



# Cambridge IGCSE™

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## CHEMISTRY

**0620/53**

Paper 5 Practical Test

**May/June 2020**

**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.

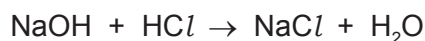
### INFORMATION

- 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                  |  |
| <b>Total</b>       |  |

This document has **12** pages. Blank pages are indicated.

- 1 You are going to investigate the temperature change when aqueous sodium hydroxide neutralises dilute hydrochloric acid. The equation for the reaction is shown.



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

### Instructions

You are going to do eight experiments.

#### Experiment 1

- Place the polystyrene cup into the 250 cm<sup>3</sup> beaker for support.
- Use a measuring cylinder to pour 5 cm<sup>3</sup> of aqueous sodium hydroxide into the polystyrene cup.
- Use a measuring cylinder to pour 45 cm<sup>3</sup> of dilute hydrochloric acid into the polystyrene cup.
- Stir the mixture in the polystyrene cup with the thermometer. Record the highest temperature reached in the table in **(a)**.
- Rinse out the polystyrene cup with distilled water.

#### Experiment 2

- Repeat Experiment 1 using 10 cm<sup>3</sup> of aqueous sodium hydroxide and 40 cm<sup>3</sup> of dilute hydrochloric acid.

#### Experiment 3

- Repeat Experiment 1 using 15 cm<sup>3</sup> of aqueous sodium hydroxide and 35 cm<sup>3</sup> of dilute hydrochloric acid.

#### Experiment 4

- Repeat Experiment 1 using 20 cm<sup>3</sup> of aqueous sodium hydroxide and 30 cm<sup>3</sup> of dilute hydrochloric acid.

#### Experiment 5

- Repeat Experiment 1 using 30 cm<sup>3</sup> of aqueous sodium hydroxide and 20 cm<sup>3</sup> of dilute hydrochloric acid.

#### Experiment 6

- Repeat Experiment 1 using 35 cm<sup>3</sup> of aqueous sodium hydroxide and 15 cm<sup>3</sup> of dilute hydrochloric acid.

#### Experiment 7

- Repeat Experiment 1 using 40 cm<sup>3</sup> of aqueous sodium hydroxide and 10 cm<sup>3</sup> of dilute hydrochloric acid.

#### Experiment 8

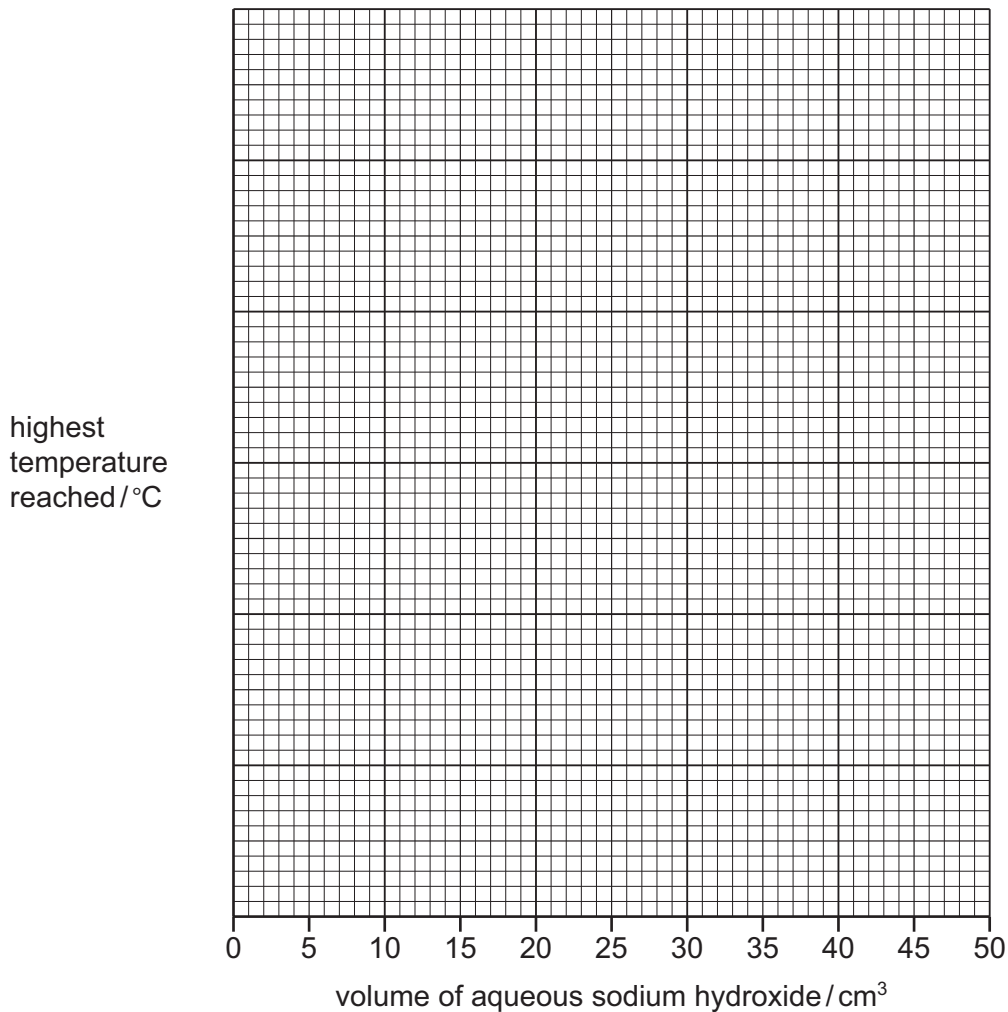
- Repeat Experiment 1 using 45 cm<sup>3</sup> of aqueous sodium hydroxide and 5 cm<sup>3</sup> of dilute hydrochloric acid.

