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Examiners' Report
June 2010

GCE Chemistry 6CH07

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Introduction

The examiners were pleased to see some candidates who had been extremely well prepared by their centres. Raw marks in the high forties were not uncommon. Of course there were, as always, candidates who had not prepared sufficiently and their performance was often weakened by a failure to read the question well.

Question 1 (a) (i)

In question 1: Candidates were led to determine the identity of an inorganic salt.

In part (a)(i), the best candidates dipped nichrome or platinum wire into concentrated hydrochloric acid, then the salt, and then placed the wire in a Bunsen flame. It was quite common not to use concentrated acid, which was not penalised on this occasion. On the other hand, candidates using the wrong acid were penalised. The type of flame is important. A luminous flame is not hot enough.

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

1 Compound **A** is a white solid that contains one Group 1 cation and one anion.

(a) (i) Describe how you would carry out a flame test on compound **A**.

(3)

Take a platinum rod and dip it into concentrated HCl, and then into the compound A, the sample which is to be tested. Then hold the platinum rod, with the sample, into the hottest part of the bunsen flame.

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Examiner Comments

This is a good answer, because the candidate has used the platinum wire to mix the salt with concentrated hydrochloric acid. The wire has then been placed in the hottest part of the Bunsen flame.

Question 1 (a) (ii)

The formula of the Group 1 ion which gives a red flame was needed. Weaker candidates did not read the question, and did not give the formula or gave the formula for a Group 2 ion.

(ii) In a flame test, compound **A** gives a red flame. Deduce the formula of the cation present.

(1)

~~calcium~~ ion. ~~(Ca^{2+})~~ Lithium.

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Examiner Comments

The correct element has been identified, but the formula of the cation has not been given.

Question 1 (b) (i)

As the question stated, either the name, calcium hydroxide, or the formula, $Ca(OH)_2$, were acceptable.

(b) On prolonged strong heating, compound **A** forms a white solid, **B**, and a gas. The gas turns limewater milky.

(i) Identify, by name or formula, the compound that is dissolved in water to make limewater.

(1)

Calcium

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Examiner Comments

This is an insuffcent answer.

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Examiner Tip

Check that your answer fully answers the question.

Question 1 (b) (ii)

The formula of the anion was required, but either CO_3^{2-} or HCO_3^- were fine. Some candidates still did not read the question well so did not give a formula. Many candidates did not know the charge on the carbonate ion. Very weak candidates did not know the correct number of oxygen atoms. Most candidates managed to justify their answer, though a few did not mention the formation of carbon dioxide and were penalised.

(ii) Suggest the formula for the anion in compound **A**. Justify your answer.

(2)

CO_3^- due to the evolution of CO_2.

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Examiner Comments

This answer would have been fine if the charge on the ion had been correct.

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Examiner Tip

Learn the formulae and charges on the common oxyanions.

Question 1 (c)-(d)

In (c)(i) and (ii), correct formulae with correct charges were needed. The main problem came in (iii) when many candidates confused the test for hydroxide ions with the test for the OH group in an alcohol.

In (d), a transferred error was allowed from a red flamed s-block element cation.

(c) When water is added to the white solid, **B**, it dissolves completely and exothermically to form solution **C**.

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

(1)

O^{2-}

(ii) Identify, by name or formula, the anion present in **C**.

(1)

OH^-

(iii) Suggest a test for the anion present in **C**. Give the result of your test.

(2)

Test Add ~~PCl5~~ PCl_5 to the anion.

Result Steamy fumes of HCl are formed.

(d) Suggest the **formula** of compound **A**.

(1)

Li_2CO_3

(Total for Question 1 = 12 marks)

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Examiner Comments

This is a typical answer, fully correct apart from the alcohol test in part (iii).

Question 2 (a) (i)

Question 2 concerned a pair of organic unknowns, though only one needed to be identified.

The yellow precipitate in (a)(i) was correctly identified by the majority of candidates. A few gave both name and formula when, as usual, both had to be correct.

2 This question is about two isomeric halogenoalkanes, **P** and **Q**.

(a) A hot aqueous solution of silver nitrate is added to each halogenoalkane. Both halogenoalkanes react to form a yellow precipitate.

(i) Identify, by name or formula, this yellow precipitate. **(1)**

~~chlorine gas~~. Iodine.

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Examiner Comments

The candidate has jumped ahead, realising that the organic compound contains iodine, but has failed to answer the question.

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Examiner Tip

It is always a good idea to read over the question again after writing the answer, to ensure that you have answered the question asked.

