Cambridge Assessment International Education

Cambridge IGCSE™

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CHEMISTRY **0620/52**

Paper 5 Practical Test **October/November 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 temperature change when aqueous sodium hydroxide neutralises dilute hydrochloric acid. The equation for the reaction is shown.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Read all of the instructions carefully before starting the experiments.

Instructions
You are going to do six experiments.

Experiment 1

- Fill a burette with dilute hydrochloric acid. Label this burette **hydrochloric acid**.
- Run some of the dilute hydrochloric acid out of the burette so that the level of the dilute hydrochloric acid is on the burette scale.
- Fill a second burette with aqueous sodium hydroxide. Label this burette **sodium hydroxide**.
- Run some of the aqueous sodium hydroxide out of the burette so that the level of the aqueous sodium hydroxide is on the burette scale.
- Run 1.0 cm^3 of dilute hydrochloric acid from the burette into the boiling tube.
- Run 9.0 cm^3 of aqueous sodium hydroxide from the second burette into the same boiling tube.
- Stir the mixture with the thermometer. Measure the highest temperature reached and record it in Table 1.1.
- Measure the pH of the mixture in the boiling tube. Record the pH in Table 1.1.
- Rinse out the boiling tube with distilled water.

Experiment 2

- Run 2.0 cm^3 of dilute hydrochloric acid from the burette into the boiling tube.
- Run 8.0 cm^3 of aqueous sodium hydroxide from the second burette into the same boiling tube.
- Stir the mixture with the thermometer. Measure the highest temperature reached and record it in Table 1.1.
- Measure the pH of the mixture in the boiling tube. Record the pH in Table 1.1.
- Rinse out the boiling tube with distilled water.

Experiment 3

- Repeat Experiment 2 using 3.0 cm^3 of dilute hydrochloric acid and 7.0 cm^3 of aqueous sodium hydroxide.

Experiment 4

- Repeat Experiment 2 using 6.0 cm^3 of dilute hydrochloric acid and 4.0 cm^3 of aqueous sodium hydroxide.

Experiment 5

- Repeat Experiment 2 using 7.0 cm^3 of dilute hydrochloric acid and 3.0 cm^3 of aqueous sodium hydroxide.

Experiment 6

- Repeat Experiment 2 using 8.0 cm^3 of dilute hydrochloric acid and 2.0 cm^3 of aqueous sodium hydroxide.

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(a) Complete Table 1.1.

