Cambridge Assessment International Education

Specimen Paper Answers – Paper 5

Cambridge IGCSE™ / IGCSE (9–1)

Chemistry 0620 / 0971

For examination from 2023

Version 1

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Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge IGCSE / IGCSE (9-1) Chemistry 0620 / 0971, and to show different examples of answers within an overall good performance.

In this booklet, we have provided answers for all questions with examiner comments where relevant. This paper requires candidates to answer short-answer and structured questions and candidates are awarded maximum of 40 marks for this paper and the mark scheme provides the answers required to gain the marks.

In some cases, the question and answer is followed by an examiner comment on the candidates answer. Additionally, the examiner has set out a number of common mistakes that occur when candidates answer the questions. In this way, it is possible to understand what candidates have done to gain their marks and how they could improve their answers and avoid errors.

The mark schemes for the Specimen Papers are available to download from the School Support Hub at www.cambridgeinternational.org/support

2023 Specimen Paper 5 Mark Scheme

Past exam resources and other teaching and learning resources are available on the School Support Hub www.cambridgeinternational.org/support

Assessment at a glance

The syllabus for Cambridge IGCSE Chemistry 0620 is available at www.cambridgeinternational.org

All candidates take three papers. Candidates who have studied the Core syllabus content, or who are expected to achieve a grade D or below, should be entered for Paper 1, Paper 3 and either Paper 5 or Paper 6. These candidates will be eligible for grades C to G.

Candidates who have studied the Extended syllabus content (Core and Supplement), and who are expected to achieve a grade C or above, should be entered for Paper 2, Paper 4 and either Paper 5 or Paper 6. These candidates will be eligible for grades A* to G.

Core assessment

Core candidates take Paper 1 and Paper 3. The questions are based on the Core subject content only:

Paper 1: Multiple Choice (Core)	
45 minutes	
40 marks	30%
40 four-option multiple-choice questions	
Externally assessed	

Paper 3: Theory (Core)	
1 hour 15 minutes	
80 marks	50%
Short-answer and structured questions	
Externally assessed	

Extended assessment

Extended candidates take Paper 2 and Paper 4. The questions are based on the Core and Supplement subject content:

Paper 2: Multiple Choice (Extended)	
45 minutes	
40 marks	30%
40 four-option multiple-choice questions	
Externally assessed	

Paper 4: Theory (Extended)	
1 hour 15 minutes	
80 marks	50%
Short-answer and structured questions	
Externally assessed	

Practical assessment

All candidates take one practical paper from a choice of two:

Paper 5: Practical Test	
1 hour 15 minutes	
40 marks	20%
Questions will be based on the experimental skills in Section 4	
Externally assessed	

Paper 6: Alternative to Practical	
1 hour	
40 marks	20%
Questions will be based on the experimental skills in Section 4	
Externally assessed	

Question 1

Question 1(a)

1 You are going to investigate the reaction between dilute hydrochloric acid and two different aqueous solutions of sodium hydroxide labelled solution **A** and solution **B**.

Read all of the instructions carefully before starting the experiments.

Instructions
You are going to do **two** experiments.

(a) Experiment 1

- Rinse a burette with dilute hydrochloric acid.
- Fill the burette with dilute hydrochloric acid.
- Run some of the dilute hydrochloric acid out of the burette so that the level of dilute hydrochloric acid is on the burette scale.
- Record the initial burette reading in Table 1.1.
- Use a measuring cylinder to pour 25 cm^3 of solution **A** into a conical flask.
- Add five drops of thymolphthalein indicator to the conical flask.
- While swirling the conical flask, slowly add the dilute hydrochloric acid from the burette to the flask until the solution just changes colour.
- Record the final burette reading in Table 1.1 and complete the table.

Experiment 2

- Fill the burette with dilute hydrochloric acid.
- Run some of the dilute hydrochloric acid out of the burette so that the level of dilute hydrochloric acid is on the burette scale.
- Record the initial burette reading in Table 1.1.
- Empty the conical flask and rinse it with distilled water.
- Use the measuring cylinder to pour 25 cm^3 of solution **B** into the conical flask.
- Add five drops of thymolphthalein indicator to the conical flask.
- While swirling the conical flask, slowly add the dilute hydrochloric acid from the burette to the flask until the solution just changes colour.
- Record the final burette reading in Table 1.1 and complete the table.

Table 1.1

	Experiment 1	Experiment 2
final burette reading / cm^3	39.5	24.0
initial burette reading / cm^3	0.0	5.0
volume of dilute hydrochloric acid added / cm^3	39.5	19.0

[4]

Mark awarded = 4 out of 4

Examiner comment

The candidate has been awarded all four marks. They recorded the initial volumes, final volumes and volume added for both experiments. The actual experimental results were compared with the supervisor's results to determine their accuracy.

