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Examiners' Report
June 2011

GCE Chemistry 6CH07 01

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Introduction

The style and format of the paper were similar to that in previous series. All the questions were accessible to well-prepared candidates and many excellent scripts were seen. The standard of the numerical work was high, although some candidates were unable to distinguish between decimal places and significant figures. A substantial number of rounding errors were seen. Other candidates insisted on quoting intermediate answers in calculations to only one significant figure, thereby considerably affecting the accuracy of their final answer. In a number of cases, candidates had failed to read the question with sufficient care and as a result, offered irrelevant answers.

Question 1 (a)

1 A student carried out a series of tests on two solids, **X** and **Y**. In parts (a) and (b), complete the inference column in the tables using names or formulae.

(a)

(3)

	Test	Observation	Inference
(i)	Carry out a flame test on solid **X**.	Lilac flame.	Cation in **X** K^+ ion
(ii)	Dissolve solid **X** in water. Add dilute nitric acid followed by aqueous silver nitrate. Test any precipitate formed with **concentrated** ammonia solution.	Pale cream precipitate formed which dissolved in **concentrated** ammonia solution.	Anion in **X** Br^- ion
(iii)	Add a few drops of concentrated sulfuric acid to a small portion of solid **X**.	A red-brown gas **Z** was released which condensed to a red-brown liquid.	Identity of gas **Z** Br_2

(iv) Give the **formula** of solid **X**.

(1)

KBr

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Examiner Comments

An excellent answer with all inferences correct.

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Examiner Tip

Use names if you are not 100% sure of the formulae of the species concerned.

1 A student carried out a series of tests on two solids, **X** and **Y**. In parts (a) and (b), complete the inference column in the tables using names or formulae.

(a)

(3)

	Test	Observation	Inference
(i)	Carry out a flame test on solid **X**.	Lilac flame.	Cation in **X** K^+
(ii)	Dissolve solid **X** in water. Add dilute nitric acid followed by aqueous silver nitrate. Test any precipitate formed with **concentrated** ammonia solution.	Pale cream precipitate formed which dissolved in **concentrated** ammonia solution.	Anion in **X** Br^-
(iii)	Add a few drops of concentrated sulfuric acid to a small portion of solid **X**.	A red-brown gas **Z** was released which condensed to a red-brown liquid.	Identity of gas **Z** NO_2

(iv) Give the **formula** of solid **X**.

(1)

KBr

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Examiner Comments

In (a)(iii), the red-brown gas was often incorrectly identified as nitrogen dioxide.

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Examiner Tip

Adding concentrated sulfuric acid to a solid containing only potassium and bromide ions cannot produce an oxide of nitrogen!

Question 1 (b)

(b) (3)

	Test	Observation	Inference
(i)	Warm a small quantity of solid **Y** with aqueous sodium hydroxide and test any gas evolved with damp red litmus paper.	Colourless gas evolved that turned damp red litmus paper blue.	Gas evolved NH_3 Cation in **Y** NH_4^+
(ii)	Acidify a solution of **Y** with dilute hydrochloric acid and then add aqueous barium chloride.	White precipitate formed.	Anion in **Y** ~~S~~ SO_4^-

(iii) Give the **formula** of solid **Y**. (1)

NH_4SO_4.

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Examiner Comments

In (b)(ii), the formula of the sulfate ion is incorrect. It should have two negative charges. In (b)(iii), the formula of ammonium sulfate is incorrect. A consequential mark for the formula in (b)(iii) was not awarded if either of the ions in (b)(i) and/or (b)(ii) had an incorrect charge - as is the case here in (b)(ii).

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Examiner Tip

In (b)(ii), had the candidate written the word "sulfate" instead, the mark would have been awarded.

(b) (3)

	Test	Observation	Inference
(i)	Warm a small quantity of solid **Y** with aqueous sodium hydroxide and test any gas evolved with damp red litmus paper.	Colourless gas evolved that turned damp red litmus paper blue.	Gas evolved NH_3 gas Cation in **Y** NH_4^+
(ii)	Acidify a solution of **Y** with dilute hydrochloric acid and then add aqueous barium chloride.	White precipitate formed.	Anion in **Y** Cl^-

(iii) Give the **formula** of solid **Y**. (1)

NH_4Cl

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Examiner Comments

In (b)(ii), the anion in Y is incorrectly identified as a chloride ion. In (b)(iii), a mark has been consequentially awarded for the formula of solid **Y** as the formula given follows on from the ions given in (b)(i) and b(ii), both of which exist.