(a) Complete the table.

|  | Experiment |    |    |    |    |    |    |    |
|--|------------|----|----|----|----|----|----|----|
|  | 1          | 2  | 3  | 4  | 5  | 6  | 7  | 8  |
| volume of aqueous sodium hydroxide/cm <sup>3</sup> | 5          | 10 | 15 | 20 | 30 | 35 | 40 | 45 |
| volume of dilute hydrochloric acid/cm <sup>3</sup> |            |    |    |    |    |    |    |    |
| highest temperature reached/°C                     |            |    |    |    |    |    |    |    |

[4]

(b) Add a suitable scale to the y-axis. Your scale should extend by at least 2 °C above your highest temperature. Plot your results from Experiments 1 to 8 on the grid. Draw **two** straight lines through your points. Extend your straight lines so that they cross.



[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** to deduce the volume of aqueous sodium hydroxide and the volume of dilute hydrochloric acid that react together to produce a neutral solution.  
Show your working **on the grid**.

volume of aqueous sodium hydroxide = ..... cm<sup>3</sup>

volume of dilute hydrochloric acid = ..... cm<sup>3</sup>  
[3]

(ii) **Use your graph** to determine the highest temperature reached if the volumes in (c)(i) were mixed together.

highest temperature reached = ..... °C [1]

(iii) Which solution, aqueous sodium hydroxide or dilute hydrochloric acid, was the most concentrated?  
Use your answer to (c)(i) to explain why.

most concentrated solution .....

explanation .....

.....  
[1]

(d) **On the graph**, sketch the lines you would expect to obtain if a copper can was used instead of a polystyrene cup. [2]

(e) Give **one** advantage and **one** disadvantage of using a burette, instead of a measuring cylinder, to add the dilute hydrochloric acid directly into the polystyrene cup.

advantage .....

.....

disadvantage .....

.....

[2]

(f) How could the reliability of the results of this investigation be checked?

.....

..... [1]

[Total: 19]

- 2 You are provided with two solids, solid **N** and solid **P**.  
Do the following tests on solid **N** and solid **P**, recording all of your observations at each stage.

**tests on solid N**

- (a) Describe the appearance of solid **N**.

..... [1]

- (b) Add about 10 cm<sup>3</sup> of distilled water to the boiling tube containing solid **N**. Place a stopper in the boiling tube and shake the tube to dissolve solid **N** and form solution **N**.

Divide solution **N** into two approximately equal portions in two boiling tubes.

- (i) To the first portion of solution **N** add aqueous ammonia slowly until it is in excess and no further changes are seen.  
Record your observations.

.....  
.....  
..... [2]

- (ii) To the second portion of solution **N** add aqueous sodium hydroxide slowly until it is in excess and no further changes are seen.

**Keep the product for (b)(iii).**

Record your observations.

.....  
.....  
..... [2]

- (iii) Pour about 3 cm depth of the product from (b)(ii) into a boiling tube. Add a piece of aluminium foil and warm the mixture gently. Test any gas produced.  
Record your observations.

.....  
.....  
..... [2]

- (c) Identify solid **N**.

.....  
..... [2]

**tests on solid P**

- (d) Carry out a flame test on solid **P**.  
Record your observations.