Common mistakes

A common error is to put the initial volumes in the row for the final volumes. Tables for recording titration results are designed in this way to allow candidates to easily subtract initial from final volumes.

Candidates should always give burette readings to a minimum of one decimal place.

Question 1(b)

(b) State the colour change observed in Experiment 1.

from ..... *blue* ..... to ..... *colourless* ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Sodium hydroxide is a strong alkali so the candidate has correctly stated blue as the initial colour of the indicator. At neutralisation, the indicator would be colourless.

Common mistakes

It's important that candidates can recall the colour changes of the indicators stated in the syllabus. Some candidates confuse the colour in acid and alkali and incorrectly state 'colourless' for thymolphthalein in alkaline conditions. In addition, 'colourless' solutions should not be described as 'clear' because a coloured solution can still be clear.

Question 1(c)(i)

(c) (i) State which solution of sodium hydroxide, solution **A** or solution **B**, is the more concentrated.

Explain your answer.

*Solution **A** is more concentrated because a greater volume of acid was*

used in the titration. ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for identifying the most concentrated solution and explaining their answer.

Common mistakes

Candidates often misinterpret titration results. In a titration, the greater the volume of known solution (titrant) that is required, the greater the concentration of the unknown solution.

Question 1(c)(ii)

(ii) Deduce the simplest whole number ratio of concentration of solution **A** : concentration of solution **B**.

2:1 ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Titration of solution **A** required 39.5 cm^3 of acid for neutralisation whereas solution **B** required 19.0 cm^3. Therefore, the ratio of the concentrations in solution **A** and **B** is 39.5:19.0. Expressed as the simplest whole number ratio gives 2:1.

Common mistakes

The most common error is to give 39.5:19.0 and not give the simplest whole number ratio. This highlights the importance of reading the question carefully and following all instructions.

Question 1(d)

(d) State the volume of hydrochloric acid needed if Experiment 1 is repeated using 10 cm^3 of solution **A**.

39.5 cm^3 ´ (10/25) = 15.8 cm^3 ..... [2]

Mark awarded = 2 out of 2

Examiner comment

25 cm^3 of solution **A** required 39.5 cm^3 of hydrochloric acid for neutralisation. If only 10 cm^3 of solution A was used, the required volume can be calculated using 39.5 cm^3 × (10/25).

The candidate has performed the calculation correctly and given the appropriate unit so has been awarded two marks.

Common mistakes

The response line does not include units so candidates must include a unit. In this question, the data is given in cm^3 and therefore the appropriate unit is cm^3. If dm^3 is used, the volumes must have been correctly converted.

Question 1(e)(i)

(e) In Experiment 2 the conical flask is rinsed with distilled water.

(i) Suggest why the conical flask is rinsed with distilled water.

to remove any solution left over from experiment 1 ..... [1]

Mark awarded = 1 out of 1

Question 1(e)(ii)

(ii) The conical flask is **not** dried after it is rinsed with distilled water.

Suggest why the conical flask is **not** dried.

Water will dilute solution B. ..... [1]

Mark awarded = 0 out of 1

Examiner comment

The candidate has not been awarded the mark. The volume of acid required is dependent on the number of moles of sodium hydroxide. Water will not affect the number of moles of sodium hydroxide so drying is not required.

Common mistakes

Candidates often think, incorrectly, that drying prevents the water from contaminating the experiment.

Question 1(f)

(f) State the effect, if any, on the volume of dilute hydrochloric acid used in Experiment 1 if the solution of sodium hydroxide is warmed before adding the dilute hydrochloric acid.

Give a reason for your answer.

effect on volume ..... *no effect* .....

reason ..... *because changing the temperature doesn't change the number of moles of sodium hydroxide* ..... [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded both marks. They have realised that the volume of hydrochloric acid required is dependent on the number of moles of sodium hydroxide, not on other factors such as temperature.

Common mistakes

Candidates are familiar with rate of reaction experiments in which the rate is dependent on the temperature. Therefore, they incorrectly think that a smaller volume of acid will be required because the reaction occurs faster.

Question 1(g)(i)

(g) (i) Suggest how the reliability of the results from Experiment 1 and Experiment 2 can be confirmed.

..... *Repeat the whole experiment and compare the two sets of results.* ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Repeating experiments allows increased reliability provided that the data is compared and anomalous results removed. The candidate has been awarded the mark for stating 'repeat and compare'.

Common mistakes

It is not sufficient to state 'repeat' alone as the result must be compared in order for reliability to be assessed.

Question 1(g)(ii)

(ii) Suggest a more accurate method of measuring the volume of the solution of sodium hydroxide.

use a burette [1]

Mark awarded = 1 out of 1

Examiner comment

In the experiment, the sodium hydroxide was measured with a measuring cylinder. A volumetric pipette or a burette would both be more accurate.

