Cambridge O Level

**Cambridge International Examinations**
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

*6218899063*

**CHEMISTRY** **5070/41**

Paper 4 Alternative to Practical **October/November 2015**

**1 hour**

Candidates answer on the Question Paper.

No Additional Materials are required.

**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.
Write your answers in the spaces provided in the Question Paper.
Electronic calculators may be used.

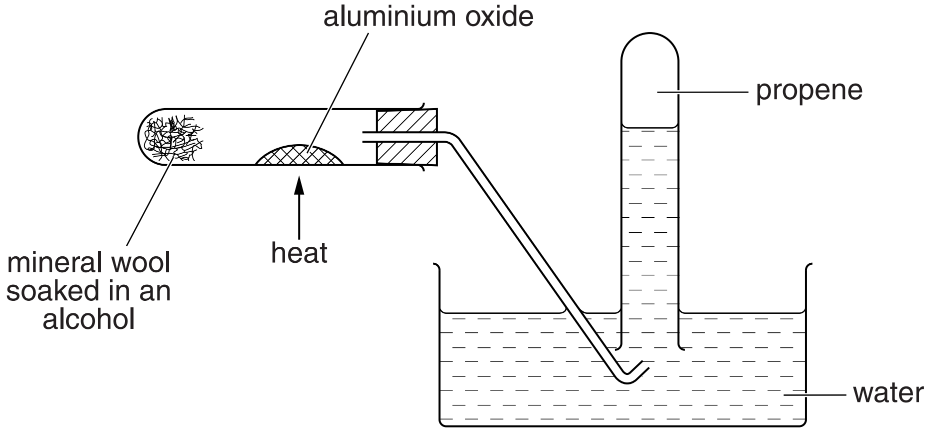
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **15** printed pages and **1** blank page.

DC (LK/CGW) 89575/4


CAMBRIDGE International Examinations

1 Propene is an alkene. It can be made from an alcohol containing three carbon atoms, $C_3H_7OH$, using the apparatus shown.




The equation for the reaction is

$$C_3H_7OH \rightarrow C_3H_6 + H_2O$$

**(a)** **(i)** Name the alcohol containing three carbon atoms that is used to make propene.

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

**(ii)** Suggest why aluminium oxide is used in this reaction.

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

**(iii)** Draw the structure of propene showing all atoms and bonds.

[1]

**(b)** Describe the test that is used to show that propene is unsaturated.

test .............................................................................................................................

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

**(c)** When propene undergoes complete combustion in air, the products are water and a colourless gas.

**(i)** Name the colourless gas. Give a test and observation to identify this gas.

name of gas .............................................................................................................................

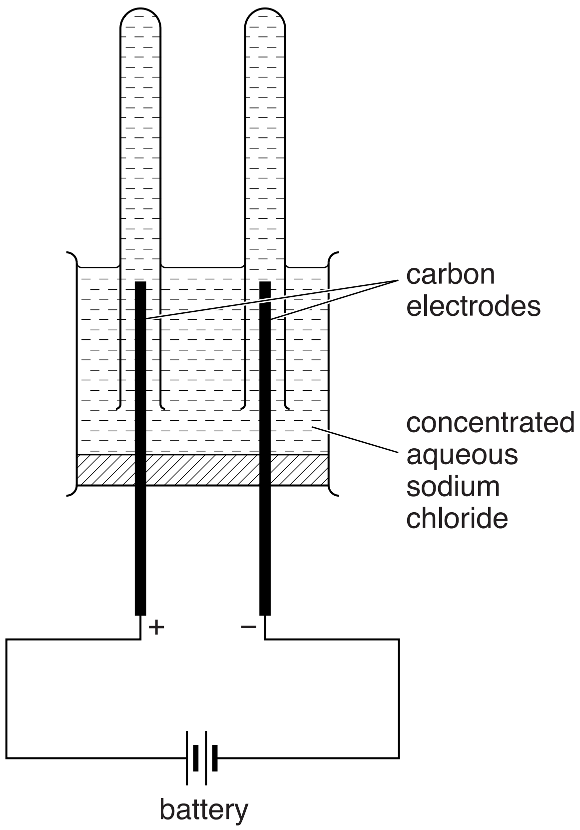
test and observation .............................................................................................................................
[2]