(b) (3)

	Test	Observation	Inference
(i)	Warm a small quantity of solid **Y** with aqueous sodium hydroxide and test any gas evolved with damp red litmus paper.	Colourless gas evolved that turned damp red litmus paper blue.	Gas evolved ammonia (NH_3) Cation in **Y** ammonium ion (NH_4^+)
(ii)	Acidify a solution of **Y** with dilute hydrochloric acid and then add aqueous barium chloride.	White precipitate formed.	Anion in **Y** sulphate ion (SO_4^{2-})

(iii) Give the **formula** of solid **Y**. (1)

$(NH_4)_2SO_4$

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Examiner Comments

This answer is correct in all respects.

Question 02

2 An organic liquid, **W**, has the structure

$$HOCH_2CH{=}CHCH_2OH$$

Complete the table by writing the observations you would expect to make when the following tests are carried out.

Test	Observation
Add **W**, drop by drop, to a small volume of bromine water and shake the mixture until there is no further change.	Colour change from orange brown to colourless
Add phosphorus(V) chloride to **W**. Test any gas evolved with damp blue litmus paper.	Steamy fumes ~~are~~ (white) are observed
Add aqueous potassium dichromate(VI), acidified with dilute sulfuric acid, to **W** and heat the mixture.	Colour change from orange to green

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Examiner Comments

An excellent answer, correct in all respects.

2 An organic liquid, **W**, has the structure

$C_4H_8O_2$

$$HOCH_2CH{=}CHCH_2OH$$

Complete the table by writing the observations you would expect to make when the following tests are carried out.

Test	Observation
Add **W**, drop by drop, to a small volume of bromine water and shake the mixture until there is no further change.	Colour change from Brown to Colouless
Add phosphorus(V) chloride to **W**. Test any gas evolved with damp blue litmus paper.	The damp blue litmus paper is bleached and turns red.
Add aqueous potassium dichromate(VI), acidified with dilute sulfuric acid, to **W** and heat the mixture.	Colour change from Orange to green.

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Examiner Comments

For the phosphorus(V) chloride test, the mark was not awarded for this answer relating to the effect of hydrogen chloride on damp blue litmus paper. The litmus paper is turned red, but is not bleached. There was frequently confusion with the result of the test for chlorine gas. The appearance of steamy fumes on evolution of hydrogen chloride was overlooked in this response.

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Examiner Tip

Check that all observations have been given.

2 An organic liquid, **W**, has the structure

$$HOCH_2CH{=}CHCH_2OH$$

Complete the table by writing the observations you would expect to make when the following tests are carried out.

Test	Observation
Add **W**, drop by drop, to a small volume of bromine water and shake the mixture until there is no further change.	Colour change from brown to colourless
Add phosphorus(V) chloride to **W**. Test any gas evolved with damp blue litmus paper.	Steamy fumes occur
Add aqueous potassium dichromate(VI), acidified with dilute sulfuric acid, to **W** and heat the mixture.	Colour change from orange to green

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Examiner Comments

This response did not include the fact that the hydrogen chloride formed when **W** reacts with phosphorus(V) chloride would turn the damp blue litmus paper red.

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Examiner Tip

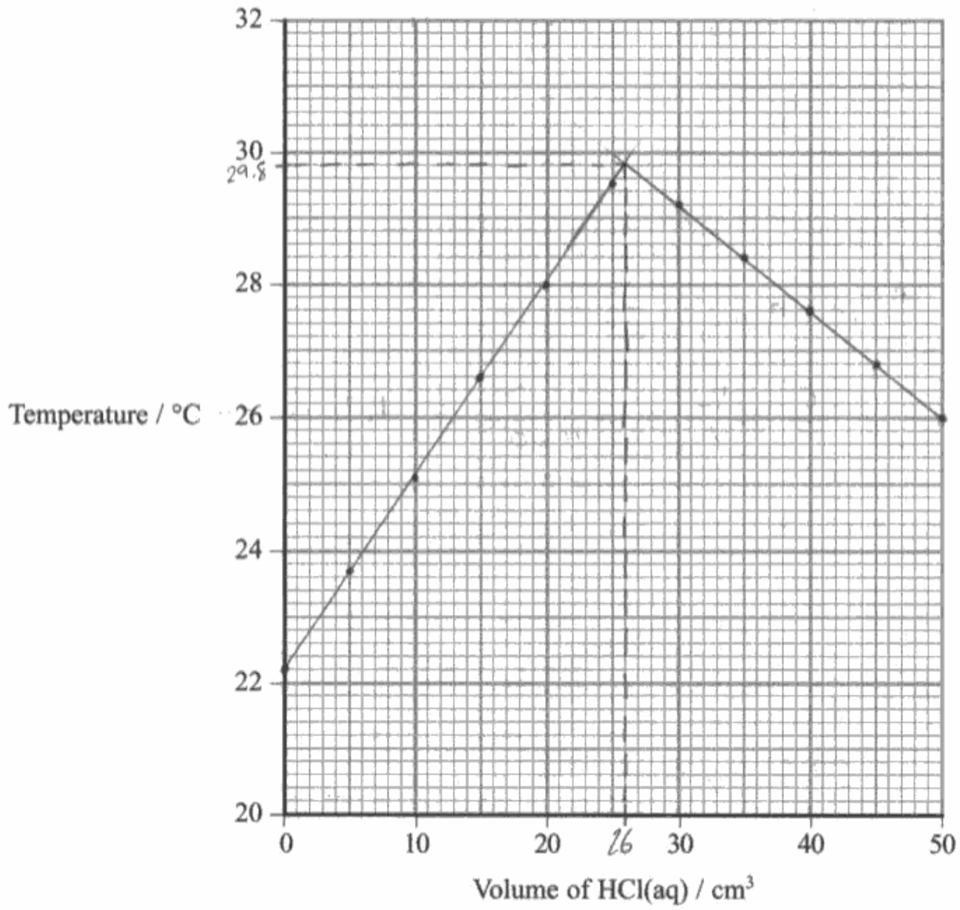
Read the question very carefully to ascertain what is required.

