Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

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| CANDIDATE NAME | |

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| CENTRE NUMBER | | CANDIDATE NUMBER | |

**CO-ORDINATED SCIENCES** **0654/51**

Paper 5 Practical Test **October/November 2015**

**2 hours**

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 for this paper are printed on page 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 document consists of **12** printed pages.

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CAMBRIDGE International Examinations

**1** You are going to investigate what happens when food is burned in air.

**(a) (i)**

- Using the forceps, pick up a piece of dry cobalt chloride paper.
  Cobalt chloride paper changes colour from blue to pale pink or white in the presence of water.
- Remove the stopper from one of the large test-tubes provided and place the piece of blue cobalt chloride paper inside.
- Wait five seconds and then record the colour of the cobalt chloride paper.

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

- Remove the cobalt chloride paper from the test-tube.

**(ii)**

- Add 10 $cm^3$ limewater to the same test-tube used in part **(i)**. Replace the stopper and shake gently for 10 seconds. Describe the appearance of the limewater.

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

**(b)**

- Remove the stopper from the second test-tube and grip it with the test-tube holder as shown in Fig. 1.1.

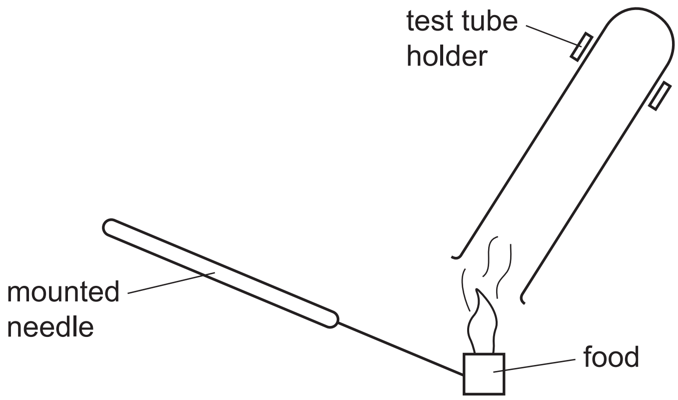


**Fig. 1.1**

- Place the piece of food provided on the mounted needle.
- Using a Bunsen burner, ignite the piece of food. Move the Bunsen burner to one side. Collect any gases produced by holding the second large test-tube inverted about 2 cm above the flame produced as shown in Fig. 1.1.
- Wait until the sides of the test-tube mist up and then place the food into the beaker of water to extinguish it.
- Replace the stopper on the test-tube.

 

Place a fresh piece of blue cobalt chloride paper into the test-tube and quickly replace the stopper.

**(i)** Wait five seconds and then describe and explain the appearance of the cobalt chloride paper.

appearance ..............................................................................................................

explanation ..............................................................................................................

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

**(ii)** Remove the piece of cobalt chloride paper and quickly add about 10 $cm^3$ limewater to the test-tube.

Replace the stopper and shake the test-tube for 10 seconds.

Describe the appearance of the limewater.

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

Explain your observation.

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

**(c)** State **two** observations of this experiment that show energy is released.

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

**(d)** State the purpose of the tests in part **(a)**.

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

**(e)** **(i)** In this experiment you burned some food in air. Name the process inside living cells that this procedure is modelling.

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

**(ii)** Use the results from part **(b)** and your knowledge to give the word equation for this process.

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

**(f)** State **one** precaution you took to make sure that the procedure in part **(b)** was carried out safely.

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

 

**(g)** A student carried out a similar procedure to measure the energy content of different foods by measuring the temperature increase of water. The apparatus is shown in Fig. 1.2.

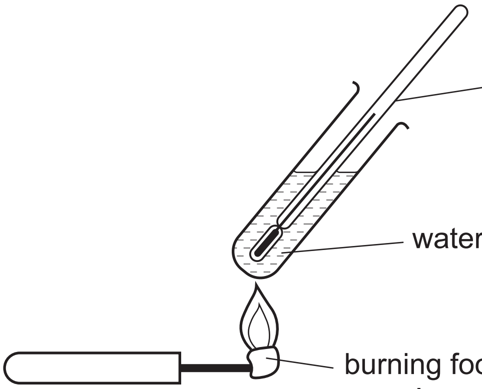


**Fig. 1.2**

**(i)** State **two** ways in which the student could make sure that this procedure is a fair comparison between different foods.