Common mistakes

Candidates often state that a 'pipette' should be used. That is insufficient to be awarded credit as the pipette could be a dropping pipette. When describing pipettes, candidates are advised to state the full name, dropping pipette and volumetric pipette, rather than just pipette.

Question 1(h)

(h) Aqueous sodium hydroxide reacts with aqueous barium chloride to form a white precipitate of barium hydroxide.

Use this information to suggest a different method of finding out which of the solutions of sodium hydroxide, solution **A** or solution **B**, is more concentrated.

In your answer, state how your results show which solution of sodium hydroxide, solution **A** or solution **B**, is more concentrated.

- *add equal volumes of solution A and B separately to the same volume of barium chloride*
- *measure the height of the precipitate formed*
- *the more concentrated solution of sodium hydroxide will form the highest precipitate.* [3]

Mark awarded = 3 out of 3

Examiner comment

The candidate has used bullet points to ensure they made sufficient points to match the mark allocation of the question. This is a sensible approach provided sufficient detail is included in each bullet point.

The candidate has been awarded full marks. They identified the dependent variable (height of precipitate), described how variables would be controlled (same volume of barium chloride) and described how the most concentrated solution would be identified (highest precipitate).

Common mistakes

Candidates often miss the fact that the question is in two parts. To be awarded full credit, candidates must suggest a different method and describe how the results show which solution of sodium hydroxide is more concentrated. This highlights the importance of reading questions carefully and planning an answer to fully address all requirements of the question.

Total mark awarded = 17 out of 18

Question 2

Question 2(a)

2 You are provided with two solids, solid **C** and solid **D**.

Do the following tests on solid **C** and solid **D**, recording all of your observations at each stage.

tests on solid C

(a) Describe the appearance of solid **C**.

green solid ..... [1]

Mark awarded = 1 out of 1

Common mistakes

Candidates must be careful to use the terms 'solid' and precipitate' in the correct context. Compound **C** is a green solid, not a green precipitate.

Question 2(b)

(b) Place about half of solid **C** in a hard-glass test-tube. Heat the solid gently then strongly.

Record your observations.

.....

liquid droplets form at the top of the test-tube ..... [2]

Mark awarded = 1 out of 2

Examiner comment

The candidate has been awarded one mark for identifying the liquid droplets at the top of the test-tube when solid **C** was heated gently. However, they did not state an observation from when solid **C** was heated strongly. When heated strongly, solid **C** turns from green to white.

Common mistakes

When strongly heated, solid **C** turns from green to white. However, the colour may appear brown or yellow and both of these were acceptable answers.

Question 2(c)

Add the rest of solid **C** to about 10 cm^3 of distilled water in a boiling tube. Stopper the boiling tube and shake it to dissolve solid **C** and form solution **C**.

Divide solution **C** into four approximately equal portions in four test-tubes.

(c) Test the pH of the first portion of solution **C**.

pH = 4 ..... [1]

Mark awarded = 1 out of 1

Examiner comment

Any pH value between 3 and 6 was acceptable so the candidate was awarded the mark.

Common mistakes

Occasionally candidates state the colour of the indicator rather than a pH value as requested in the question.

Question 2(d)

(d) To the second portion of solution **C**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Record your observations.

no reaction ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for stating that no reaction occurred. However, a better observation would have been to state that 'no change was seen'.

Common mistakes

Candidates often give a dashed line '–' to represent 'no reaction'. However, this cannot be credited as it is insufficient to indicate 'no reaction' as it could mean the candidate has left the question blank. If no change is seen, candidates must state this.

Question 2(e)

(e) To the third portion of solution **C**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.

Record your observations.

white precipitate ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for stating an accurate colour and the fact that a precipitate formed.

Common mistakes

The colour of any precipitate formed must be stated. In this case, the precipitate is white but in some cases the precipitate colour will be less distinct. Candidates often state 'blueish' or 'reddish'. This should be avoided and more accurate descriptions given. For example, 'blue-green' or 'red-brown'. Answers which include unrelated colours, such as 'red-blue' cannot be credited as the candidate is essentially giving two answers.

Question 2(f)

(f) To the fourth portion of solution **C**, add aqueous ammonia dropwise and then in excess.

Record your observations.

.....

green precipitate ..... [2]

Mark awarded = 1 out of 2

Examiner comment

The candidate has been awarded one mark for stating an accurate colour and the fact that a precipitate formed. However, they have not described any observations for when excess ammonia was added. In excess ammonia, the precipitate remains.

Question 2(g)

(g) Identify solid **C**.

iron(II) sulfate ..... [2]

Mark awarded = 2 out of 2

Examiner comment

The appearance of compound **C** as a green solid suggests it contains Fe^{2+} ions and this is confirmed by the green precipitate with aqueous ammonia.