..... [1]

- (e) Place solid **P** in a boiling tube. Add about 10 cm<sup>3</sup> of distilled water to the boiling tube. Place a stopper in the boiling tube and shake the tube to dissolve solid **P** and form solution **P**.

Divide solution **P** into three approximately equal portions in three test-tubes.

- (i) To the first portion of solution **P** add about 1 cm depth of dilute nitric acid and a few drops of aqueous silver nitrate.  
Record your observations.

..... [1]

- (ii) To the second portion of solution **P** add about 1 cm depth of dilute nitric acid and a few drops of aqueous barium nitrate.  
Record your observations.

.....  
..... [1]

- (iii) Add the third portion of solution **P** to the test-tube containing aqueous bromine.  
Record your observations.

.....  
..... [1]

- (f) Identify solid **P**.

.....  
..... [2]

[Total: 15]











## Notes for use in qualitative analysis

## Tests for anions

| anion   | test  | test result   |
|---|---|---|
| carbonate ( $\text{CO}_3^{2-}$ )                | add dilute acid   | effervescence, carbon dioxide produced  |
| chloride ( $\text{Cl}^-$ )<br>[in solution]     | acidify with dilute nitric acid, then add aqueous silver nitrate                      | white ppt.  |
| bromide ( $\text{Br}^-$ )<br>[in solution]      | acidify with dilute nitric acid, then add aqueous silver nitrate                      | cream ppt.  |
| iodide ( $\text{I}^-$ )<br>[in solution]        | acidify with dilute nitric acid, then add aqueous silver nitrate                      | yellow ppt.   |
| nitrate ( $\text{NO}_3^-$ )<br>[in solution]    | add aqueous sodium hydroxide, then aluminium foil; warm carefully                     | ammonia produced  |
| sulfate ( $\text{SO}_4^{2-}$ )<br>[in solution] | acidify, then add aqueous barium nitrate  | white ppt.  |
| sulfite ( $\text{SO}_3^{2-}$ )                  | add dilute hydrochloric acid, warm gently and test for the presence of sulfur dioxide | sulfur dioxide produced<br>will turn acidified aqueous potassium manganate(VII) from purple to colourless |

## Tests for aqueous cations

| cation                             | effect of aqueous sodium hydroxide                          | effect of aqueous ammonia                                       |
|------------------------------------|---|---|
| aluminium ( $\text{Al}^{3+}$ )     | white ppt., soluble in excess, giving a colourless solution | white ppt., insoluble in excess                                 |
| ammonium ( $\text{NH}_4^+$ )       | ammonia produced on warming                                 | –   |
| calcium ( $\text{Ca}^{2+}$ )       | white ppt., insoluble in excess                             | no ppt., or very slight white ppt.                              |
| chromium(III) ( $\text{Cr}^{3+}$ ) | green ppt., soluble in excess                               | grey-green ppt., insoluble in excess                            |
| copper(II) ( $\text{Cu}^{2+}$ )    | light blue ppt., insoluble in excess                        | light blue ppt., soluble in excess, giving a dark blue solution |
| iron(II) ( $\text{Fe}^{2+}$ )      | green ppt., insoluble in excess                             | green ppt., insoluble in excess                                 |
| iron(III) ( $\text{Fe}^{3+}$ )     | red-brown ppt., insoluble in excess                         | red-brown ppt., insoluble in excess                             |
| zinc ( $\text{Zn}^{2+}$ )          | white ppt., soluble in excess, giving a colourless solution | white ppt., soluble in excess, giving a colourless solution     |

**Tests for gases**

| gas                               | test and test result   |
|-----------------------------------|--|
| ammonia (NH <sub>3</sub> )        | turns damp red litmus paper blue   |
| carbon dioxide (CO <sub>2</sub> ) | turns limewater milky  |
| chlorine (Cl <sub>2</sub> )       | bleaches damp litmus paper   |
| hydrogen (H <sub>2</sub> )        | 'pops' with a lighted splint   |
| oxygen (O <sub>2</sub> )          | relights a glowing splint  |
| sulfur dioxide (SO <sub>2</sub> ) | turns acidified aqueous potassium manganate(VII) from purple to colourless |

**Flame tests for metal ions**

| metal ion                      | flame colour |
|--------------------------------|--------------|
| lithium (Li <sup>+</sup> )     | red          |
| sodium (Na <sup>+</sup> )      | yellow       |
| potassium (K <sup>+</sup> )    | lilac        |
| copper(II) (Cu <sup>2+</sup> ) | blue-green   |

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