Question 3

Graph plotting and chemistry calculation skills were both examined in this question, which carried a maximum of fourteen marks.

(a) (i) Plot a graph of temperature against volume of acid added on the axes below. Draw two straight lines on your graph and extrapolate the lines until they intersect.

(2)



(ii) Use the extrapolated lines on your graph to read off the maximum temperature reached in the neutralization reaction.

(2)

Maximum temperature ......29.8...... °C

(iii) The point at which the two extrapolated lines meet corresponds to the volume of hydrochloric acid required for neutralization. Read off this volume from your graph.

(1)

Volume of hydrochloric acid ......~~26~~ 26...... cm^3

(iv) Calculate the number of moles of sodium hydroxide in 50.0 cm^3 of a 1.00 mol dm^{-3} solution.

(1)

$n = cV$

$= 1 \times \frac{50}{1000} = 0.05$ mols

(v) $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

Use this equation and your answers to (iii) and (iv) to calculate the concentration of the hydrochloric acid in mol dm^{-3}.

(2)

~~A~~ n(HCl) = 0.05 mol,

$C = \frac{n}{V} = \frac{0.05}{26 \times 10^{-3}} = 1.92$ mol dm^{-3}

(b) (i) Use your graph and answer to (a)(ii) to calculate the maximum temperature **change**, ΔT, for the reaction.

(1)

29.8 - 22.2

$\Delta T =$ 7.6 °C

(ii) Use your value for the temperature rise, ΔT, to calculate the heat energy produced when 50.0 cm^3 of sodium hydroxide is exactly neutralized by the volume of hydrochloric acid you obtained in (a)(iii).

Use the expression

energy produced (J) = total mass of solution × specific heat capacity of solution × temperature rise

[Assume the specific heat capacity of the solution to be 4.2 J g^{-1} °C^{-1} and the density of the solution to be 1.0 g cm^{-3}]

(2)

~~E = 50 × 4.2 × 7.6~~ ~~E = 1596 J~~

total volume = 50 + 26 = 76 cm^3

m = 1 × 76 = 76 g.

E = 76 × 4.2 × 7.6
= 2425.92 J

(iii) Use your answers to (a)(iv) and (b)(ii) to calculate the enthalpy change, in kJ mol^{-1}, for this reaction.

Give your answer to **two** significant figures and include a sign.

(3)

~~ΔH enthalpy = 1596 × 10⁻³ / 0.05 = 32 kJ mol⁻¹~~

ΔH enthalpy = 2425.92 × 10⁻³ / 0.05 = 49 kJ mol⁻¹

ΔH = ~~32~~ 49 kJ mol^{-1}

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Examiner Comments

An excellent answer, except that the negative sign has been omitted in (b)(iii). The reaction is exothermic and so a minus sign is required.

