Cambridge Assessment International Education

# Cambridge O Level

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*4707171568*

**CHEMISTRY** **5070/32**

Paper 3 Practical Test **May/June 2023**

**1 hour 30 minutes**

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions.

**INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

**INFORMATION**

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].
- Notes for use in qualitative analysis are provided in the question paper.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| Total | |

This document has **12** pages. Any blank pages are indicated.


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**1** Aqueous ammonia is a solution of ammonia gas.

You are provided with two samples of aqueous ammonia labelled **A** and **B**.

You are going to investigate the reaction between these samples and 0.500 mol / $dm^3$ hydrochloric acid.

**Read all the instructions carefully before starting the experiments.**

**Instructions**

You are going to do **four** titration experiments.

Rinse and fill a burette with 0.500 mol / $dm^3$ hydrochloric acid.

**(a)** Experiment 1

- Use a volumetric pipette to add 25.0 $cm^3$ of **A** to a conical flask.
- Add five drops of methyl orange indicator to the conical flask.
- Record the initial burette reading in Table 1.1.
- Add 0.500 mol / $dm^3$ hydrochloric acid from the burette while swirling the flask, adding drop by drop near the end-point, until the solution just changes colour.
- Record the final burette reading in Table 1.1.

Experiment 2

- Empty the conical flask and rinse it with distilled water.
- Refill the burette if necessary.
- Repeat experiment 1.

Complete Table 1.1 with the volume used in each experiment.

**Table 1.1**

| | Experiment 1 | Experiment 2 |
|---|---|---|
| final burette reading / $cm^3$ | | |
| initial burette reading / $cm^3$ | | |
| volume used / $cm^3$ | | |

[4]

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**(b)** Experiments 3 and 4

- Empty the conical flask and rinse it with distilled water.
- Refill the burette if necessary.
- Repeat Experiments 1 and 2 using **B** instead of **A**.
- Record the initial and final burette readings for experiments 3 and 4 in Table 1.2.
- Complete Table 1.2 with the volumes used in experiments 3 and 4.

**Table 1.2**

| | Experiment 3 | Experiment 4 |
|---|---|---|
| final burette reading / $cm^3$ | | |
| initial burette reading / $cm^3$ | | |
| volume used / $cm^3$ | | |

[2]

**(c)** State the colour change observed in the flask in each experiment.

from ..... to ..... [1]

**(d)** Suggest why you are provided with a white tile for use in these titrations.

..... [1]

**(e)** Calculate the mean volume of 0.500 mol / $dm^3$ hydrochloric acid needed to neutralise 25.0 $cm^3$ of **A** and of **B**.

mean volume of acid needed for solution **A** ..... $cm^3$

mean volume of acid needed for solution **B** ..... $cm^3$
[1]

**(f)** The equation for the reaction between hydrochloric acid and aqueous ammonia is shown.

$$HCl + NH_3 \rightarrow NH_4Cl$$

Use the mean volume of acid needed to neutralise 25.0 $cm^3$ of **A** from **(e)** to calculate the concentration of ammonia in **A**.

Give your answer to an appropriate number of significant figures.

concentration ..... mol / $dm^3$ [2]

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**(g)** Calculate the volume of ammonia gas measured at room temperature and pressure, r.t.p., dissolved in 25.0 $cm^3$ of **A**.

The volume of one mole of any gas at r.t.p. is 24 $dm^3$.

volume ..... $dm^3$ [2]

**(h)** Use your answers to **(e)** and **(g)** to calculate the volume of ammonia gas measured at r.t.p. dissolved in 25.0 $cm^3$ of **B**.

volume ..... $dm^3$ [1]

**(i)** The burette is rinsed with 0.500 mol / $dm^3$ hydrochloric acid immediately before it is filled.

Explain why the burette should **not** be rinsed with distilled water immediately before it is filled with 0.500 mol / $dm^3$ hydrochloric acid.

.....

.....

..... [2]

**(j)** Suggest why universal indicator is **not** suitable for use in these titrations.

..... [1]

[Total: 17]

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**2** You are provided with solution **W** and solid **X**.

Do the following tests, recording all of your observations at each stage.

**Tests on solution W**

**(a)** Put 1 cm depth of **W** into a test-tube. Add aqueous sodium hydroxide drop by drop until a change is seen.

Then add a further 2 cm depth of aqueous sodium hydroxide.

Record your observations.

.....

.....

..... [2]

**(b)** Put 1 cm depth of **W** into a test-tube. Add 2 cm depth of dilute nitric acid and then add 1 cm depth of aqueous barium nitrate.

Record your observations.

.....

..... [1]

**(c)** Identify the cation and the anion in **W**.

cation ..... anion ..... [2]

**(d)** Put 1 cm depth of **W** into a boiling tube. Add 1 cm depth of aqueous hydrogen peroxide.

Record your observations.