**(ii)** Construct an equation for the complete combustion of propene.

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

[Total: 9]

**2** A student uses the apparatus shown to electrolyse concentrated aqueous sodium chloride.




**(a)** Name the gas given off at the negative electrode. Give a test and observation to identify this gas.

name of gas ..............................................................................................................

test and observation ..............................................................................................................
[2]

**(b)** **(i)** Name the product at the positive electrode.

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

**(ii)** Construct the ionic equation for the reaction taking place at the positive electrode.

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

**(c)** **(i)** The concentrated aqueous sodium chloride is replaced in the apparatus with dilute sulfuric acid. Name the gas given off at the positive electrode. Give a test and observation to identify this gas.

name of gas ..............................................................................................................

test and observation ..............................................................................................................
[2]

**(ii)** Construct the ionic equation for the reaction taking place at the positive electrode.

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

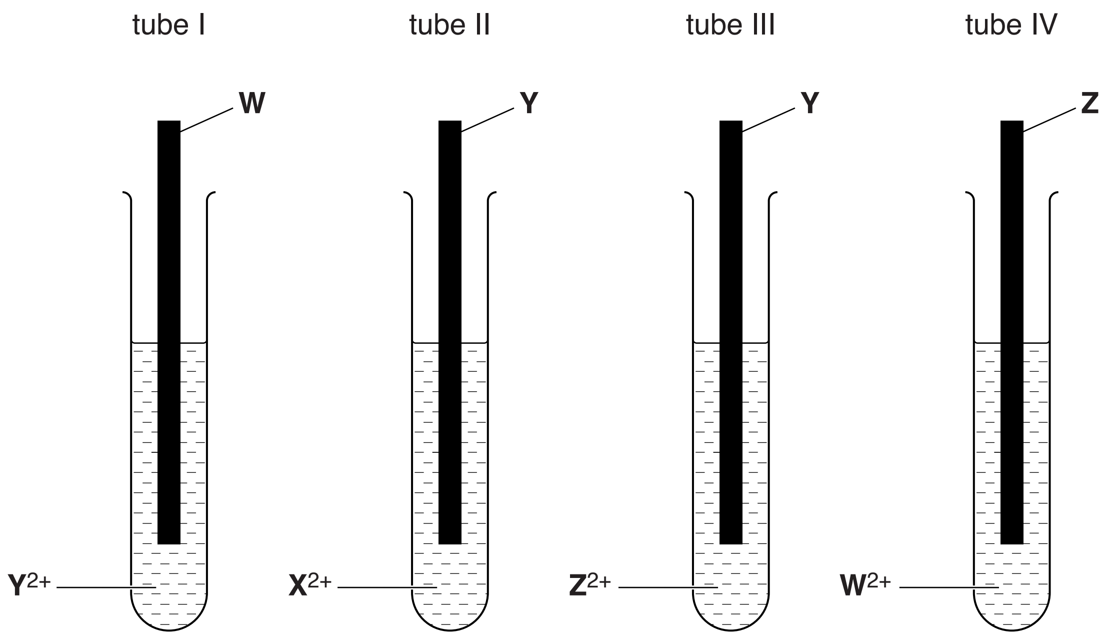
[Total: 7]

In questions **3** to **5** inclusive, place a tick (✓) in the box against the correct answer.

**3** The order of reactivity of four metals **W**, **X**, **Y** and **Z** is shown.

| | |
|---|---|
| most reactive | **W** |
| | **X** |
| | **Y** |
| least reactive | **Z** |

The metals are placed in test-tubes containing aqueous ionic solutions.




Predict in which of the tubes a reaction will occur.