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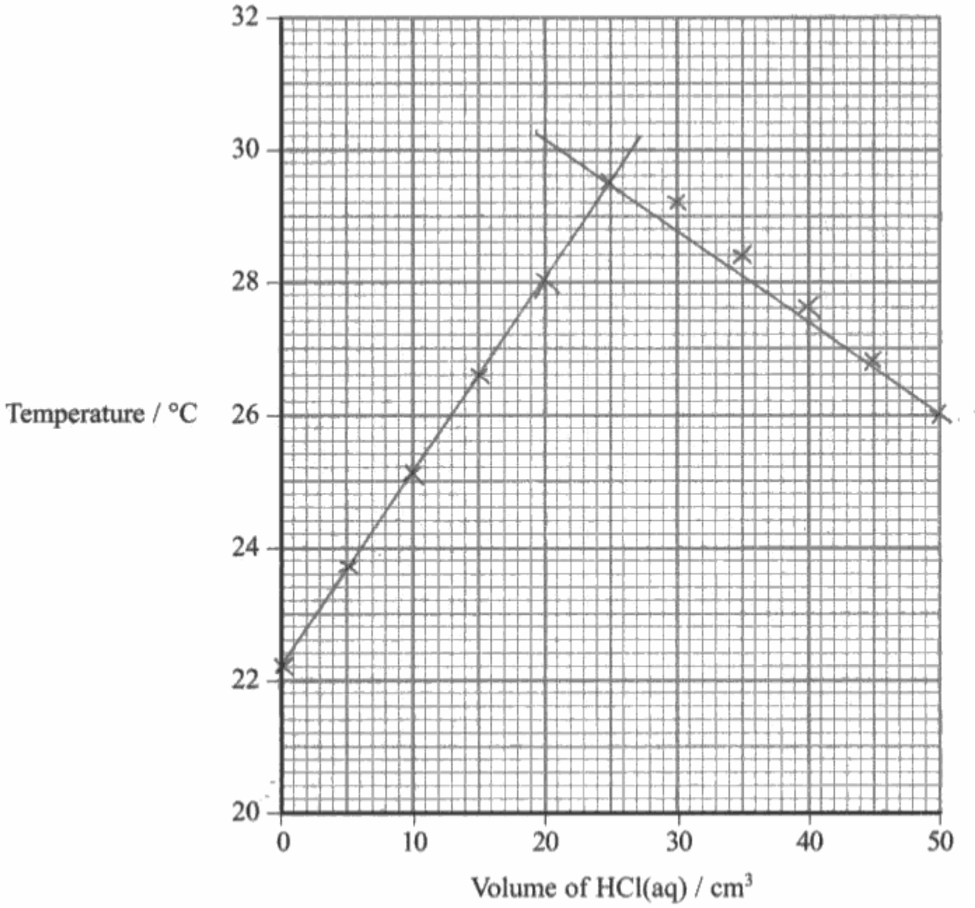
Examiner Tip

Always check at the end of an energetics calculation whether the reaction is exothermic or endothermic. Then give the correct sign.

(a) (i) Plot a graph of temperature against volume of acid added on the axes below. Draw two straight lines on your graph and extrapolate the lines until they intersect.

(2)



(ii) Use the extrapolated lines on your graph to read off the maximum temperature reached in the neutralization reaction.

(2)

Maximum temperature ....29.5.... °C

(iii) The point at which the two extrapolated lines meet corresponds to the volume of hydrochloric acid required for neutralization. Read off this volume from your graph.

(1)

Volume of hydrochloric acid ....25.... cm^3

(iv) Calculate the number of moles of sodium hydroxide in 50.0 cm^3 of a 1.00 mol dm^{-3} solution.

(1)

moles = $\frac{C \times V}{1000}$ moles = $\frac{50 \times 1}{1000}$

moles = 0.05

(v) $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

0.05 moles 0.05 moles

Use this equation and your answers to (iii) and (iv) to calculate the concentration of the hydrochloric acid in mol dm^{-3}.

(2)

moles = $\frac{C \times V}{1000}$

$0.05 = \frac{C \times 25}{1000}$

$C = \frac{0.05 \times 1000}{25}$ C = 2 mol dm^{-3}

(b) (i) Use your graph and answer to (a)(ii) to calculate the maximum temperature **change**, ΔT, for the reaction.

(1)

(29.5) - (22.2) = 7.3 ΔT = 7.3 °C

(ii) Use your value for the temperature rise, ΔT, to calculate the heat energy produced when 50.0 cm^3 of sodium hydroxide is exactly neutralized by the volume of hydrochloric acid you obtained in (a)(iii).

Use the expression

energy produced (J) = total mass of solution × specific heat capacity of solution × temperature rise

[Assume the specific heat capacity of the solution to be 4.2 J g^{-1} °C^{-1} and the density of the solution to be 1.0 g cm^{-3}]

(2)

(50×1) × 4.2 × 7.3 = 1533 Joules

(iii) Use your answers to (a)(iv) and (b)(ii) to calculate the enthalpy change, in kJ mol^{-1}, for this reaction.

Give your answer to **two** significant figures and include a sign.

