UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

5215845674

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **May/June 2011**

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 a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.
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.

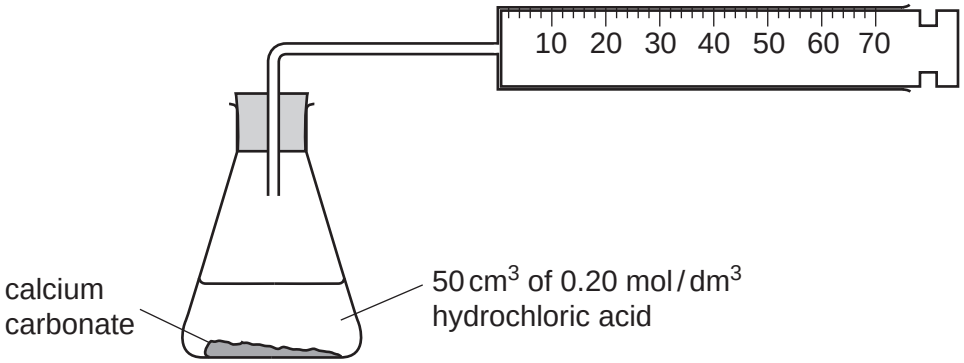
For Examiner's Use

This document consists of **14** printed pages and **2** blank pages.

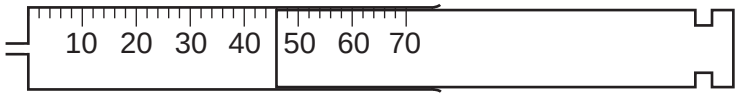
UNIVERSITY of CAMBRIDGE International Examinations

[Turn over

1 A student adds hydrochloric acid to calcium carbonate to produce carbon dioxide.



The diagram below shows the gas syringe containing the volume of carbon dioxide collected in one minute.



(a) What volume of carbon dioxide is collected in one minute?

.....cm^3 [1]

(b) Will the volume collected during the second minute be less than, the same, or more than the volume collected during the first minute? Explain your answer.

.....

.....

.....[2]

The equation for the reaction is

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$$

(c) 50 cm^3 of 0.20 mol/dm^3 hydrochloric acid is added to an excess of calcium carbonate.

(i) Calculate the number of moles in 50 cm^3 of 0.20 mol/dm^3 hydrochloric acid.

..... moles [1]

(ii) Calculate the relative formula mass of calcium carbonate.
[A_r: C,12; O,16; Ca, 40.]

.....[1]

(iii) Using your answers to **(c)(i)** and **(c)(ii)** and the equation for the reaction, ca... the mass of calcium carbonate required to completely react with 50 cm... 0.20 mol/dm^3 hydrochloric acid.

.....cm^3 [1]

(iv) Calculate the maximum volume of carbon dioxide that is produced when 50 cm^3 of 0.20 mol/dm^3 of hydrochloric acid reacts completely with the excess calcium carbonate.
[1 mole of a gas occupies a volume of 24 dm^3 at room temperature and pressure.]

.....cm^3 [1]

(d) Suggest how the speed of this reaction can be **increased** by changing

(i) the particle size of calcium carbonate,

.....[1]

(ii) the concentration of hydrochloric acid.

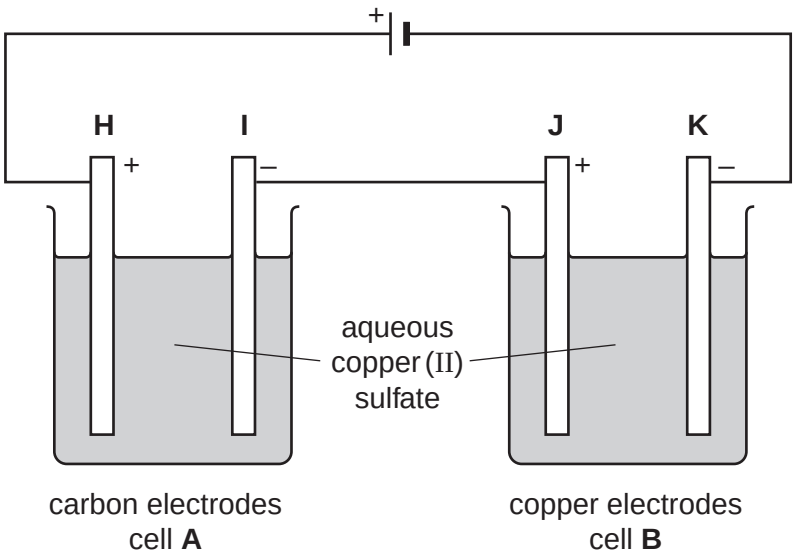
.....[1]

(e) Suggest another way in which the student can increase the speed of the reaction.

