(1)

To condense the bromoethane formed.

ResultsPlus
Examiner Comments

This misses the point altogether.

Question 4(f)

These basic techniques of organic preparation are essential knowledge at this level.

(f) State the purpose of the following in this procedure:

(i) Washing the product with dilute sodium carbonate solution (step 6).

(1)

Remove ~~Wash off~~ any acid

(ii) Adding anhydrous calcium chloride to the organic layer (step 8).

(1)

To dry the mixture.

ResultsPlus
Examiner Comments

A clear, concise answer.

(f) State the purpose of the following in this procedure:

(i) Washing the product with dilute sodium carbonate solution (step 6).

(1)

to react & remove any of the aqueous H_3PO_4 left

(ii) Adding anhydrous calcium chloride to the organic layer (step 8).

(1)

To ~~dry the~~ react any water left behind

(g) Suggest a suitable temperature range for the collection of the product in the final

ResultsPlus
Examiner Comments

The answer is 4(f)(i) is excellent but in (f)(ii) the start of what looks like a correct answer is crossed out and replaced by something which does not actually make sense.

ResultsPlus
Examiner Tip

Do read through your answers.

(f) State the purpose of the following in this procedure:

(i) Washing the product with dilute sodium carbonate solution (step 6).

(1)

to remove excess acid.

(ii) Adding anhydrous calcium chloride to the organic layer (step 8).

(1)

acts as dehydrating agent.

(g) Suggest a suitable temperature range for the collection of the product in the final

ResultsPlus
Examiner Comments

Note that dehydration refers to the removal of the elements of water in a chemical reaction. 'Drying' is required here.

Question 4(g)

Many candidates appear to find the idea of collecting a distillate over a range 1 degree either side of the boiling temperature extremely hard to grasp. Some attempts at this question made no sense at all.

(g) Suggest a suitable temperature range for the collection of the product in the final distillation (step 9), giving the temperatures in whole numbers.

(1)

From 37 °C

To 39 °C

ResultsPlus
Examiner Comments

A rare perfect answer.

(g) Suggest a suitable temperature range for the collection of the product in the final distillation (step 9), giving the temperatures in whole numbers.

(1)

From 38.4°c

To 78.4°c

ResultsPlus

Examiner Comments

Here the candidate has just selected the two boiling points given in the data table.

(g) Suggest a suitable temperature range for the collection of the product in the final distillation (step 9), giving the temperatures in whole numbers.

(1)

From 4 °C

To 0 °C

ResultsPlus

Examiner Comments

It is quite difficult to see what this candidate had in mind.

ResultsPlus

Examiner Tip

Answers to this type of question are ofen to be found in the data provided.

Question 4(h)(i-iii)

The calculation of yield is a well-established question on this paper and most candidates showed an excellent understanding of the method. The most usual difficulty was in calculating the mass of ethanol from the volume and density.

While the rounding of intermediate answers was not penalised, retaining the data in the calculator and using these unrounded figure is good practice. This procedure saves time for the candidate, reduces the likelihood of keying errors and provides a more accurate final answer.

(h) (i) Calculate the number of moles of ethanol used in the preparation.

(1)

$D = \frac{m}{V}$

Mass = 0.789 × 10

= 7.89

= 7.89g

Moles = $\frac{7.89}{46}$

= 0.172 mol

(ii) Given that one mole of ethanol forms one mole of bromoethane, calculate the maximum mass, in grams, of bromoethane that may be prepared using 10 cm^3 of ethanol.

(1)

Mass = mole × Rmm

= 0.172 × 109

= 18.75 g

ResultsPlus
Examiner Comments

The first two steps in the calculation are completed successfully (albeit with a rounded value). However, in the final step the figures are inverted leading to a yield in excess of 100%.

ResultsPlus
Examiner Tip

Answers need to make sense; if you obtain a yield greater than 100%, review your calculation.

(h) (i) Calculate the number of moles of ethanol used in the preparation.

(1)

mass of ethanol = 10 × 0.789 = 7.89 g

mole = $\frac{7.89}{46}$ = 0.17 mol

(ii) Given that one mole of ethanol forms one mole of bromoethane, calculate the maximum mass, in grams, of bromoethane that may be prepared using 10 cm^3 of ethanol.

(1)

no of mole = 0.17 mol

mass = 0.17 × 109 = 18.53 g

(iii) Using the procedure described, a student prepared 13.3 g of bromoethane. Calculate the percentage yield of bromoethane in this preparation.

(1)

= $\frac{13.3}{18.53}$ × 100

= 71.8 %

ResultsPlus
Examiner Comments

Here the candidate has rounded the first answer to two significant figures and used the rounded answer for the second step. Note that the answer is appreciably different with the rounded value and that, quite illogically, the candidate has given subsequent answers to four significant figures, possibly because all answers are then expressed to two decimal places.

ResultsPlus
Examiner Tip

Best practice is to use unrounded values in successive calculations but at least strive for consistency.

Question 4(h)(iv)

The selection of ethanol as the reagent from which the yield must be calculated is determined by the simple fact that the bromine is in excess. Too many candidates failed to appreciate the need for them to study carefully the method given in the stem of the question and others sought complex answers where none was necessary.

Question 4(h)(v)

The reasons for yields of less than 100% in organic synthesis are well known and it is encouraging to see that many candidates showed that they understood clearly the meaning of terms like 'transfer losses'. However, a number of candidates suggested that energy losses would lead to loss of yield.

(v) Suggest **one** reason, other than volatility of the reactants or products, why the preparation does **not** produce a 100 % yield.

(1)

Measurement of ~~preparing~~ the reactants' volume for the experiment during preparation might not be 100% accurate to produce 100% yield.

ResultsPlus
Examiner Comments

Accuracy of measurement is unlikely to score on this type of question.

ResultsPlus
Examiner Tip

Unless clearly indicated otherwise, it is sensible to assume that the procedures in an experiment have been followed correctly.

(v) Suggest **one** reason, other than volatility of the reactants or products, why the preparation does **not** produce a 100 % yield.

(1)

Losses of reactants during transfer between apparatus.

Ethanol used is impure.

ResultsPlus
Examiner Comments

Here the candidate has offered two answers, one correct and one incorrect.

ResultsPlus
Examiner Tip

In general a mixture of correct and wrong answers will not score. In this question this general rule is emphasised because 'one' is in bold print.

ResultsPlus
Examiner Tip

Most candidates would improve their marks in this examination by following some fairly obvious guidelines:

Read the question carefully and take account of any specific excluded types of answer.

Ensure that you can draw clear and accurate diagrams of the basic apparatus used in AS Chemistry.

Check that you understand how to express numerical answers to specified numbers of significant figures and decimal places.

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