(3)

~~1533 Joules~~ ~~to~~ 1533 Joules to 1.533 kJ

~~1.533~~ / ~~0.05~~ ~~1.533~~ / ~~0.05~~ = ~~30~~

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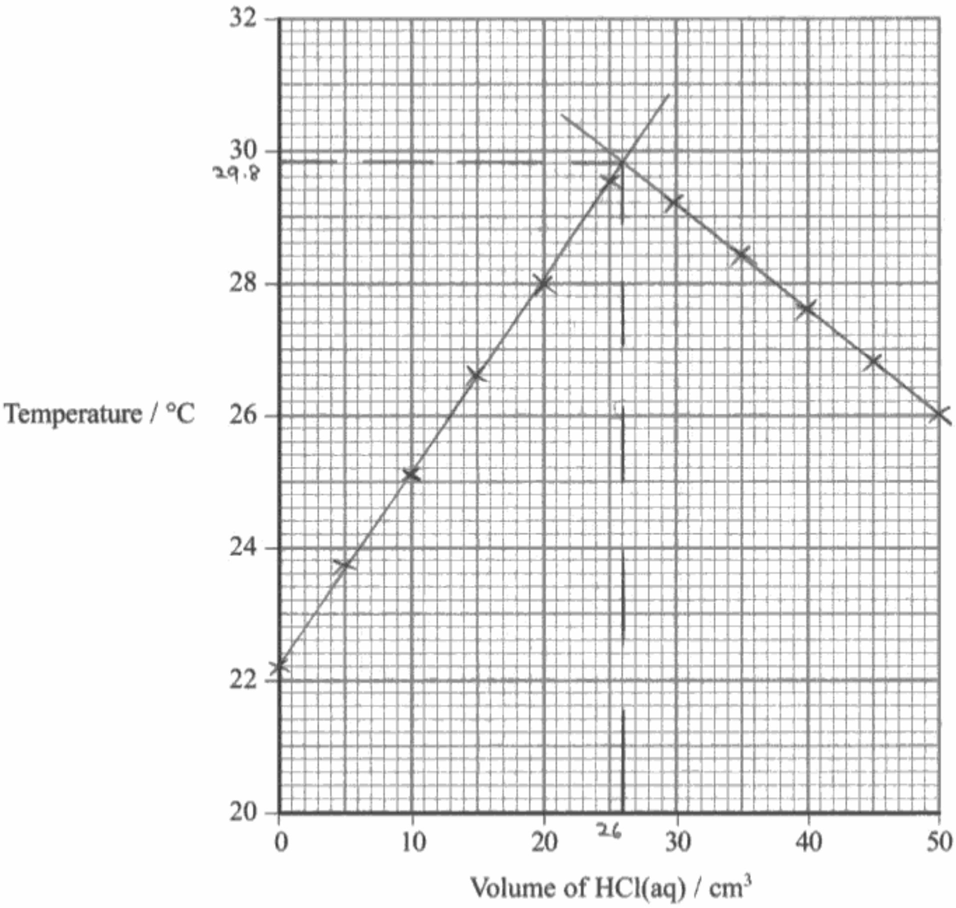
Examiner Comments

In part (a), note how the right-hand straight line misses the points and so the two straight lines do not intersect above 29.5 °C. The two straight lines should intersect at a temperature above the highest temperature given in the table of results! Despite this error, consequential marking allows the award of further marks in later parts of the question.

(a) (i) Plot a graph of temperature against volume of acid added on the axes below. Draw two straight lines on your graph and extrapolate the lines until they intersect.

(2)



(ii) Use the extrapolated lines on your graph to read off the maximum temperature reached in the neutralization reaction.

(2)

Maximum temperature ....29.8.... °C

(iii) The point at which the two extrapolated lines meet corresponds to the volume of hydrochloric acid required for neutralization. Read off this volume from your graph.

(1)

Volume of hydrochloric acid ....26.0.... cm^3

(iv) Calculate the number of moles of sodium hydroxide in 50.0 cm^3 of a 1.00 mol dm^{-3} solution.

(1)

$n_{NaOH} = \left(\frac{50}{1000}\right)(1)$

$= 0.05$ mol

$\therefore$ 0.05 mol.

(v) $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

Use this equation and your answers to (iii) and (iv) to calculate the concentration of the hydrochloric acid in mol dm^{-3}.

(2)

$0.05 = \left(\frac{26}{1000}\right)(M)$

$M = 1.92$ mol dm^{-3}

$\therefore$ 1.92 mol dm^{-3}.

(b) (i) Use your graph and answer to (a)(ii) to calculate the maximum temperature **change**, ΔT, for the reaction.

(1)

$\Delta T =$ 7.6 °C

$29.8 - 22.2 = 7.6$ °c

(ii) Use your value for the temperature rise, ΔT, to calculate the heat energy produced when 50.0 cm^3 of sodium hydroxide is exactly neutralized by the volume of hydrochloric acid you obtained in (a)(iii).

Use the expression

energy produced (J) = total mass of solution × specific heat capacity of solution × temperature rise

[Assume the specific heat capacity of the solution to be 4.2 J g^{-1} °C^{-1} and the density of the solution to be 1.0 g cm^{-3}]

(2)

Energy produced = (50 + 26) × 4.2 × 7.6

~~= 326.8 J~~

~~= 0.327 kJ~~

= 2425.9 J

= 2.43 kJ

(iii) Use your answers to (a)(iv) and (b)(ii) to calculate the enthalpy change, in kJ mol^{-1}, for this reaction.