Question 2 (a) (ii)

Some candidates gave structural or displayed formulae, which were penalised, but this did not prevent them answering later parts correctly.

(ii) The isomers have relative molecular mass 169.9. Deduce the molecular formula of the isomers.

(1)

$CH_3(CH_2)_nI = 169.9$

$(CH_2)_n = 28$

$n = 2$

molecular formula : $CH_3(CH_2)_2I$

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Examiner Comments

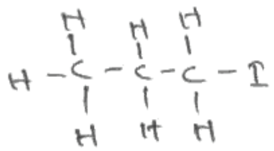
This candidate has a good method, and knows what they are doing, but has failed to answer the question, by giving the structural formula.

Question 2 (a) (iii)-(b) (ii)

The reason for the difference in rate of hydrolysis was often missed, so many gave the displayed formula of 1-bromobutane. The resulting alcohol was usually consistently identified with the corresponding alcohol to the halogenoalkane given in (iii). The part of this question that even the weakest candidates were able to do was (b)(i), giving the correct colour change from orange to green. As with (a)(iv), consistent answers were usually given to (b)(ii). Though some mistakenly gave the general name of the functional group.

(iii) Halogenoalkane **P** forms the yellow precipitate faster than halogenoalkane **Q**. Draw a displayed formula for halogenoalkane **P**.

(1)



(iv) Give the name or structural formula of the alcohol, **R**, formed by the reaction of halogenoalkane, **P**, with hot aqueous silver nitrate.

(1)

~~CH_3CH_2OH~~ . $CH_3CH_2CH_2OH$.

(b) When **R** is boiled with a mixture of potassium dichromate(VI) and dilute sulfuric acid, the organic product **S** forms.

(i) Give the colour change you would expect to see.

(2)

From Orange. to Green.

(ii) Give the **name** of **S**.

(1)

propanoic acid.

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Examiner Comments

This illustrates how a candidate can make an early error but, by applying their chemical knowledge correctly from then on, can still achieve most of the credit.

Question 2 (b) (iii)

It was important to give the answer in terms of the question. The organic compound R had been oxidized to S.

Question 3 (a) (i)

Question 3 was about the determination of the purity of potassium iodate(V), an experiment which seemed to be familiar to most of the candidates.

Only weak candidates gave burette, rather than pipette, in (a)(i). The examiners would prefer to see correct spelling of chemical apparatus.

(a) (i) Name the piece of apparatus used to remove the 10.0 cm^3 portions of potassium iodate(V) solution (step 2).

(1)

A ~~pipette~~ measuring cylinder

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Examiner Comments

A measuring cylinder is not sufficiently accurate.

Question 3 (a) (ii)

Many candidates wanted to use an acid-base indicator. A few gave the starch colour change the wrong way round.

(ii) Name the indicator you would use for the titration and give the colour change you would expect to see (step 4).

(2)

Indicator Starch

Colour change from ~~blu~~ colourless **to** blue black.

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Examiner Comments

It is important to identify the substance in the flask in a titration in order to get the colour change correct.

Question 3 (b) (i)

Calculation of titres was very well done in (b)(i).

(b) The following results were obtained for the titrations.

Titration number	1	2	3
Final burette reading / cm^3	19.50	33.20	46.95
Initial burette reading / cm^3	5.00	19.50	33.20
Titre / cm^3	14.50	13.70	13.76

(i) Complete the table by calculating the titres.

(1)

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Examiner Comments

But there are exceptions! It is particularly important to check your work at the beginning of a calculation.

Question 3 (b) (ii)-(e)

The need for concordant values, within 0.2 cm3, was well recognised in (ii).

The common error in (iii) was to forget to divide by 1000.

In (c), errors were to multiply the answer to (b)(iii) by two, rather than dividing by two, or to give the same answer as in (b)(iii). Such candidates need more practice in calculations based on chemical equations.

Similar problems arose in (d), where the answer to (c) was multiplied by three instead of dividing by three, or dividing by five or multiplying by three fifths or five thirds.

Conical flasks, measuring cylinders or even beakers were wrongly given in (c)(i).

Most candidates gained some credit in (c)(ii). Very few did not make up their solutions to ‘the mark’, but collection of the washings from the weighing bottle or mixing beaker, and failing to shake the mixture at the end, were often missed.

In (iii), consistent answers gained by multiplying the answer to (d) by ten were the norm, though a few divided by ten.

Candidates seemed to find (iv) rather easier, multiplying their answer to (iii) by 214.

Calculation of yield proved more challenging. Many candidates took an incorrect answer to (iv) and divided 0.1 by it rather than dividing their answer to (iv) by 0.1 before multiplying by 100. This was probably done to give a percentage less than 100.