.....[1]

[Total: 10]

2 The apparatus below is used to compare the results of passing a current through aq... copper(II) sulfate using different electrodes.



(a) What colour is aqueous copper(II) sulfate?

.....[1]

(b) (i) In which cell, **A** or **B**, is a colour change **not** seen in the solution?

.....[1]

(ii) Describe what is seen at each electrode in this cell, as the electrolysis proceeds?

.....

.....[2]

(iii) Explain why a colour change is **not** seen in the solution in this cell.

.....[1]

(c) (i) What colour change is seen in the solution in the other cell?

.....[1]

(ii) At which electrode **H**, **I**, **J or K** is a gas produced?

..... [1]

(iii) Name this gas.

.....[1]

Give a test for this gas

test .....

observation .....[1]

(iv) What is seen at the other electrode in this cell?

.....[1]

[Total: 10]

For questions **3** to **7** inclusive, place a tick (✓) in the box against the correct answer.

3 A sample of zinc sulfate contains zinc powder as an impurity.
Which of the following methods will produce zinc sulfate crystals?

(a) Shake with water, filter and crystallise the filtrate. ☐

(b) Shake with ethanol, filter and crystallise the filtrate. ☐

(c) Shake with water, filter, wash the residue with water and dry it. ☐

(d) Shake with ethanol, filter, wash the residue with ethanol and dry it. ☐

[1]

4 5.00 g of an organic compound **G** contains 2.73 g of carbon, 0.45 g of hydrogen, and 1.82 g oxygen.
[A_r: H,1; C,12; O,16]

Its empirical formula is

(a) CHO ☐

(b) CH_4O ☐

(c) C_2H_4O ☐

(d) C_2H_2O ☐

[1]

5 A student is given some propanol.
He reacts half of it with acidified potassium dichromate(VI) to produce an acid.
He then adds this acid to the remaining propanol, together with a few drops of concentrated sulfuric acid, to make an ester.
The formula for the ester is

(a) $CH_3CO_2C_2H_5$ ☐

(b) $C_2H_5CO_2C_2H_5$ ☐

(c) $C_2H_5CO_2C_3H_7$ ☐

(d) $C_3H_7CO_2C_2H_5$ ☐

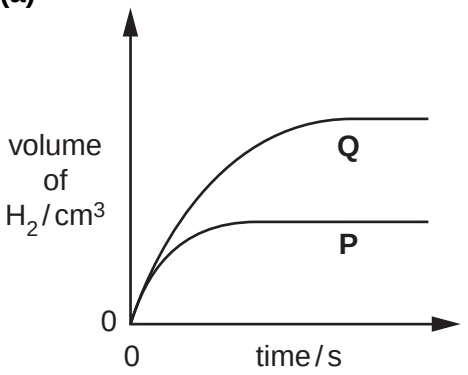
[1]

6 A student adds 5.0 cm^3 of 0.20 mol/dm^3 hydrochloric acid to an excess of zinc p... The volume of hydrogen evolved is recorded at regular time intervals until no more ga... produced.
This is experiment **P**.

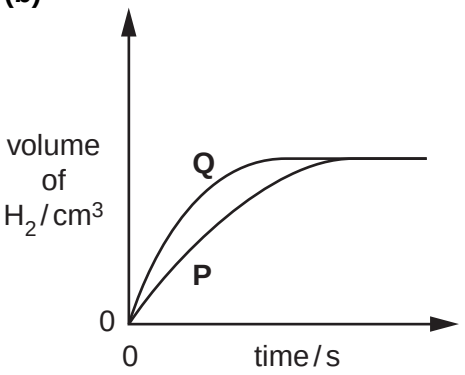
The experiment is repeated using 20.0 cm^3 of 0.10 mol/dm^3 hydrochloric acid and an excess of zinc powder.
This is experiment **Q**.

Which one of the following is obtained?