The formation of a white precipitate with acidified barium nitrate identifies the anion as sulfate, SO_4^{2-}. Therefore, the candidate has been awarded both marks for identifying the compound as iron(II) sulfate.

Common mistakes

The question asks for the compound to be identified but it doesn't specify if a name or a formula is required. Therefore, either are acceptable. For transition elements, the oxidation number must also be included. If both a name and a formula are given, both must be correct. An incorrect formula or oxidation number could negate a previously correct name so care must be taken to ensure accuracy with formulae.

Question 2(h)

tests on solid D

(h) Do a flame test on solid **D**.

Record your observations.

Orange-red ..... [1]

Add the rest of solid **D** to about 10 cm^3 of distilled water in a boiling tube. Stopper the boiling tube and shake it to dissolve solid **D** and form solution **D**.

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for carefully describing the flame colour as orange-red.

Question 2(i)

Add the rest of solid **D** to about 10 cm^3 of distilled water in a boiling tube. Stopper the boiling tube and shake it to dissolve solid **D** and form solution **D**.

Divide solution **D** into two approximately equal portions in two test-tubes.

(i) To the first portion of solution **D**, add aqueous sodium hydroxide dropwise and then in excess.

Record your observations.

.....

white precipitate that is insoluble in excess ..... [2]

Mark awarded = 2 out of 2

Examiner comment

The candidate has been awarded the mark for stating an accurate colour and the fact that a precipitate formed. They have also stated that the precipitate is insoluble in excess so have been awarded both marks.

Common mistakes

When describing the observations of reagents 'in excess', candidates can sometimes confuse terminology. Suitable observations, that can be applied to any reagent, include:

the precipitate remains / the precipitate is insoluble in excess / no change is seen

or

the precipitate dissolves / the precipitate is soluble in excess.

Question 2(j)

(j) To the second portion of solution **D**, add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Record your observations.

white precipitate ..... [1]

Mark awarded = 1 out of 1

Examiner comment

The candidate has been awarded the mark for stating an accurate colour and the fact that a precipitate formed.

Common mistakes

Acidified silver nitrate solution is used to identify the halide ions. The colour of chloride, bromide and iodide ions are relatively similar so care must be taken to make accurate observations. The observations must also be unambiguous if they are to be credited. For example, stating 'white-cream' cannot be credited because it doesn't differentiate between the white of the chloride ion and the cream of the bromide ion.

Question 2(k)

(k) Identify solid **D**.

.....

calcium chloride ..... [2]

Mark awarded = 2 out of 2

Examiner comment

The formation of a white precipitate, that is insoluble in excess, with aqueous sodium hydroxide, identifies the cation as calcium, Ca^{2+}. The white precipitate with acidified silver nitrate identifies the anion as chloride, Cl^-. Therefore, the candidate has been awarded both marks for identifying the compound as calcium chloride.

Common mistakes

Candidates often confuse the identification of calcium and zinc ions because they both form a white precipitate with aqueous sodium hydroxide. However, the precipitate with calcium is insoluble in excess, whereas the precipitate with zinc is soluble in excess.

Total mark awarded = 14 out of 16

Question 3

Question 3

3 The label on a bottle of orange drink states 'contains no artificial colours'.

A scientist thinks that the orange colour in the drink is a mixture of two artificial colours:

- Sunset Yellow E110
- Allura Red E129.

Plan an experiment to show that the orange colour in the drink does **not** contain these two artificial colours.

Your plan should describe the use of common laboratory apparatus and samples of E110, E129 and the orange colouring from the drink.

You may draw a diagram to help answer the question.

- *use chromatography*
- *draw a baseline in pencil a short distance from the bottom of the chromatography paper*
- *put a small spot of the orange drink and small spots of E110 and E129 on the baseline*
- *put the chromatography paper in a beaker with solvent in, but make sure the solvent touches the paper but is below the baseline*
- *measure the height of all the spots after the solvent has moved up the chromatography paper*
- *compare the height of E110 and E129 with the orange drink spot to see if they are the same*

[6]

Mark awarded = 6 out of 6

Examiner comment

The candidate has been awarded full marks for a clear, detailed plan.

The question was worth six marks and therefore six separate points have to be made to be awarded full credit. The candidate has used six separate bullet points, each containing a separate point, to ensure they have made sufficient points to be awarded full credit.

Common mistakes

Some candidates may find it easier to draw a diagram to help them describe the experiment. A diagram will receive credit but it should be clearly labelled and annotated where appropriate.

When planning any experiment or investigation, it is always sensible to plan the answer before starting to write it down. This allows a clear, logical plan to be formulated that includes all the necessary information.

Total mark awarded = 6 out of 6

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