.......................................................................................................................................

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

**(ii)** State why this procedure would not be suitable for accurately measuring the total energy content of food.

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

**Please turn over for Question 2.**

**2** Potassium iodide can be converted to iodine by an oxidising agent.
The presence of starch produces a blue-black colour when the iodine is formed.
The time for the blue-black colour to appear depends on the rate of the reaction between potassium iodide and the oxidising agent.

You are going to investigate whether certain metal ions can catalyse this reaction. You will also identify the metal ion **X**$^{2+}$.

**A** is potassium iodide solution.

**B** is a solution of the oxidising agent.

**(a) (i)**
- Using the measuring cylinder labelled **B**, place 10 cm$^3$ of **B** in a conical flask or beaker.
- Add five drops of starch to the flask.
- Using a second measuring cylinder labelled **A**, add 10 cm$^3$ of **A** to the flask and swirl once, starting the stopclock at the same time.
- Stop the stopclock when the solution turns blue-black. Record the time *t* in seconds to the nearest second in the second row of Table 2.1. [1]

**Table 2.1**

| volume of **B** / cm$^3$ | drops of starch | volume of **A** / cm$^3$ | 1 cm$^3$ of solution of metal ion | time *t* / s | $\frac{1}{t}$ / $\frac{1}{s}$ |
|---|---|---|---|---|---|
| 10.0 | 5 | 10.0 | none added | | |
| 10.0 | 5 | 10.0 | none added | | |
| 10.0 | 5 | 10.0 | $Fe^{2+}$ | | |
| 10.0 | 5 | 10.0 | $Fe^{3+}$ | | |
| 10.0 | 5 | 10.0 | **X**$^{2+}$ | | |

**(ii)** Repeat **(a)(i)** and record the time *t* in seconds to the nearest second in the next row of Table 2.1. [2]

**(b) (i)**
- Using the measuring cylinder labelled **B**, place 10 cm$^3$ of **B** in a conical flask or beaker.
- Add five drops of starch to the flask.
- Using the measuring cylinder labelled **C** add 1 cm$^3$ of the solution containing the $Fe^{2+}$ ion to the flask.
- Using the measuring cylinder labelled **A**, add 10 cm$^3$ of **A** to the flask and swirl once, starting the stopclock at the same time.
- Stop the stopclock when the solution turns blue-black. Record the time *t* in seconds to the nearest second in the appropriate row of Table 2.1. [1]

**(ii)** Repeat **(b)(i)**, replacing the solution containing the $Fe^{2+}$ ion with the solution containing the $Fe^{3+}$ ion.

Record the time $t$ in seconds to the nearest second in the appropriate row of Table 2.1. [1]

**(iii)** Repeat **(b)(i)**, replacing the solution containing the $Fe^{2+}$ ion with the solution containing the $\mathbf{X}^{2+}$ ion.

Record the time $t$ in seconds to the nearest second in the appropriate row of Table 2.1. [1]

**(c)** **(i)** Calculate the values of $\frac{1}{t}$ for each reading of time $t$. Enter the values in Table 2.1. These represent the rates of the reaction.

[1]

**(ii)** Using your results in Table 2.1, state and explain whether the metal ions are acting as catalysts for this reaction.

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**(d)** Use the two results obtained when no metal ion was added to comment on the reliability of the experiment. You must show how you use these two results.

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.......................................................................................................................................

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

**(e)** **(i)** The addition of the metal ion in **(b)** increases the total volume of the solution in the experiment.

Suggest a modification to the method in **(a)(i)** which would result in the overall experiment being a fairer test.

Explain why you have chosen this modification.

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

**(ii)** A student suggests that the reaction involving the solution containing the $\mathbf{X}^{2+}$ ion is a completely different reaction and that $\mathbf{X}^{2+}$ ions reacts with iodide ions.

Carry out **(b)(iii)** again using the solution containing the $\mathbf{X}^{2+}$ ion but carefully observe the reaction mixture instead of timing the reaction.