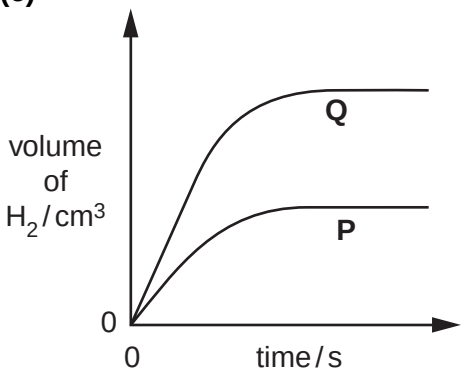
(a)



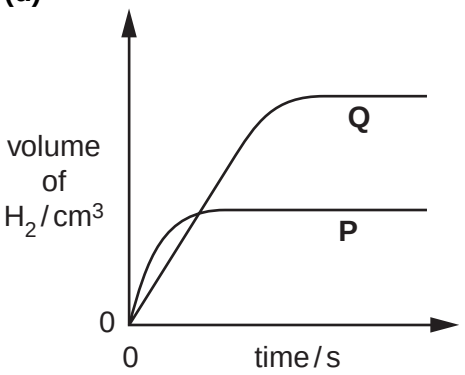
(b)



(c)

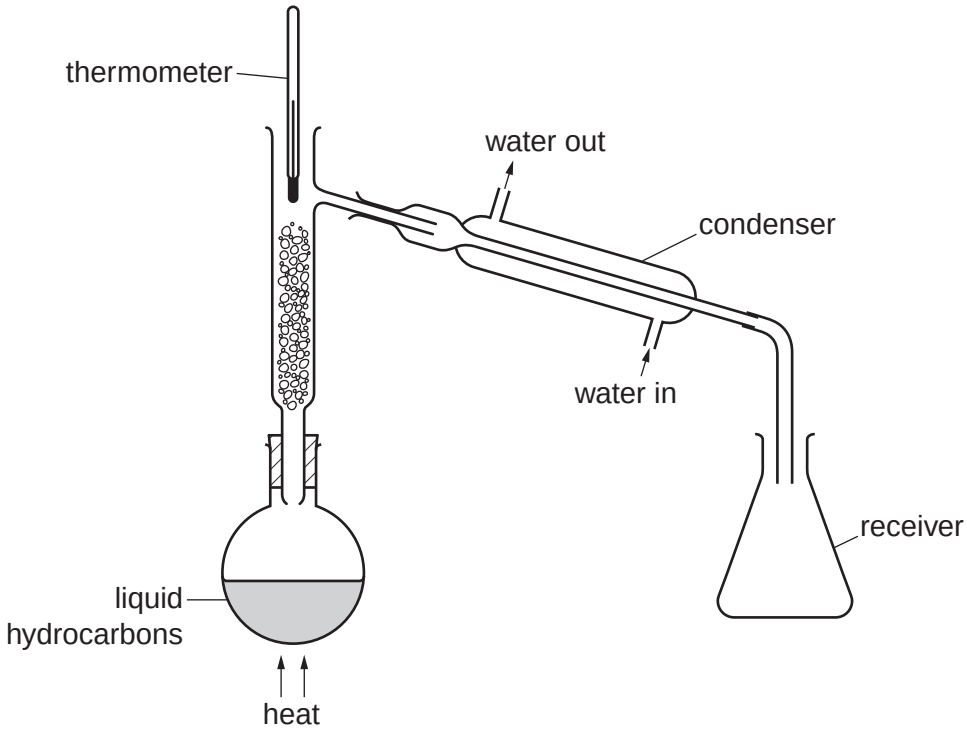


(d)



[1]

7 A student sets up the apparatus shown below in order to separate two hydrocarb… fractional distillation.



What error is the student making in setting up the apparatus?

(a) The thermometer is in the wrong position. ☐

(b) There should be a bung in the top of the fractionating column. ☐

(c) There should be a bung in the top of the receiver. ☐

(d) The water enters the condenser in the wrong place. ☐

[1]

8 **M** is a mixture of iron(II) sulfate and iron(III) sulfate.
A student determines the mass of iron(II) sulfate in the mixture using 0.0180 mol/ aqueous potassium manganate(VII), solution **S**.

(a) Potassium manganate(VII), which is purple, oxidises the iron(II) ions in the mixture.

Why does potassium manganate(VII) not react with iron(III) ions?

.....[1]

(b) A sample of **M** is added to a previously weighed container, which is then reweighed.

mass of container + **M** = 17.01 g
mass of container = 11.93 g

Calculate the mass of **M** used in the experiment.

..... g [1]

(c) The sample of **M** is placed in a flask, dissolved in 100 cm^3 of dilute sulfuric acid and mixed thoroughly. The solution is made up to 250 cm^3 with distilled water. This is solution **P**.

25.0 cm^3 of **P** is transferred into a conical flask.

What piece of apparatus should be used to transfer 25.0 cm^3 of **P**?

