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## 0620/52

October/November 2019

**1 hour 15 minutes**

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions

**READ THESE INSTRUCTIONS FIRST**

Write your centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

Notes for use in qualitative analysis are provided on pages 11 and 12.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

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

This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **9** printed pages and **3** blank pages.



- 1 You are going to investigate the temperature changes when two different solids, **N** and **O**, dissolve in water.

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

### Instructions

You are going to do two experiments.

#### (a) Experiment 1

- Put a polystyrene cup in the 250 cm<sup>3</sup> beaker for support.
- Use the measuring cylinder to pour 30 cm<sup>3</sup> of distilled water into the polystyrene cup.
- Measure the initial temperature of the distilled water and record it in the table.
- Add all of solid **N** to the distilled water, start the timer and stir the mixture with the stirring thermometer.
- Continue to stir the mixture and measure the temperature of the mixture every 30 seconds for three minutes (180 seconds).
- Record your results in the table.

| time/s                      | 0 | 30 | 60 | 90 | 120 | 150 | 180 |
|-----------------------------|---|----|----|----|-----|-----|-----|
| temperature of mixture / °C |   |    |    |    |     |     |     |

[2]

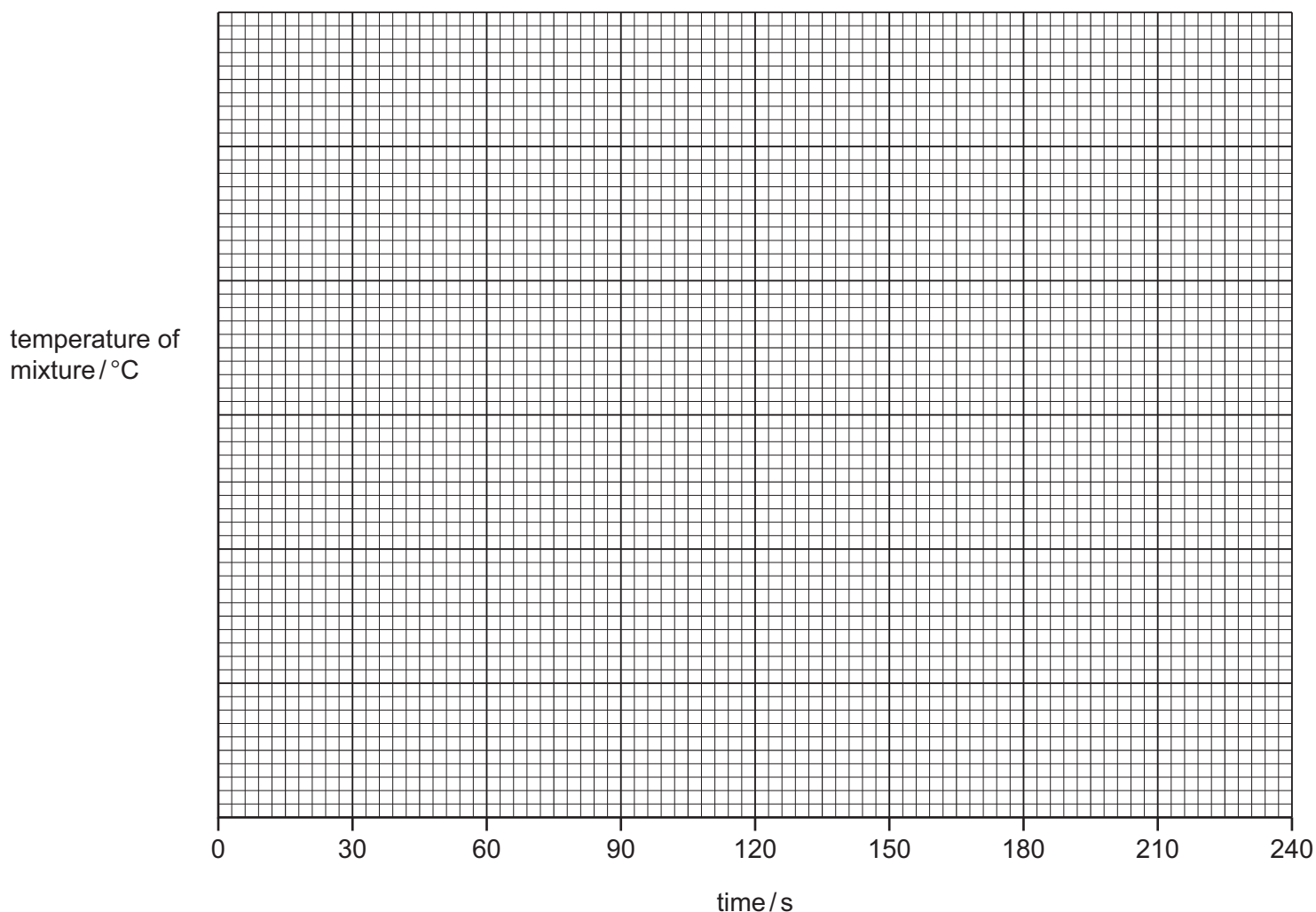
#### (b) Experiment 2

- Place the other polystyrene cup in the 250 cm<sup>3</sup> beaker for support.
- Use the measuring cylinder to pour 30 cm<sup>3</sup> of distilled water into the polystyrene cup.
- Measure the initial temperature of the distilled water and record it in the table.
- Add all of solid **O** to the distilled water, start the timer and stir the mixture with the stirring thermometer.
- Continue to stir the mixture and measure the temperature of the mixture every 30 seconds for three minutes (180 seconds).
- Record your results in the table.

| time/s                      | 0 | 30 | 60 | 90 | 120 | 150 | 180 |
|-----------------------------|---|----|----|----|-----|-----|-----|
| temperature of mixture / °C |   |    |    |    |     |     |     |

[2]

- (c) Plot your results for Experiments 1 and 2 on the grid. Draw **two** smooth line graphs. Clearly label your graphs.



[4]

- (d) (i) **From your graph**, deduce the time taken for the initial temperature of the solution in Experiment 2 to change by 3 °C.

Show clearly **on the grid** how you worked out your answer.

..... s [3]

- (ii) Extend your graph for Experiment 1 to suggest the expected temperature of the mixture after 240 seconds.

..... °C [1]

- (e) Is the energy change in Experiment 2 exothermic or endothermic? Explain your answer.

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