Many good candidates scored full marks on sections (b), (c), (d) and (e).

(ii) Explain why the correct value for the mean titre is 13.73 cm^3.

(1)

This is because when find the mean titre, the first titre should be omitted, because there is a difference of more than 0.2 cm^3 for it. so the average of other two titre should be taken.

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

(1)

$c = \frac{n}{v}$

Amount = $0.0200 \times \frac{13.73}{1000}$

= 2.746×10^{-4} moles.

(c) The ionic equation for the reaction between iodine and sodium thiosulfate in the titration is shown below.

$$I_2(aq) + 2S_2O_3^{2-}(aq) \rightarrow 2I^-(aq) + S_4O_6^{2-}(aq)$$

Calculate the number of moles of iodine in solution **T** using this equation and your answer to (b)(iii).

(1)

mole ratio of iodine : sodiumthiosulfate

= 1 : 2

Amount of iodine = $\frac{1}{2} \times 2.746 \times 10^{-4}$

= 1.373×10^{-4} moles.

(d) The ionic equation for the reaction of iodate(V) ions with iodide ions is shown below.

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

Using this equation and your answer to (c), calculate the number of moles of iodate(V) ions which reacted to produce solution **T**.

(1)

mole ratio of iodate (v) : iodine

= 1 : 5

Amount of iodate (v) = $\frac{1}{5} \times 1.373 \times 10^{-4}$

= 2.746×10^{-5} moles.

(e) (i) Name the appropriate flask used in step 1.

(1)

100cm³ volumetric flask.

(ii) Describe how you would make up exactly 100 cm³ of potassium iodate(V) solution in this flask, ready for step 2.

(3)

Pour the sample which was dissolved in the ~~flask~~ beaker into the 100 cm³ volumetric flask. Wash the rinsings of the beaker into the flask. Then fill the volumetric flask with water untill it reaches the 100 cm³ mark. Then close the flask with the lid and invert the flask and shake well.

(iii) Calculate the number of moles of potassium iodate(V) in 100 cm³ of the solution, using your answer to (d).

(1)

Amount $= 2.746 \times 10^{-5} \times 10$

$= 2.746 \times 10^{-4}$ moles

(iv) Calculate the mass of potassium iodate(V) in the sample.

[Assume the molar mass of potassium iodate(V) is 214 g mol^{-1}]

(1)

mass $= 2.746 \times 10^{-4} \times 214$

$= 5.88 \times 10^{-2}$ g

(v) Calculate the percentage purity of the sample.

(1)

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Examiner Comments

This example shows how a candidate has got most of the credit, despite a mistake in part (d). Regrettably, they did not calculate a percentage yield. 59% would have gained the final mark.

Question 3 (f)

It was necessary to identify the hazard by saying what the sulfuric acid does, rather than just identifying sulfuric acid.

Question 4 (a)

In this question, an understanding of how to calculate amounts of chemicals needed for an experiment was examined.

In (i), only better candidates were able to show a reasoned answer, and jumbles of figures were very common.

Part (ii) was answered better although many, having found the correct mass, were unable to calculate the volume by dividing mass by density.

The common error in (iii) was to find the mass of 0.1 mol of potassium bromide.

(a) (i) Show, by calculation, that 0.125 mol of butan-1-ol is needed to make 0.100 mol of 1-bromobutane.

(2)

moles of 1-bromobutene ~~= 0.100 moles~~

= ~~0.10 moles~~

∴ ~~mole ratio of 1-bromobutene : butan-1-ol~~

$\frac{80}{100} \times 0.125 = 0.1$ moles

(ii) Calculate the volume of 0.125 mol of butan-1-ol, in cm^3.

(2)

Density (butan-1-ol) = mass / volume

(mass of butan-1-ol) = moles × molar mass

= 0.125 × 74

= 9.25 g

0.81 = 9.25 / volume

∴ volume = 9.25 / 0.81

= 11.4 cm^3

(iii) Calculate the minimum mass of potassium bromide required in step 1.

[The molar mass of potassium bromide is 119 g mol^{-1}]

(1)

mole ratio of KBr : HBr : $CH_3CH_2CH_2CH_2OH$

1 : 1 : 1

∴ moles of KBr = 0.125 moles

∴ mass = moles × molar mass

= 0.125 × 119

= ~~14.9~~ = 14.9 g

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Examiner Comments

This would have gained full credit, but for the failure of the candidate to state which chemical their calculation referred to.

Question 4 (b)

There were many good diagrams gaining full marks. The example illustrates some instructive points.

