Cambridge Assessment International Education

Example Responses – Paper 5

Cambridge IGCSE™ / IGCSE (9–1) Chemistry 0620 / 0971

For examination from 2023

Cambridge Pathway

Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge IGCSE / IGCSE (9-1) Chemistry 0620 / 0971.

This booklet contains responses to all questions from June 2023 Paper 51, which have been written by a Cambridge examiner. Responses are accompanied by a brief commentary highlighting common errors and misconceptions where they are relevant.

The question papers and mark schemes are available to download from the School Support Hub

0620 / 0971 June 2023 Question Paper 51

0620 / 0971 June 2023 Mark Scheme 51

0620 / 0971 June 2023 Confidential Instructions 51

Past exam resources and other teaching and learning resources are available from the School Support Hub

Question 1

1 You are going to investigate the reaction between aqueous ammonia and two different aqueous solutions of copper(II) sulfate labelled **A** and **B**. Solutions **A** and **B** have different concentrations.

Read all of the instructions carefully before starting the experiments.

Instructions
You are going to do two experiments.

(a) Experiment 1

- Fill a burette with solution **A**. Run some of solution **A** out of the burette so that the level of solution **A** is on the burette scale.
- Record the initial burette reading in Table 1.1.
- Use the measuring cylinder to pour 25 cm^3 of the aqueous ammonia into the conical flask.
- Stand the conical flask on a white tile.
- Slowly add solution **A** from the burette to the conical flask, while swirling the flask, until the mixture in the conical flask just starts to become cloudy.
- Record the final burette reading in Table 1.1.

Experiment 2

- Empty the conical flask and rinse it with distilled water.
- Empty the burette and rinse it with distilled water.
- Rinse the burette with solution **B**.
- Repeat Experiment 1 using solution **B** instead of solution **A**.
- Complete Table 1.1.

Table 1.1

	Experiment 1 using solution **A**	Experiment 2 using solution **B**
final burette reading / cm^3	21.5	23.2
initial burette reading / cm^3	0.2	9.0
volume of aqueous copper(II) sulfate added / cm^3	21.3	14.2

[4]

Examiner comment

- The final burette reading should always be greater than the initial. It is common to record them as shown in the table, with the final reading above the initial. This is to make the subtraction of the initial reading from the final reading easier.
- The volume of aqueous copper(II) sulfate added is calculated by subtracting the initial reading from the final reading. Some candidates were not awarded the mark because they either added the two readings or recorded the volume as 25 cm^3, presumably thinking that the aqueous copper(II) sulfate was added using the volumetric pipette.
- All readings from the same item of apparatus should be recorded to the same number of decimal places. Some candidates recorded values such as '9.0' to '9' and were not awarded this mark.

- The mark for accuracy was determined by comparing the volume of aqueous copper(II) sulfate used in Experiment 1 to that used in Experiment 2. In the Confidential Instructions, the concentrations of solutions A and B were given to two decimal places, and it is important that centres prepare the solutions required for the quantitative practical (Question 1) accurately. Where two different concentrations of an aqueous solution of the same substance are required, it is a good idea to prepare a larger volume than is required of the more concentrated one and then dilute some of that solution to make the less concentrated one.

(b) Explain why a white tile is used during the titration.

to make it easier to tell when the mixture starts to become cloudy

[1]

Examiner comment

- Candidates who just stated that it enabled the colour change or formation of a precipitate to be seen were not awarded the mark as they could be seen without the white tile. The white tile made the observation clearer rather than possible.
- It was evident that many candidates were not familiar with the use of a white tile during a titration and gave answers based on protecting the bench or raising the conical flask up.

(c) In Experiment 2 the burette and the conical flask are both rinsed with water. The burette is then rinsed with solution **B**.

(i) State why both the burette and the conical flask are rinsed with water.

to remove substances remaining from Experiment 1 [1]

(ii) Explain why the burette is then rinsed with solution **B**.

to remove water which would dilute solution B

[1]

Examiner comment

While most candidates appreciated the need to remove the water, some candidates gave vague answers such as 'to make it a fair test' or were still focusing on removing solution A left from Experiment 1. These answers did not gain the mark.