Give your answer to **two** significant figures and include a sign.

(3)

~~$\Delta H = -\frac{0.327}{0.05}$~~

~~= −6.5 kJ mol⁻¹~~

$\Delta H = -\frac{2.43}{0.05}$

= −49 kJ mol^{-1}

ΔH = −49 kJ mol^{-1}

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Examiner Comments

An excellent answer, correct in all aspects.

Question 4 (a)

4 An experiment was carried out to determine the concentration of a solution of potassium iodate(V), KIO_3.

Procedure

1. From a large volume of a solution of potassium iodate(V), use a pipette to withdraw a 25.00 cm^3 sample and place the sample in a conical flask.

2. Add excess amounts of both potassium iodide solution and dilute sulfuric acid to the 25.00 cm^3 of potassium iodate(V) solution in the conical flask. The iodate(V) ions oxidize iodide ions to iodine, in acidic solution, as shown in Equation 1:

$$IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O \qquad \textbf{(Equation 1)}$$

3. Titrate the iodine formed with a solution of sodium thiosulfate, $Na_2S_2O_3$, using starch as indicator.

$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6 \qquad \textbf{(Equation 2)}$$

Results

Number of titration	1	2	3
Burette reading (final) / cm^3	25.10	26.35	24.10
Burette reading (initial) / cm^3	0.00	2.05	0.00
Volume of $Na_2S_2O_3$ used / cm^3	25.10	24.30	24.10

(a) (i) Which **two** titrations should be used to calculate the mean (average) titre? Explain your answer.

(2)

2, 3. Because the first titration is a roughf fitration and is not always very acurrate.

(ii) Calculate the mean titre in cm^3.

(1)

~~$\frac{26.35 + 24.10}{2} = \frac{50.45}{2} = 25.225\ cm^3$~~

$\frac{24.30 + 24.10}{2} = \frac{48.4}{2} = 24.2\ cm^3$

(iii) The sodium thiosulfate solution used in the titration has a concentration of 0.100 mol dm^{-3}. Calculate the number of moles of sodium thiosulfate in the mean titre.

(1)

$\text{moles} = \frac{C \times V}{1000}$ $\text{moles} = \frac{0.1 \times 24.2}{1000}$

$\text{moles} = 2.42 \times 10^{-3}$

(iv) Use **Equation 2** to calculate the number of moles of iodine, I_2, that reacted with the number of moles of sodium thiosulfate you have calculated in part (a)(iii).

(1)

$\frac{2.42 \times 10^{-3}}{2} = 1.21 \times 10^{-3}$

(v) Use your answer to part (a)(iv) and **Equation 1** to calculate the number of moles of iodate(V) ions in 25.00 cm^3 of solution.

(1)

$\frac{1.21 \times 10^{-3}}{3} = 4.03 \times 10^{-4}$

(vi) Use your answer to (a)(v) to calculate the concentration of the potassium iodate(V) solution, KIO_3, **in g dm^{-3}**.

[The molar mass of KIO_3 is 214 g mol^{-1}]

(2)

$\text{moles} = \frac{\text{Mass}}{Mr}$ $4.03 \times 10^{-4} = \frac{\text{Mass}}{214}$

mass = 0.086 g

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Examiner Comments

The correct titration numbers are identified in (a)(i). The calculations in (a)(ii) to (a)(v) are correct. In (a)(vi), the mass of potassium iodate(V) is correct, but this value has not been divided by the volume of solution, which is 0.02500 dm^3. Therefore, only one mark (out of a possible two) has been awarded for (a)(vi).

4 An experiment was carried out to determine the concentration of a solution of potassium iodate(V), KIO_3.

Procedure

1. From a large volume of a solution of potassium iodate(V), use a pipette to withdraw a 25.00 cm^3 sample and place the sample in a conical flask.

2. Add excess amounts of both potassium iodide solution and dilute sulfuric acid to the 25.00 cm^3 of potassium iodate(V) solution in the conical flask. The iodate(V) ions oxidize iodide ions to iodine, in acidic solution, as shown in Equation 1:

$$IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O \qquad \textbf{(Equation 1)}$$

3. Titrate the iodine formed with a solution of sodium thiosulfate, $Na_2S_2O_3$, using starch as indicator.

$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6 \qquad \textbf{(Equation 2)}$$

Results

Number of titration	1	2	3
Burette reading (final) / cm^3	25.10	26.35	24.10
Burette reading (initial) / cm^3	0.00	2.05	0.00
Volume of $Na_2S_2O_3$ used / cm^3	25.10	24.30	24.10

(a) (i) Which **two** titrations should be used to calculate the mean (average) titre? Explain your answer.