.....[1]

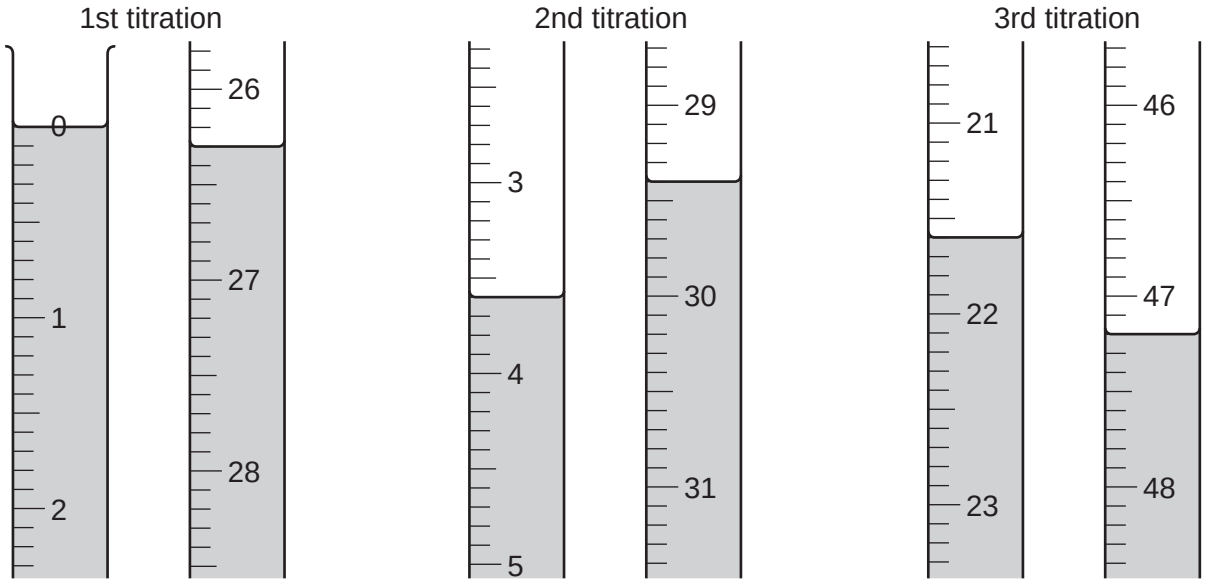
(d) Solution **S** is put into a burette and run into the conical flask containing **P** until the end-point is reached.

What is the colour of the solution in the conical flask

(i) before **S** is added, ...

(ii) at the end-point when **S** is just in excess? ..... [1]

(e) Three titrations are done. The diagrams below show parts of the burette with the 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 **S** used / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results.

Using these results, the average volume of **S** used is

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

(f) **S** is 0.0180 mol/dm^3 potassium manganate(VII).

Calculate the number of moles of potassium manganate(VII) in the average volume of **S** in **(e)**.

..... moles [1]

(g) **One** mole of potassium manganate(VII) reacts with **five** moles of iron(II) sulfate.

Deduce the number of moles of iron(II) sulfate in 25.0 cm^3 of **P**.

..... moles [1]

(h) Calculate

(i) the number of moles of iron(II) sulfate in 250 cm^3 **P**,

..... moles [1]

(ii) the mass of iron(II) sulfate in 250 cm^3 of **P**.
[M_r: $FeSO_4$, 152]

..... g [1]

(i) Using your answers to **(b)** and **(h)(ii)**, calculate the mass of iron(II) sulfate in 1000 g of **M**.

..... g [1]

[Total: 13]

9 The following table shows the tests a student does on compound **V** and the conc… made from observations.
Complete the table by stating the conclusion in test **(a)**, the observation in test **(c)** a… suggest both the tests and observations that lead to the conclusions in tests **(b)** and **(d)**.

test	observation	conclusion
(a) V is dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.	A colourless solution is obtained.	
(b)(i) **(ii)**		**V** may contain Al^{3+}, Ca^{2+} or Zn^{2+} ions, **V** may contain Ca^{2+} ions.
(c) To the second part aqueous ammonia is added until a change was seen.		The presence of Ca^{2+} ions in **V** is confirmed.
(d)		**V** contains NO_3^- ions.

[Total: 10]

10 **(a)** The reaction between aqueous barium chloride and dilute sulfuric acid produces a precipitate of barium sulfate.

State the colour of this precipitate.

.....[1]

A series of experiments are done to find the mass of precipitate when different volumes of dilute sulfuric acid are added to a fixed volume of aqueous barium chloride.

Solution **J** is 1.00 mol/dm^3 barium chloride.
Solution **K** is sulfuric acid of unknown concentration.

10 cm^3 of **J** is put into each of six test-tubes. Increasing volumes of **K** are added to each test-tube. The mixtures are filtered and the precipitates washed with water, dried and placed in a previously weighed container which is reweighed.

