UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0160969008

CHEMISTRY **5070/43**

Paper 4 Alternative to Practical **May/June 2010**

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.

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

For Examiner's Use

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

DC (LEO/KN) 26315/1

UNIVERSITY *of* CAMBRIDGE International Examinations

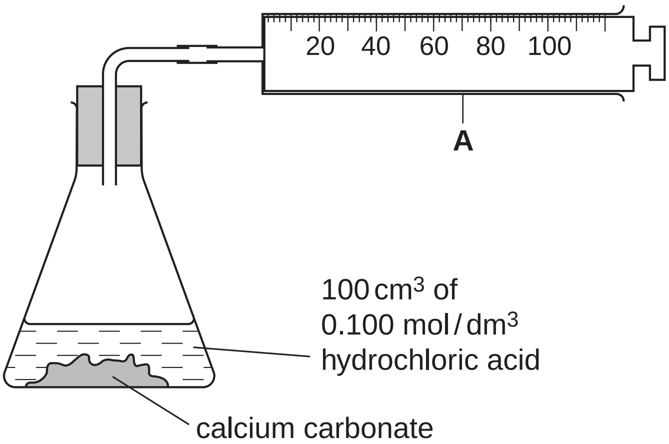
[Turn over

For Examiner's Use

1 A student added 100 cm^3 of 0.100 mol/dm^3 hydrochloric acid (an excess) to a known mass of calcium carbonate contained in a conical flask. The reaction produced carbon dioxide according to the following equation.

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

The apparatus is shown below.



(a) Name the apparatus labelled **A**.

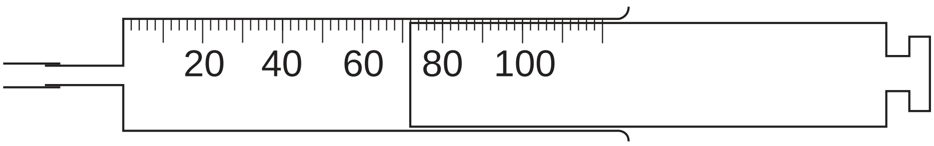
.... [1]

(b) Give a test to confirm the presence of carbon dioxide.

test ....

observation .... [1]

(c) The diagram below shows apparatus **A** at the completion of the reaction.



apparatus **A**

What volume of carbon dioxide was collected?

.... cm^3 [1]

(d) Using your answer to **(c)**, calculate the number of moles of carbon dioxide produced in the reaction.
[One mole of a gas occupies 24 000 cm^3 at room temperature and pressure.]

.... moles [1]

For Examiner's Use

(e) **(i)** Using the equation for the reaction and your answer to **(d)**, suggest the number of moles of calcium carbonate that reacted with 0.100 mol/dm^3 hydrochloric acid.

.... moles [1]

(ii) Calculate the relative formula mass of calcium carbonate, $CaCO_3$.
[A_r: Ca, 40; C, 12; O, 16]

.... [1]

(iii) Using your answers to **(e)(i)** and **(ii)**, calculate the mass of calcium carbonate that reacted with 0.100 mol/dm^3 hydrochloric acid.

.... g [1]

(f) The experiment was repeated using magnesium carbonate instead of calcium carbonate. The mass of magnesium carbonate used was identical to the mass of calcium carbonate in the previous experiment.
Calculate the volume of carbon dioxide collected.
[A_r: Mg, 24; C, 12; O, 16]

.... cm^3 [2]

[Total: 9]

[Turn over

2 A student was given a sample of zinc and a beaker half-filled with aqueous copper(II) sulfate.

For Examiner's Use

(a) Describe the appearance of

(i) zinc,

.... [1]

(ii) aqueous copper(II) sulfate.

.... [1]

When the zinc was added to the aqueous copper(II) sulfate an exothermic reaction occurred and a red solid was deposited on the base of the beaker.

(b) **(i)** How did the student know that the reaction was exothermic?

.... [1]

(ii) Name the red solid.

.... [1]

(c) Describe two **other** changes that were seen during the reaction.

1 ....

2 ....
[2]

(d) **(i)** Write an equation for the reaction between zinc and aqueous copper(II) sulfate.

.... [1]

(ii) What type of reaction is represented by this equation?

.... [1]

[Total: 8]

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

For Examiner's Use

3 Which **two** of the following compounds will decolourise bromine water?

A C_2H_4
B C_2H_6
C C_3H_6
D C_3H_8

(a) **A** and **D** ☐

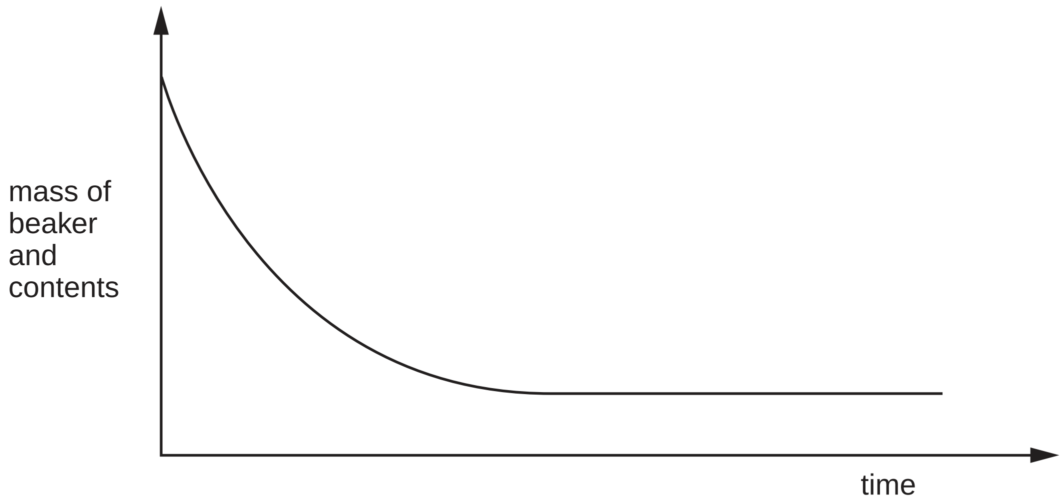
(b) **B** and **C** ☐

(c) **A** and **C** ☐

(d) **B** and **D** ☐ [1]