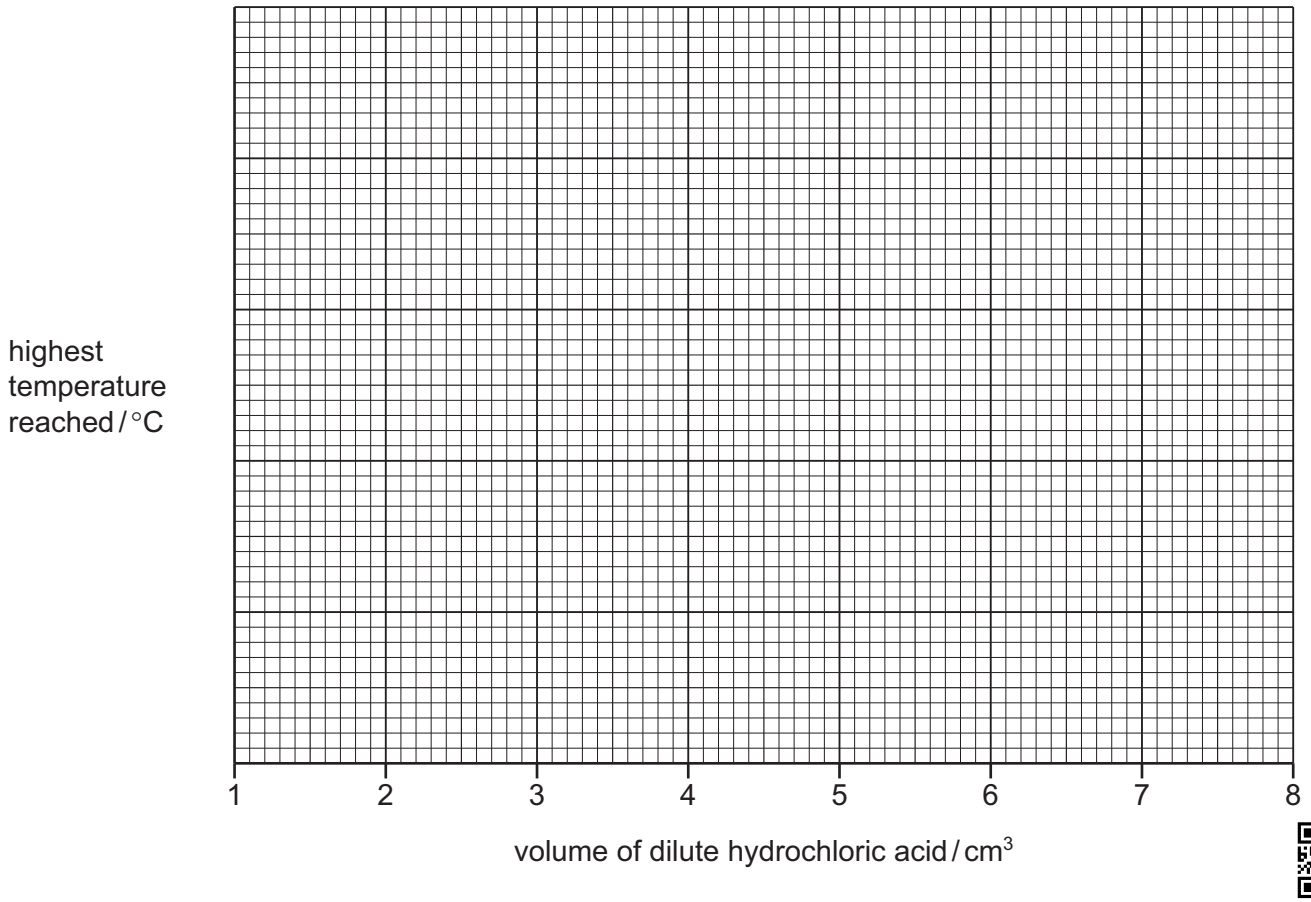
View solution

Table 1.1

	experiment					
	1	2	3	4	5	6
volume of dilute hydrochloric acid / cm^3	1.0	2.0	3.0	6.0	7.0	8.0
volume of aqueous sodium hydroxide / cm^3						
highest temperature reached / °C						
pH						

[4]

(b) Add a suitable scale to the *y*-axis in Fig. 1.1. **Your scale should extend by at least 2 °C above your highest temperature in Table 1.1.**
Plot your results from Experiments 1 to 6 on the grid.
Draw **two** straight lines through your points, one through the first three points and one through the last three points. Extend your straight lines so that they cross.



View solution

Fig. 1.1

[5]

(c) The point on the graph where the two straight lines cross is where all of the aqueous sodium hydroxide reacts with all of the dilute hydrochloric acid to form a neutral solution.

(i) **Use your graph** in Fig. 1.1 to deduce the volume of dilute hydrochloric acid and the volume of aqueous sodium hydroxide that react together to produce a neutral solution. Show your working **on Fig. 1.1**.

volume of dilute hydrochloric acid = ... cm^3

volume of aqueous sodium hydroxide = ... cm^3

[3]

(ii) Predict the pH of the solution in the boiling tube when the volumes in **(c)(i)** are mixed together.

pH = ... [1]

(iii) Deduce which solution, dilute hydrochloric acid or aqueous sodium hydroxide, is the most concentrated.

Use your answer to **(c)(i)** to explain why.

View solution

most concentrated solution .....

explanation .....

.....

[1]

(d) State how the pH and temperature recorded in each experiment would differ, if at all, if a polystyrene cup is used in place of the boiling tube.

Explain any differences.

View solution

pH .....

temperature .....

explanation .....

.....

[3]

(e) The volumes of the solutions used in these experiments were measured using a burette.

View solution

Explain why a volumetric pipette could **not** be used instead of a burette in this experiment.

..... [1]

[Total: 18]

2 You are provided with two substances: solid **K** and solid **L**.
Do the following tests on the substances, recording all of your observations at each stage.

Tests on solid K

Transfer solid **K** to a boiling tube. Add about 10 cm^3 of distilled water to the boiling tube containing solid **K**. Place a stopper in the boiling tube and shake the tube to dissolve solid **K** and form solution **K**. Divide solution **K** into three approximately equal portions in three test-tubes.

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

Record your observations.

View solution

.....

..... [2]

(b) (i) Identify **two** cations that the result in **(a)** shows could be in solid **K**.

View solution

.....

..... [2]

(ii) Describe an additional test that could be carried out on solution **K** to confirm which of the two cations you have identified in **(b)(i)** is in solid **K**.

You do not need to carry out this test.

View solution

.....

..... [1]

(c) To the second portion of solution **K**, add a few drops of acidified aqueous potassium manganate(VII).

Record your observations.

View solution

.....

..... [1]

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

Record your observations.

View solution

.....

..... [1]

(e) Identify the anion in solid **K**.

View solution

..... [1]

Tests on solid L

(f) Carry out a flame test on solid **L**.

View solution

Record your observations.

..... [1]

Divide the remaining solid **L** into two approximately equal portions in one hard-glass test-tube and one boiling tube.

(g) Heat the first portion of solid **L** in the hard-glass test-tube very strongly using a roaring Bunsen flame. Test and identify any gas produced.

View solution

Record your observations.

.....

.....

identity of gas .....

[3]

(h) To the second portion of solid **L** in the boiling tube, add about 2 cm depth of aqueous sodium hydroxide and a piece of aluminium foil. Heat the mixture gently. Test any gas produced.

.....

..... [2]

(i) Identify solid **L**.

View solution

.....

..... [2]

[Total: 16]

3 The solubility of solid sodium sulfate in water changes as the temperature of the water changes.

Plan an experiment to find out how the solubility of sodium sulfate in water changes with temperature.

You are provided with sodium sulfate, distilled water and common laboratory apparatus.

View solution

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

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