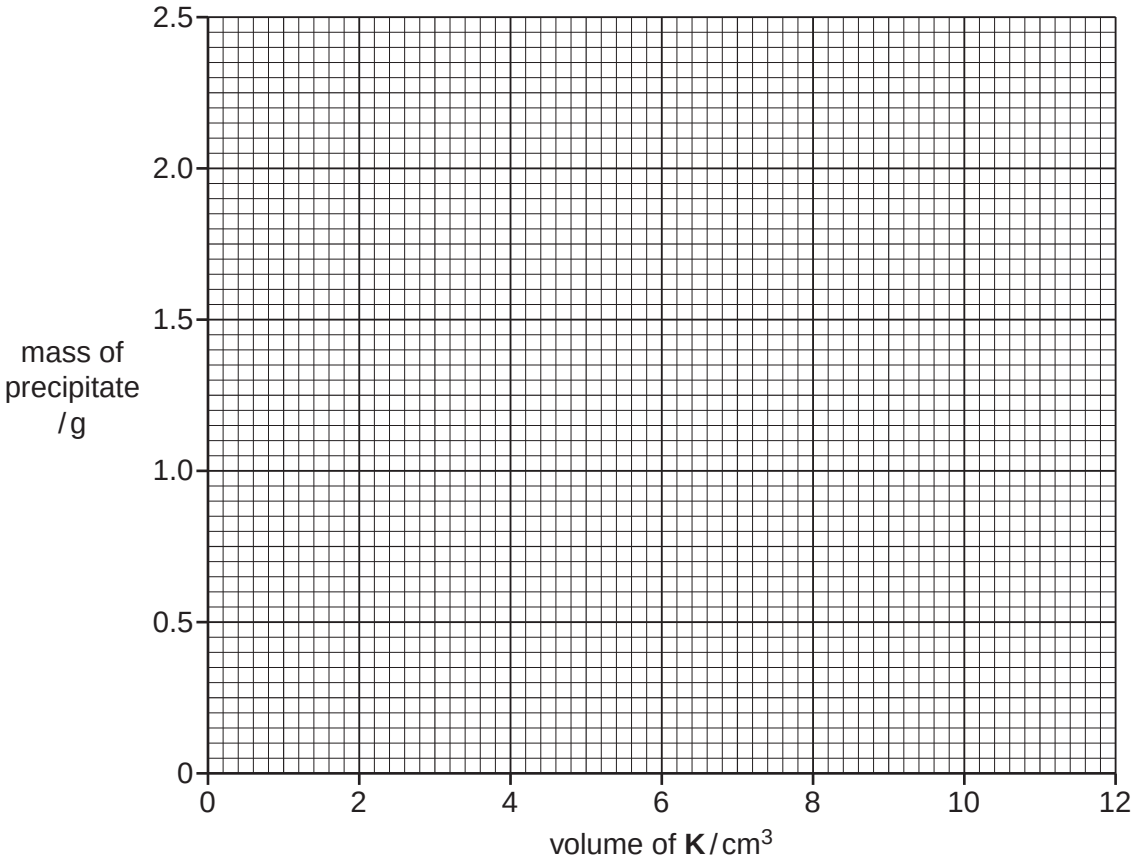
(b) The table below shows the results of these experiments.

Complete the final column.

volume of **J** /cm^3	volume of **K** /cm^3	mass of empty container / g	mass of container + precipitate / g	mass of precipitate / g
10.0	2.0	3.50	4.08	
10.0	4.0	3.50	4.55	
10.0	6.0	3.50	5.25	
10.0	8.0	3.50	5.83	
10.0	10.0	3.50	5.83	
10.0	12.0	3.50	5.83	

[2]

(c) Plot the mass of precipitate against the volume of **K** on the grid. Join the points w... best fit straight lines.



[3]

(d) One of the results is incorrect. Circle this result on your grid and suggest what the correct result should be.

..... g [1]

(e) Use the data on your grid to deduce

(i) the volume of **K** which would produce 1.50 g of precipitate,

.....cm^3 [1]

(ii) the maximum mass of precipitate that is produced,

..... g [1]

(iii) the minimum volume of **K** which reacts completely with the maximum mass in **(ii)**.

..... g [1]

(f) Write the equation for the reaction between barium chloride and sulfuric acid.

..... [2]

(g) Using your answers to **(e)(iii)** and **(f)**, calculate the concentration of the sulfuric acid, **K**, used in the experiment.

.....mol / dm^3 [1]

[Total: 12]

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