**(a)** I only ☐

**(b)** I and III only ☐

**(c)** II and IV only ☐

**(d)** IV only ☐

[Total: 1]

4 Compound **Q** contains 40.00% carbon, 6.67% hydrogen and 53.33% oxygen by mass.

What is the empirical formula of **Q**?
[$A_r$: C, 12; H, 1; O, 16]

**(a)** CHO ☐

**(b)** $CH_2O$ ☐

**(c)** $CH_2O_2$ ☐

**(d)** $C_4H_2O$ ☐

[Total: 1]

5 A precipitate will **not** form by mixing aqueous solutions of

**(a)** barium chloride and silver nitrate. ☐

**(b)** barium nitrate and sulfuric acid. ☐

**(c)** sodium hydroxide and calcium nitrate. ☐

**(d)** sodium hydroxide and sulfuric acid. ☐

[Total:1]

**6** A student determines the percentage by mass of water in oxalic acid crystals by titration.

**(a)** A sample of oxalic acid crystals is added to a previously weighed container, which is then reweighed.

| | | |
|---|---|---|
| mass of container + oxalic acid crystals | = | 11.32 g |
| mass of container | = | 7.89 g |

Calculate the mass of oxalic acid crystals used in the experiment.

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

**(b)** The sample of oxalic acid crystals is dissolved in distilled water and the solution made up to 500 $cm^3$. This is solution **H**.

Name the apparatus in which solution **H** should be made up to 500 $cm^3$.

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

**(c)** A 25.0 $cm^3$ portion of **H** is transferred into a conical flask.

**(i)** Name the apparatus used to transfer 25.0 $cm^3$ of **H** into the conical flask.

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

**(ii)** **H** is a colourless solution.

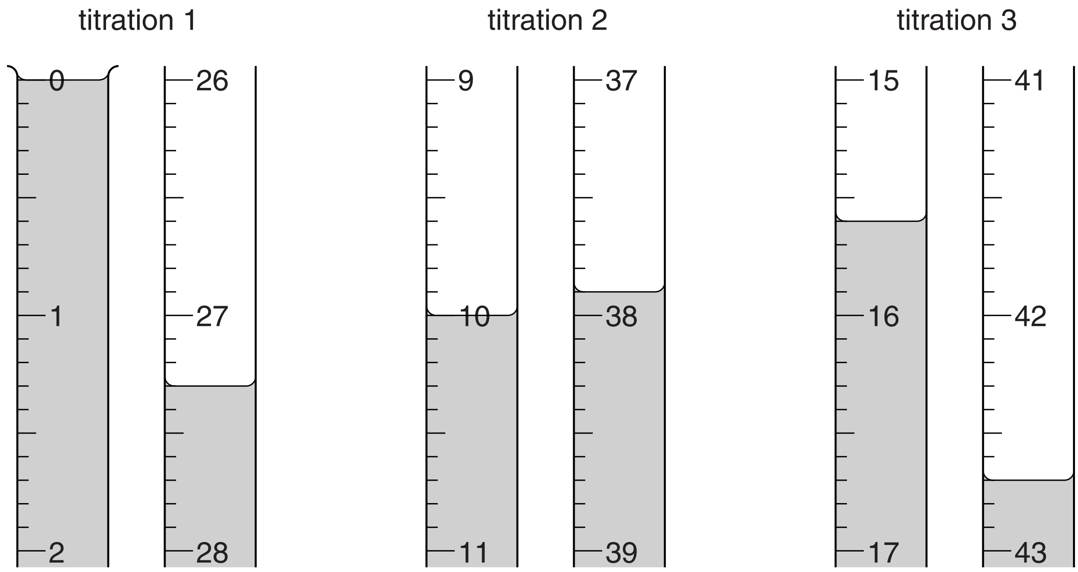
**G** is 0.0200 mol / $dm^3$ potassium manganate(VII).

**G** is put into a burette and run into the conical flask containing **H**.

What is the colour of the solution in the conical flask when **G** is just in excess?

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

**(d)** The student does three titrations. The diagrams below show parts of the burette with the liquid levels at the beginning and end of each titration.




Use the diagrams to complete the following table.

| titration number | 1 | 2 | 3 |
|---|---|---|---|
| final burette reading / $cm^3$ | | | |
| initial burette reading / $cm^3$ | | | |
| volume of **G** / $cm^3$ | | | |
| best titration results (✓) | | | |

**Summary**

Tick (✓) the best titration results.

Using these results, the average volume of **G** is

.................................................... $cm^3$. [4]

**(e)** **G** is 0.0200 mol / $dm^3$ potassium manganate(VII). Calculate the number of moles of potassium manganate(VII) in the average volume of **G** used in **(d)**.

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

**(f)** **Two** moles of potassium manganate(VII) react with **five** moles of oxalic acid crystals.

Deduce the number of moles of oxalic acid crystals in 25.0 $cm^3$ of **H**.