(iii) Describe how the result of Experiment 2 would be different if the conical flask is rinsed with aqueous ammonia after rinsing with water.
Explain your answer.

rinsing the flask with ammonia would leave ammonia in the flask

and so more solution B would be needed [2]

Examiner comment

Vague answers such as 'the results would change' were not awarded any marks. Some candidates did not read the question carefully and gave answers that suggested the burette (rather than the conical flask) was rinsed with aqueous ammonia.

(d) **(i)** Deduce which solution of copper(II) sulfate, **A** or **B**, is more concentrated. Explain your answer.

B is more concentrated as a smaller volume of solution B was required [1]

Examiner comment

- Both identification of the more concentrated solution and the reason were required to gain the mark. Some candidates did not give a reason and so were not awarded the mark.
- A common error was to state solution A was more concentrated because more solution A was used.

(ii) Deduce how many times more concentrated this solution of copper(II) sulfate is than the other solution of copper(II) sulfate.

21.3 ÷ 14.2 = 1.5 [1]

Examiner comment

Candidates could be awarded the mark even if their answer to the preceding part was incorrect. The two most common errors candidates made were to calculate the difference between the two titres or to invert the division and so gave an answer of less than 1 (which would mean the solution was less concentrated rather than more concentrated). Candidates were expected to give their answers to at least 1 decimal place.

(f) Deduce the volume of solution **A** required when Experiment 1 is carried out with 10 cm^3 of aqueous ammonia.

8.5 cm^3 [2]

Examiner comment

- This answer was based on the completed table in **1(a)**.
- One mark was awarded for a correct volume and the other for the correct units of volume. The units mark could be awarded even if the numerical value was incorrect. A common error was for candidates to base their answer on the final burette reading rather than the titre (and so give an answer of, using the figures in **1(a)**, 8.6), this meant the only mark available was the one for the units.

(g) In Experiments 1 and 2, the volume of aqueous ammonia is measured using a measuring cylinder.

Give an advantage and a disadvantage of using a volumetric pipette instead of a measuring cylinder to measure the volume of aqueous ammonia.

advantage more accurate

disadvantage takes longer

[2]

Examiner comment

Some candidates gave answers which suggested they did not understand the difference between a volumetric pipette and a teat or dropping pipette. Both items appear on the apparatus list in the syllabus and so candidates should be familiar with the use of both. Some candidates stated, correctly, that a volumetric pipette can only measure a fixed volume, however, this was not a problem in these experiments as the volume of aqueous ammonia was fixed at 25 cm^3.

Question 2

2 You are provided with solid **E**.
Do the following tests on solid **E**, recording all of your observations at each stage.

Tests on solid E

Divide solid **E** into two approximately equal portions in two boiling tubes.

(a) **Gently** heat the first portion of solid **E**.

Record your observations.

solid E became a liquid. Condensation was seen at the top of the boiling tube [2]

Examiner comment

- As 2 marks were available, candidates should have realised that two appropriate observations would be required to gain full marks.
- Many candidates noted the formation of a liquid and so gained 1 of the 2 marks available.
- Far fewer candidates noted the formation of droplets of water or steam.

(b) State what conclusion can be made about solid **E** from the observations in **(a)**.

solid E is hydrated

[1]

Examiner comment

Candidates who did not notice the formation of condensation or steam were unlikely to be awarded the mark available. The formation of condensation or steam means that water is lost when the solid is heated.

Add about 15 cm^3 of distilled water to the boiling tube containing the second portion of solid **E**. Place a stopper in the boiling tube and shake the tube to dissolve solid **E** and form solution **E**.

Divide solution **E** into seven approximately equal portions in one boiling tube and six test-tubes.

(c) To the first portion of solution **E** in the boiling tube, add aqueous sodium hydroxide dropwise and then in excess.

Keep the product for use in (d).

Record your observations.

dropwise *red-brown precipitate*

in excess *the precipitate does not redissolve*

[2]

Examiner comment

- Candidates are required to use the term 'precipitate' when describing the formation of a solid from the combining of two aqueous solutions. If previously clear solutions become cloudy when they are mixed together it means that an insoluble solid, a precipitate, has been formed.
- Most candidates gave correct observations, although there were some unexpected descriptions of the colour. It is a good idea to look at the 'Notes for use in qualitative analysis' on the last two pages of the examination paper to see what colours are to be expected in these qualitative tests.