(2)

25.10 and 24.10 should be used to calculate mean titre.

The reason 26.35 is not taken is because the initial reading on Burette is 2.05, it has to be zero.

(ii) Calculate the mean titre in cm^3. (1)

$\left(\frac{25.10 + 24.10}{2}\right) cm^3$

$= 24.6\ cm^3$

(iii) The sodium thiosulfate solution used in the titration has a concentration of 0.100 mol dm^{-3}. Calculate the number of moles of sodium thiosulfate in the mean titre. (1)

mole = conc × vol

$= 0.100 \times \frac{24.6}{1000}$

$= 2.46 \times 10^{-3}$ mol

(iv) Use **Equation 2** to calculate the number of moles of iodine, I_2, that reacted with the number of moles of sodium thiosulfate you have calculated in part (a)(iii). (1)

mole ratio of $Na_2S_2O_3 : I_2$

= 2 : 1

$= 2.46 \times 10^{-3} \times \frac{1}{2}$

$= 1.23 \times 10^{-3}$ mol

(v) Use your answer to part (a)(iv) and **Equation 1** to calculate the number of moles of iodate(V) ions in 25.00 cm^3 of solution. (1)

mole ratio = 3 : 1

$= 4.1 \times 10^{-4}$ mol

(vi) Use your answer to (a)(v) to calculate the concentration of the potassium iodate(V) solution, KIO_3, **in g dm^{-3}**.

[The molar mass of KIO_3 is 214 g mol^{-1}] (2)

$4.1 \times 10^{-4} = \frac{mass}{214}$

∴ mass = 0.088 g

Conc = $\frac{0.088}{\frac{25}{1000}}$

$= 3.5\ g\,dm^{-3}$

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Examiner Comments

In (a)(i), a substantial number of candidates rejected the use of titre number 2 in calculating the mean titre as the initial reading was not 0.00 cm^3. The overall value of the titre is what matters, not the initial reading.

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Examiner Tip

Make sure you understand how the mean titre is calculated when carrying out a titration.

Question 4 (b) (i)

(b) (i) The error associated with reading the 25.00 cm^3 volume of the potassium iodate(V) solution in a pipette is ± 0.06 cm^3.

Calculate the percentage error associated with using a 25.00 cm^3 pipette.

(1)

Percentage error $= \frac{\pm 0.06}{25.00} \times 100$

$= 0.24\%$

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Examiner Comments

In (b)(i), the percentage error has been correctly calculated.

(b) (i) The error associated with reading the 25.00 cm^3 volume of the potassium iodate(V) solution in a pipette is ± 0.06 cm^3.

Calculate the percentage error associated with using a 25.00 cm^3 pipette.

(1)

$\frac{0.06 + 0.06}{25 cm^3} \times 100\%$

$= 0.48\%$.

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Examiner Comments

In (b)(i), the percentage error is incorrect. The pipette volume measurement should be considered as a single reading - and so the error of 0.06 cm^3 is not doubled.

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Examiner Tip

Always check whether the value under consideration is from a single reading, or from two readings.

Question 4 (b) (ii)

(ii) Describe **two** things you could do to ensure that the burette readings are as accurate as possible. Assume that the burette has been appropriately rinsed and filled with the sodium thiosulfate solution.

(2)

1 Take several redings and use the mean value.

2 Look at the scale at eye level to avoid parallax error.

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Examiner Comments

In (b)(ii), only one mark has been awarded (for the answer numbered "2"). The mean titre has been calculated from the two concordant values in the table of results.

Question 5 (a) (i) 1

(a) (i) Identify the technique shown in each diagram.

(2)

Diagram 1 Condensation

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Examiner Comments

In (a)(i), Diagram 1, the technique shown is heating under reflux. The answer given here is incorrect.

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Examiner Tip

Learn the different types of technique encountered in practical organic chemistry.

(a) (i) Identify the technique shown in each diagram.

(2)

Diagram 1 Heat under reflux

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Examiner Comments
The answer given for (a)(i) is correct.

Question 5 (a) (i) 2

Diagram 2 Fractional Distillation.

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Examiner Comments
The technique shown in Diagram 2 is simple distillation rather than fractional distillation.

Diagram 2 Distillation.

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Examiner Comments
The technique shown in Diagram 2 is distillation.

Question 5 (a) (ii)

(ii) Explain why a stopper should **not** be placed in the top of the condenser shown in diagram 1.

(1)

Heat will not be able to ~~[illegible]~~ escape.

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Examiner Comments

The response given here was frequently seen. This was not given the mark. The problem would be the build-up of pressure if a stopper were placed in the top of the condenser.

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Examiner Tip

Always consider carefully the feasibility of any apparatus drawn.