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

**(g)** Deduce the number of moles of oxalic acid crystals in 500 $cm^3$ of **H**.

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

**(h)** Use your answers to **(a)** and **(g)** to calculate the relative formula mass of oxalic acid crystals.

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

**(i)** Oxalic acid crystals contain water and oxalic acid, $H_2C_2O_4$. Use your answer to **(h)** to calculate the percentage by mass of water in oxalic acid crystals.
[$A_r$: H, 1; C, 12; O, 16]

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

[Total: 14]

7 The following table shows the tests a student does on compound **Z**. Complete the table by adding the conclusion for test **(a)**, the observations for tests **(b)** and **(c)** and both the test and observation which lead to the conclusion for test **(d)**.

| test | observations | conclusions |
|---|---|---|
| **(a)** **Z** is dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**. | A coloured solution is formed. | |
| **(b)** **(i)** To the first part, aqueous sodium hydroxide is added until a change is seen.<br>**(ii)** An excess of aqueous sodium hydroxide is added to the mixture from **(i)**. | | **Z** contains $Cu^{2+}$ ions. |
| **(c)** **(i)** To the second part, aqueous ammonia is added until a change is seen.<br>**(ii)** An excess of aqueous ammonia is added to the mixture from **(i)**. | | The presence of $Cu^{2+}$ ions is confirmed. |
| **(d)** | | **Z** contains $Cl^{-}$ ions. |

[8]

**(e)** Conclusion: The formula of compound **Z** is ........................................... [1]

[Total: 9]

Question 8 begins on page 12.

**8** A student does an experiment to investigate the reaction between dilute sulfuric acid and aqueous sodium hydroxide.

The student transfers 50.0 $cm^3$ of 1.00 mol / $dm^3$ aqueous sodium hydroxide to a beaker which is allowed to stand for a few minutes. The temperature of the solution is recorded. 5.0 $cm^3$ portions of sulfuric acid are added to the solution from a burette and the temperature of the solution is recorded after each addition.

**Results**

| volume of sulfuric acid added / $cm^3$ | temperature / °C |
|---|---|
| 0.0 | 24.2 |
| 5.0 | 25.7 |
| 10.0 | 27.1 |
| 15.0 | 28.6 |
| 20.0 | 30.0 |
| 25.0 | 31.5 |
| 30.0 | 31.2 |
| 35.0 | 30.4 |
| 40.0 | 29.6 |
| 45.0 | 28.8 |
| 50.0 | 28.0 |

**(a)** Why was the aqueous sodium hydroxide allowed to stand for a few minutes before adding the first portion of sulfuric acid?