Test the gas given off.

Describe the test and its result.

Identify the gas.

Keep the mixture for use in **(e)**.

observations .....

.....

test for gas and result .....

.....

identity of gas .....

[4]

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**(e)** Add aqueous sodium hydroxide drop by drop to the mixture from **(d)** until a change is seen.

Then add a further 2 cm depth of aqueous sodium hydroxide.

Record your observations.

.....

.....

..... [2]

**(f)** Identify the cation produced by the reaction in **(d)**.

..... [1]

**Test on solid X**

**(g)** Put a piece of **X** into a test-tube and add 2 cm depth of dilute sulfuric acid.

Record your observations.

Test the gas given off.

Describe the test and its result.

Identify the gas.

observations .....

.....

test for gas and result .....

.....

identity of gas .....

[4]

**(h)** Suggest the identity of **X**.

..... [1]

[Total: 17]

**3 You are not expected to do any experimental work for this question.**

Baking soda is used to make bread rise. When baking soda is heated, it decomposes and carbon dioxide gas is released.

Baking soda also decomposes gradually when it is stored. The longer the baking soda is stored, the less carbon dioxide it releases when it is heated.

Plan an investigation to show which of two different samples of baking soda has been stored for longer.

Your plan should include the use of common laboratory apparatus and the two samples of baking soda. No other chemicals should be used.

Your plan should include:

- the apparatus needed
- the method to use
- the measurements to take
- the variables to control
- how to use the results to determine which sample has been stored for longer.

You may draw a diagram to help you answer the question.

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[6]

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## Notes for use in qualitative analysis

### Tests for anions

| anion | test | test result |
|---|---|---|
| carbonate, $CO_3^{2-}$ | add dilute acid, then test for carbon dioxide gas | effervescence, carbon dioxide produced |
| chloride, $Cl^-$ [in solution] | acidify with dilute nitric acid, then add aqueous silver nitrate | white ppt. |
| bromide, $Br^-$ [in solution] | acidify with dilute nitric acid, then add aqueous silver nitrate | cream ppt. |
| iodide, $I^-$ [in solution] | acidify with dilute nitric acid, then add aqueous silver nitrate | yellow ppt. |
| nitrate, $NO_3^-$ [in solution] | add aqueous sodium hydroxide, then aluminium foil; warm carefully | ammonia produced |
| sulfate, $SO_4^{2-}$ [in solution] | acidify with dilute nitric acid, then add aqueous barium nitrate | white ppt. |
| sulfite, $SO_3^{2-}$ | add a small volume of acidified aqueous potassium manganate(VII) | the acidified aqueous potassium manganate(VII) changes colour from purple to colourless |

### Tests for aqueous cations

| cation | effect of aqueous sodium hydroxide | effect of aqueous ammonia |
|---|---|---|
| aluminium, $Al^{3+}$ | white ppt., soluble in excess, giving a colourless solution | white ppt., insoluble in excess |
| ammonium, $NH_4^+$ | ammonia produced on warming | – |
| calcium, $Ca^{2+}$ | white ppt., insoluble in excess | no ppt. or very slight white ppt. |
| chromium(III), $Cr^{3+}$ | green ppt., soluble in excess | green ppt., insoluble in excess |
| copper(II), $Cu^{2+}$ | light blue ppt., insoluble in excess | light blue ppt., soluble in excess, giving a dark blue solution |
| iron(II), $Fe^{2+}$ | green ppt., insoluble in excess, ppt. turns brown near surface on standing | green ppt., insoluble in excess, ppt. turns brown near surface on standing |
| iron(III), $Fe^{3+}$ | red-brown ppt., insoluble in excess | red-brown ppt., insoluble in excess |
| zinc, $Zn^{2+}$ | white ppt., soluble in excess, giving a colourless solution | white ppt., soluble in excess, giving a colourless solution |

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## Tests for gases

| gas | test and test result |
|---|---|
| ammonia, $NH_3$ | turns damp red litmus paper blue |
| carbon dioxide, $CO_2$ | turns limewater milky |
| chlorine, $Cl_2$ | bleaches damp litmus paper |
| hydrogen, $H_2$ | ‘pops’ with a lighted splint |
| oxygen, $O_2$ | relights a glowing splint |
| sulfur dioxide, $SO_2$ | turns acidified aqueous potassium manganate(VII) from purple to colourless |

## Flame tests for metal ions

| metal ion | flame colour |
|---|---|
| lithium, $Li^+$ | red |
| sodium, $Na^+$ | yellow |
| potassium, $K^+$ | lilac |
| copper(II), $Cu^{2+}$ | blue-green |
| calcium, $Ca^{2+}$ | orange-red |
| barium, $Ba^{2+}$ | light green |

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