(b) Complete and label the diagram below of the apparatus assembled in steps 1, 2 and 3.

[You may assume that the apparatus is suitably clamped.]

(4)

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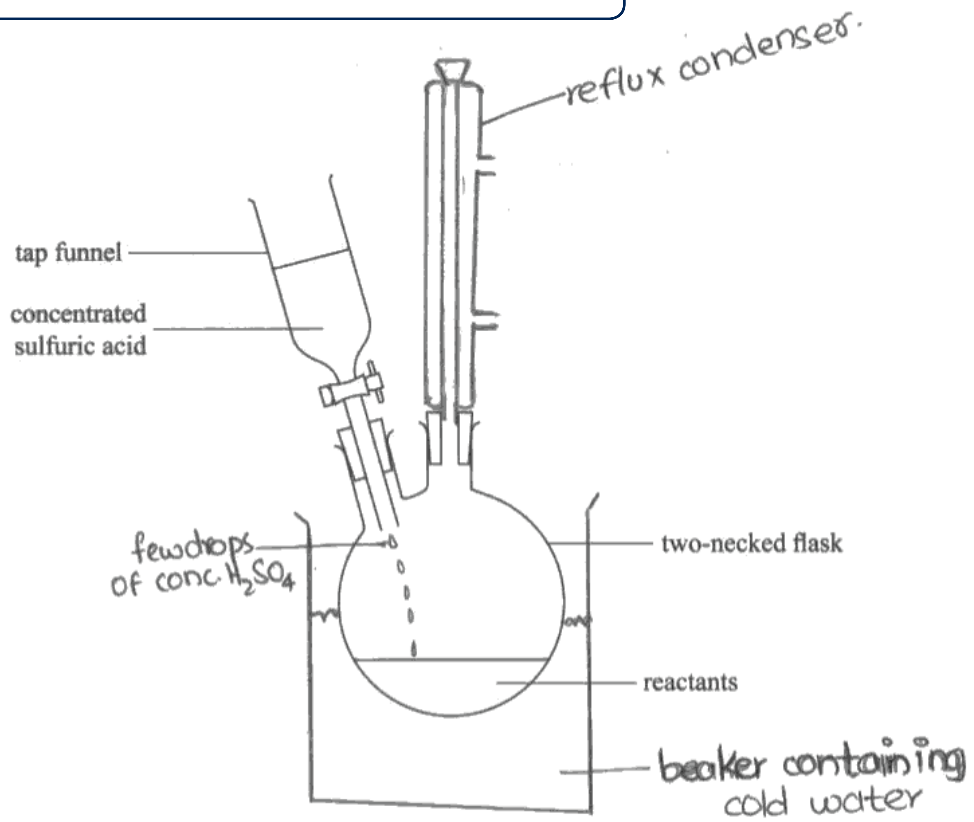
The water flow direction is omitted and there appears to be a stopper in the top of the condenser.



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Examiner Tip

In apparatus diagrams, make sure you leave spaces for gases to flow through, where appropriate.

Question 4 (c) (i)

The reason was commonly omitted, though the lower layer was often correctly identified.

Question 4 (c) (ii)

In (c)(ii), both the reason for the washing and the cause of the gas were needed for both marks.

Common errors were to be vague - 'to remove impurities'. Some gave 'to remove butan-1-ol'.

Question 4 (d) (i)

Only good candidates realised that the final step in the purification of a liquid is redistillation.

(d) (i) What further step is necessary to purify the 1-bromobutane obtained in step 10? (1)

It is heated up
Add $KMnO_4$ to 100.7°– 102.7°C

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Examiner Comments

Here the candidate has almost got there, but missed the need to condense the product.

Question 4 (d) (ii)

Good candidates recognised that a sharp boiling point was an indication of purity of a liquid.

Advice to candidates

- RTQ3 Read the question three times, 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 such as: preparation of a standard solution; preparation of dry crystals of a salt; preparation and purification of an organic liquid.
- Be familiar with titrations from the course including knowledge of appropriate indicators and their colour changes.
- Be aware that there are two types of titration, namely acid-base and redox.
- Practise calculations involving moles and masses, volumes of liquids, volumes of gases, volumes of solutions of known concentration and yields of reactions.
- Know the tests for common cations and anions in the course.
- For the organic chemicals you have met in the course, know their tests, and the tests for the products formed in their reactions.

Grade Boundaries

Grade	Max. Mark	A	B	C	D	E	N	U
Raw boundary mark	50	33	28	23	19	15	11	0
Uniform boundary mark	60	48	42	36	30	24	18	0

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