(d) Transfer about 2 cm depth of the product from **(c)** into a clean boiling tube.
Warm the mixture **gently**. Test and identify the gas produced.

the gas turned damp red litmus paper to blue

identity of gas *ammonia*

[2]

Examiner comment

- Where candidates are told to test any gas produced, they are expected to state the test and result for a positive gas test carried out. While most candidates correctly stated that the gas formed was ammonia, a significant number of those did not give a positive test and result.
- Some candidates reported positive tests for gases that simply could not have been formed in this reaction.

(e) To the second portion of solution **E**, add about 1 cm depth of aqueous sodium thiosulfate. Leave the mixture to stand for about three minutes.

Record your observations.

the solution turned dark red and then returned to its original yellow colour [2]

Examiner comment

- As two marks were available, candidates should have realised that two appropriate observations would be required to be awarded full marks.
- In this instance, two colours were required, the colour when the aqueous sodium thiosulfate was first added and the colour after the mixture had been left to stand. Many candidates gave only one colour rather than two.

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

Record your observations.

a white precipitate forms [1]

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

Record your observations.

no change [1]

Examiner comment

As the test carried out was the test for halide ions and solid **E** did not contain any halide ions, there should have been no reaction and so no change observed. Many candidates reported seeing a white precipitate, which cannot have been formed unless the samples used were contaminated. In these situations, the Supervisor's Results are checked to see if there is evidence of a contaminated sample. For this reason, it is important that the practical tasks in Question 1 and Question 2 are completed by a good practical chemist so that problems with the materials used can be identified during the marking process and appropriate allowances made.

(h) To the fifth portion of solution **E**, add about 2 cm depth of aqueous sodium carbonate.

Record your observations.

a red-brown precipitate is formed

.... [1]

(i) To the sixth portion of solution **E**, add about 1 cm depth of aqueous potassium iodide followed by about 1 cm depth of starch solution.

Record your observations.

the solution turned brown and then blue-black when starch was added

.... [2]

Examiner comment

- As two marks were available candidates should have realised that two appropriate observations would be required to be awarded full marks.
- In this instance two colours were required: the colour when the aqueous potassium iodide was added and the colour after the starch solution was added. Many candidates gave only one colour rather than two.

(j) To the seventh portion of solution **E** add a few drops of acidified aqueous potassium manganate(VII).

Record your observations.

the solution became pink

.... [1]

Examiner comment

The test carried out was the test for sulfite ions and should have been negative as there were no sulfite ions present. Many candidates correctly reported the negative test result and were awarded the mark. However, many candidates reported the formation of a purple solution (and the mark was awarded) which suggests that they must have added far more than ‘a few drops’ of aqueous potassium manganate(VII) as stated in the instructions.

(k) Identify the **three** ions in solid **E**.

solid E contains the ions ammonium, iron(III) and sulfate

.... [3]

Examiner comment

If formulae are given rather than the names of ions, then those formulae must be fully correct to be awarded the marks available:

- Most candidates correctly identified the presence of sulfate ions.
- Iron, rather than iron(III), was insufficient to be awarded a mark.
- A common error was to identify nitrate ions and being present rather than ammonium ions.

Question 3

3 Solid cobalt(II) oxide is a base which is insoluble in water. It reacts very slowly with cold dilute sulfuric acid to form a solution of cobalt(II) sulfate.

Describe how to make pure, dry crystals of hydrated cobalt(II) sulfate.

You are provided with cobalt(II) oxide, dilute sulfuric acid and common laboratory apparatus.

- pour dilute sulfuric acid into a conical flask
- add excess cobalt(II) oxide to the dilute sulfuric acid
- stir and heat the mixture
- filter to remove the excess cobalt(II) oxide
- place the filtrate in an evaporating basin and warm it until a saturated solution is formed
- cool the saturated solution, filter off the crystals of hydrated cobalt(II) sulfate and dry them with filter paper

[6]

Examiner comment

- It is a good idea to write answers to the planning question as a series of steps or bulleted points.
- There is no advantage to writing a list of apparatus that will be used, if there is mark for the use of appropriate apparatus then the mark will only be awarded if the item of apparatus is used in an appropriate way.
- Candidates should read the question carefully, many answers to this question started with cobalt(II) sulfate solution and so could only gain the last 2 marking points.
- It is a good idea to plan an answer out before starting to write it. Many answers seen had footnotes or additions where important steps had initially been omitted.

Cambridge Assessment International Education
The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom
t: +44 1223 553554
e: info@cambridgeinternational.org   www.cambridgeinternational.org