Suggest what observations may have led the student to think that this was a different reaction.

..........................................................................................................................................

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

**(f)** Use ammonia solution to identify metal **X** in the solution containing the $\mathbf{X}^{2+}$ ion.

Record your observations.

observations ..........................................................................................................................

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metal **X** is ..................................................................................................................... [2]

**3** You are going to measure the capacity and the outer surface area of the walls of a plastic cup.

**(a)** The capacity of a cup is the maximum volume of liquid that it can hold. The volume will be estimated by finding the average diameter of the cup and then considering the cup to be an approximate cylinder.

**(i)** Measure, to the nearest 0.1 cm, the height $h$ of the cup as shown in Fig. 3.1.

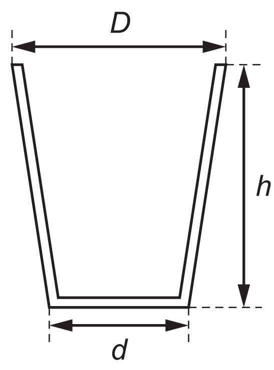


**Fig. 3.1**

$h$ = .............................. cm

**(ii)** Measure the diameter $D$ of the top of the cup. $D$ = .............................. cm

**(iii)** Measure the diameter $d$ of the bottom of the cup. $d$ = .............................. cm

**(iv)** Calculate the average diameter $d_A$ using your results from **(a)(ii)** and **(a)(iii)** and the equation

$$d_A = \frac{(D+d)}{2}$$

$d_A$ = .............................. cm

**(v)** Calculate the approximate volume $V$ of the cup using the equation

$$V = \frac{\pi d_A^2 h}{4}$$

$V$ = .............................. $cm^3$ [6]

**(b)** **(i)** Fill the measuring cylinder with water up to a mark in excess of 200 $cm^3$.

Record this reading $R_1$. $R_1$ = .......................... $cm^3$

Pour water from the measuring cylinder into the cup until it is full.

Record the new reading $R_2$. $R_2$ = .......................... $cm^3$

Determine the volume of water $V_W$ that the cup can hold. Show your working.

$V_W$ = .......................... $cm^3$ [2]

**(ii)** Suggest **one** possible source of inaccuracy in this procedure.

..........................................................................................................................................

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

**(iii)** State which of the two values, $V$ obtained in **(a)(v)** or $V_W$ obtained in **(b)(i)** is the more accurate.

Explain your answer.

..........................................................................................................................................

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

**(c)** Empty the water from the cup. Use the string and the metre rule provided to determine the average circumference *C* of the cup.

**(i)** Describe the method that you used and show your working.

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*C* = ................................ cm [3]

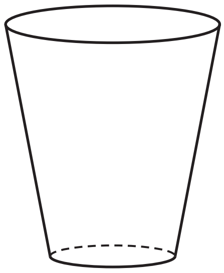

**Fig. 3.2**

**(ii)** Show on Fig. 3.2 where you placed the string to measure the average circumference. [1]

**(iii)** Calculate the approximate curved surface area *A* of the cup using the equation

$$A = Ch$$

*A* = ................................ $cm^2$ [1]

 

## NOTES FOR USE IN QUALITATIVE ANALYSIS

### Test for anions

| *anion* | *test* | *test result* |
|---|---|---|
| carbonate ($CO_3^{2-}$) | add dilute acid | effervescence, carbon dioxide produced |
| chloride ($Cl^-$) [in solution] | acidify with dilute nitric acid, then add aqueous silver nitrate | white ppt. |
| nitrate ($NO_3^-$) [in solution] | add aqueous sodium hydroxide then aluminium foil; warm carefully | ammonia produced |
| sulfate ($SO_4^{2-}$) [in solution] | acidify then add aqueous barium chloride *or* aqueous barium nitrate | white ppt. |

### Test for aqueous cations

| *cation* | *effect of aqueous sodium hydroxide* | *effect of aqueous ammonia* |
|---|---|---|
| ammonium ($NH_4^+$) | ammonia produced on warming | - |
| 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 | green ppt., insoluble in excess |
| 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 |

### Test for gases

| *gas* | *test and test results* |
|---|---|
| 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 |