Cambridge Assessment International Education

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CHEMISTRY **0620/51**

Paper 5 Practical Test **May/June 2023**

1 hour 15 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 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.

View solution

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		
initial burette reading / cm^3		
volume of aqueous copper(II) sulfate added / cm^3		

[4]

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

View solution

.....

..... [1]

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

View solution

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

..... [1]

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

View solution

.....

..... [1]

(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.

View solution

.....

..... [2]

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

View solution

.....

..... [1]

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

..... [1]

(e) Describe how the reliability of the results obtained can be checked.

View solution

.....

..... [1]

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

..... [2]

(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 .....

disadvantage .....

[2]

View solution

[Total: 16]

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**.

View solution

Record your observations.

.....

..... [2]

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

View solution

.....

..... [1]

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.

View solution

Keep the product for use in (d).

Record your observations.

dropwise .....

in excess .....
[2]

(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.

View solution

.....

.....

identity of gas .....
[2]

(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.

View solution

Record your observations.

.....

..... [2]

(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.

View solution

Record your observations.

.....

..... [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.

View solution

Record your observations.

.....

..... [1]

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

View solution

Record your observations.

.....

..... [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.

View solution

Record your observations.

.....

..... [2]

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

View solution

Record your observations.

.....

..... [1]

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

View solution

.....

..... [3]

[Total: 18]

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.

View solution

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.

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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
calcium, Ca^{2+}	orange-red
barium, Ba^{2+}	light green
copper(II), Cu^{2+}	blue-green

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