- (f) State **two** possible sources of error in these experiments. Suggest **two** improvements to reduce each of these sources of error.

source of error 1 .....

improvement 1 .....

source of error 2 .....

improvement 2 .....

[4]

- (g) Suggest and explain the effect on the results if Experiment 1 were repeated using  $15\text{ cm}^3$  of distilled water.

.....

..... [2]

[Total: 19]

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

**tests on solid P**

- (a) Do a flame test on a small sample of solid **P**.  
Record your observations.

..... [1]

Add the rest of solid **P** to about 10 cm<sup>3</sup> of distilled water in a boiling tube. Stopper the boiling tube and shake the mixture to dissolve solid **P** and form solution **P**. Divide solution **P** into three approximately equal portions in two test-tubes and one boiling tube.

- (b) (i) Add a few drops of aqueous sodium hydroxide to the first portion of solution **P** in a test-tube.  
Record your observations.

..... [1]

- (ii) Now add an excess of aqueous sodium hydroxide to the mixture.  
Record your observations.

..... [1]

- (c) (i) Add a few drops of aqueous ammonia to the second portion of solution **P** in a test-tube.  
Record your observations.

..... [1]

- (ii) Now add an excess of aqueous ammonia to this mixture.  
Record your observations.

..... [2]

- (d) Add a small piece of aluminium foil and about 2 cm<sup>3</sup> of aqueous sodium hydroxide to the third portion of solution **P** in a boiling tube. Gently warm the mixture. Test the gas produced with litmus paper.  
Record your observations.

.....

..... [3]

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

..... [2]

**tests on solid Q**

- (f) Do a flame test on a small sample of solid **Q**.  
Record your observations.

..... [1]

- (g) Add the rest of solid **Q** to about 5 cm<sup>3</sup> of distilled water in a test-tube. Stopper the test-tube and shake the mixture to dissolve solid **Q**.

Add a few drops of dilute nitric acid and about 1 cm<sup>3</sup> of aqueous silver nitrate to this solution.  
Record your observations.

..... [1]

- (h) Identify solid **Q**.

..... [2]

[Total: 15]

- 3 The table gives some information about the properties of three substances found in a hand cream.

| substance         | reaction with dilute nitric acid |
|-------------------|----------------------------------|
| polystyrene beads | no reaction                      |
| calcium carbonate | reacts and dissolves             |
| sodium fluoride   | dissolves                        |

Use the information in the table to plan an experiment to obtain a pure, dry sample of polystyrene beads from this mixture of substances.

You are provided with a mixture of the three substances and common laboratory apparatus.

.....

.....

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.....

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.....

..... [6]







**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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