(ii) Explain why a stopper should **not** be placed in the top of the condenser shown in diagram 1.

(1)

because gas is produced and if there was a lid, the pressure would increase.

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Examiner Comments

This response was awarded the mark for this question.

Question 5 (b) (i)

(b) (i) Give **one** reason why the iodine was added over a period of time and in small amounts.

(1)

So that all the added iodine gets reacted.

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Examiner Comments

Many answers suggested that the iodine was added over a period of time, and in small amounts, to ensure that it all reacted. This was not the reason. Focus should have been on the exothermic nature of the reaction.

(b) (i) Give **one** reason why the iodine was added over a period of time and in small amounts.

(1)

To prevent too much heat being produced

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Examiner Comments

This answer is correct as it recognises the exothermic nature of the reaction.

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Examiner Tip

Always be aware of good practice designed to enhance safety when carrying out experiments in the laboratory.

Question 5 (b) (ii)

(ii) Explain why water baths were used in both step 6 and step 8 rather than heating the flasks directly with a Bunsen flame.

(1)

Both organic compound are flammable. Direct heating may cause combustion.

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Examiner Comments

In (b)(ii), an awareness of the danger inherent if a Bunsen burner were to be used near flammable organic chemicals was required.

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Examiner Tip

Think "safety" when considering practical aspects of chemistry.

Question 5 (b) (iii)

(iii) Suggest the temperature range suitable for the collection of iodoethane shown in diagram 2.

(1)

From 70 to 75 °C

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Examiner Comments

This was considered a suitable temperature range to collect iodoethane, which boils at 72 °C.

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Examiner Tip

Always check the table of data. The boiling point of iodoethane was given.

Question 5 (c)

(c) (i) Calculate the number of moles of iodine, I_2, in 25.4 g of iodine.

Use the relative atomic mass of I = 127

(1)

no. of moles $= \frac{25.4\text{ g}}{127\text{ g mol}^{-1}}$

$= 0.2$ mol #

(ii) In this reaction, 1 mol I_2 forms 2 mol CH_3CH_2I.

Calculate the maximum mass of iodoethane, in g, that could be formed from 25.4 g of iodine.

Use the following relative atomic masses: C = 12, H = 1, I = 127

(3)

no. of moles of iodoethane $= 0.2 \times 2$

$= 0.4$ mol

molar mass of iodoethane $= 12 \times 2 + 5 + 127$

$= 156\text{ g mol}^{-1}$

∴ max. mass of iodoethane $= 0.4\text{ mol} \times 156\text{ g mol}^{-1}$

$= 62.4$ g #

(iii) In a preparation, the mass of iodoethane collected was 23.4 g.

Calculate the percentage yield in this preparation.

(1)

Percentage yield $= \frac{23.4\text{ g}}{62.4\text{ g}} \times 100\%$

$= 37.5\%$ #

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Examiner Comments

In (c)(i), candidates often used the molar mass for 1 mol of iodine atoms, I, instead of the correct molar mass for 1 mol of iodine molecules, I_2. The mass of 25.4 g of iodine should have been divided by 254 NOT 127 g mol^{-1}.

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Examiner Tip

Check whether the data refers to atoms or to molecules of an element.

(c) (i) Calculate the number of moles of iodine, I_2, in 25.4 g of iodine.

Use the relative atomic mass of I = 127

(1)

$n = \frac{m}{M_r} = \frac{25.4}{254} = 0.1$ mole.

(ii) In this reaction, 1 mol I_2 forms 2 mol CH_3CH_2I.

Calculate the maximum mass of iodoethane, in g, that could be formed from 25.4 g of iodine.

Use the following relative atomic masses: C = 12, H = 1, I = 127

(3)

$n = 0.2$ moles

$M_r = 12 \times 2 + 5 + 127 = 156$

mass $= 0.2 \times 156$

$= 31.2$ g

(iii) In a preparation, the mass of iodoethane collected was 23.4 g.

Calculate the percentage yield in this preparation.

(1)

% yield $= \frac{23.4}{31.2} \times 100 = 75\%$

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Examiner Comments

An excellent answer, correct in all respects.

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Examiner Tip

Always set out your answers to calculation questions in a logical and orderly fashion. Writing neatly helps, too. Show each step clearly.

Paper Summary

Advice to candidates:-

- Read each question carefully - twice before you answer it and once after to make sure you have answered it.

- Be familiar with the various practical preparation techniques you have used in the course.

- Be familiar with the titrations you have met during the course.

- Practise calculations involving moles and masses, percentage yields, volumes of liquids, volumes of gases and volumes of solutions of known concentration.

- Know the tests for common cations, anions and gases relevant to AS chemistry.

- For the organic chemicals you have met during the course, know the tests for the functional groups they contain and the results of positive tests for these functional groups.

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