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

**(b)** What type of reaction does the temperature rise suggest?

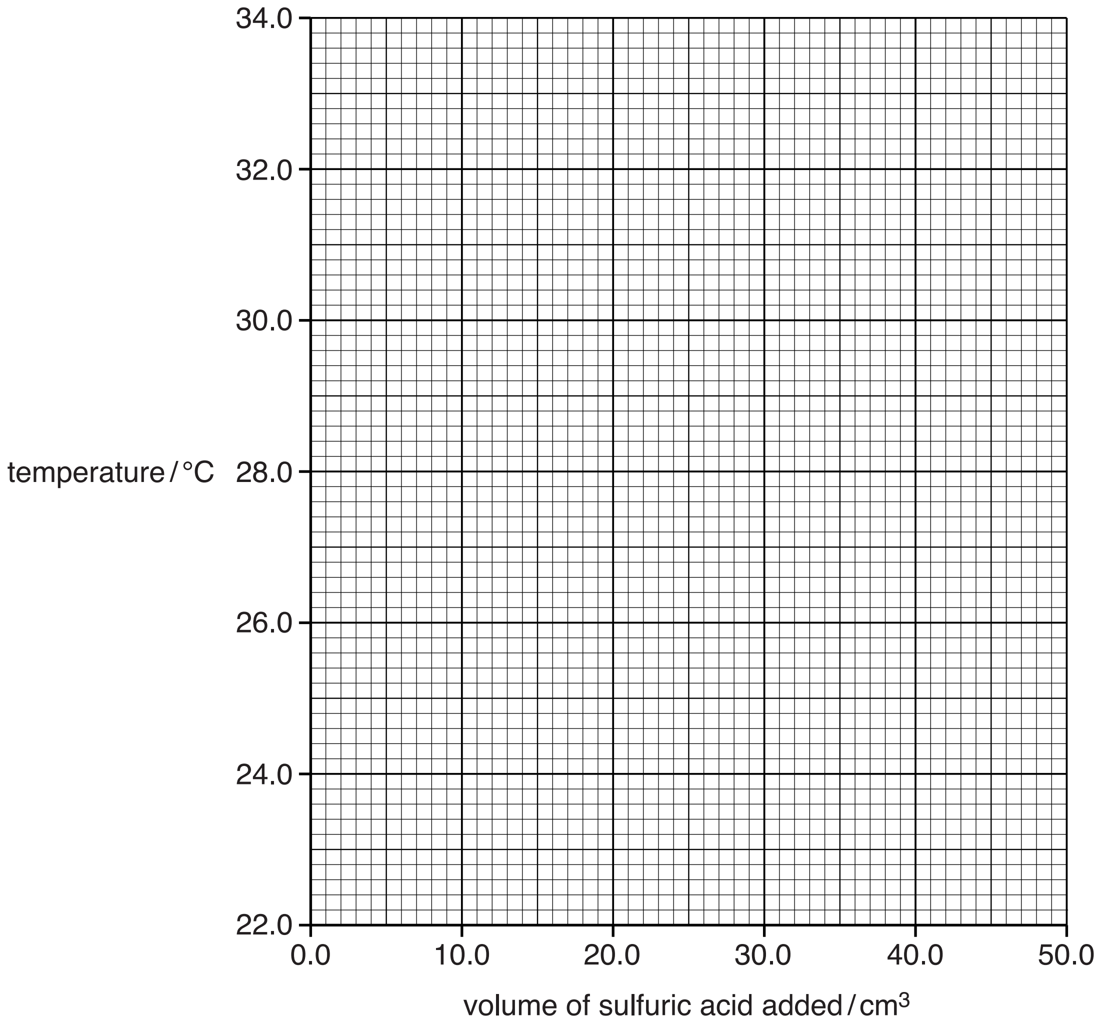
.............................................................................................................................. [1]

**(c)** Why does the temperature begin to decrease after 25.0 $cm^3$ of the sulfuric acid has been added?

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

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

**(d)** On the grid plot a graph of temperature against volume of sulfuric acid added. Draw two straight lines through the points on your graph and extend the lines until they intersect.




[3]

**(e)** Using your graph,

**(i)** what is the volume of sulfuric acid required to react with all the aqueous sodium hydroxide,

.................................................... $cm^3$ [1]

**(ii)** what is the temperature of the mixture when this volume of sulfuric acid is added?

.......................................................°C [1]

**(f)** **(i)** Construct the equation for the reaction between sulfuric acid and aqueous sodium hydroxide.

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

**(ii)** The student used $50.0\,cm^3$ of $1.00\,mol/dm^3$ aqueous sodium hydroxide.

Using your equation in **(f)(i)** and your answer from **(e)(i)** calculate the concentration of the sulfuric acid used.

.......................................... $mol/dm^3$ [2]

**(g)** **(i)** The maximum temperature change can be calculated from your answer to **(e)(ii)** and the initial temperature of the aqueous sodium hydroxide. Calculate this temperature change.

.....................................................°C [1]

**(ii)** Calculate the total volume of liquid in the beaker when the maximum temperature is reached.

.................................................. $cm^3$ [1]

**(iii)** Use the formula below to determine the enthalpy change, $\Delta H$, in the reaction.

$$\Delta H = \frac{\text{volume in } \mathbf{(g)(ii)} \times 4.2 \times \text{temperature change in } \mathbf{(g)(i)}}{1000 \times \text{moles of aqueous sodium hydroxide used}}$$

.............................................. kJ/mol [2]

**(h)** When aqueous sodium hydroxide is neutralised by dilute sulfuric acid, aqueous sodium sulfate forms. Describe how the student can make pure dry crystals of sodium sulfate from this solution.

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

.....................................................................................................................................[3]

[Total: 18]

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