[Total: 1]

4 Two solutions were mixed in a beaker and the total mass of the beaker and contents recorded at intervals. The graph shows the results.



Which two solutions would give this graph?

(a) aqueous copper(II) sulfate and aqueous ammonia ☐

(b) aqueous sodium carbonate and dilute nitric acid ☐

(c) aqueous sodium hydroxide and aqueous zinc sulfate ☐

(d) dilute hydrochloric acid and aqueous sodium sulfate ☐ [1]

[Total: 1]

5 A small piece of each of the following metals was added to a beaker half filled with water. Which metal reacted vigorously on the surface of the water?

(a) iron ☐

(b) lead ☐

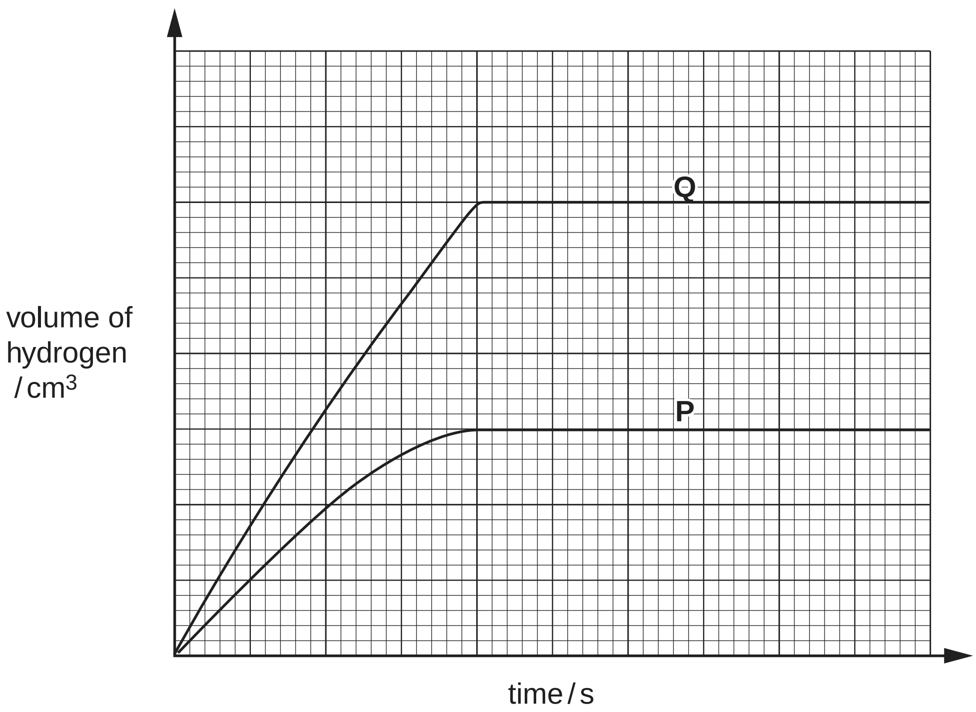
(c) sodium ☐

(d) zinc ☐ [1]

[Total: 1]

6 A student added 10.0 cm^3 of 0.100 mol/dm^3 hydrochloric acid to an excess of zinc. The volume of hydrogen produced was recorded at intervals until no more gas was produced. This was experiment **P**.
The experiment was repeated with a different acid solution, again using an excess of zinc. This was experiment **Q**.

The graphs of the two experiments are shown on the grid below.



Which acid solution would give the graph for experiment **Q**?

(a) 10 cm^3 of 0.050 mol/dm^3 hydrochloric acid ☐

(b) 10 cm^3 of 0.200 mol/dm^3 hydrochloric acid ☐

(c) 20 cm^3 of 0.100 mol/dm^3 hydrochloric acid ☐

(d) 20 cm^3 of 0.200 mol/dm^3 hydrochloric acid ☐ [1]

[Total: 1]

7 The reaction between barium chloride and sulfuric acid produces a precipitate of barium sulfate.
The equation for the reaction is

$$BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$$

10 cm^3 of 0.100 mol/dm^3 barium chloride was added to 10 cm^3 of 0.100 mol/dm^3 sulfuric acid.
The precipitate was removed by filtration, dried and weighed.

Four more experiments were done with solutions of the same concentration.
Which experiment produced twice as much precipitate as produced in the first experiment?

(a) 10 cm^3 of $BaCl_2$ + 20 cm^3 of H_2SO_4 ☐

(b) 20 cm^3 of $BaCl_2$ + 10 cm^3 of H_2SO_4 ☐

(c) 20 cm^3 of $BaCl_2$ + 20 cm^3 of H_2SO_4 ☐

(d) 15 cm^3 of $BaCl_2$ + 15 cm^3 of H_2SO_4 ☐ [1]

[Total: 1]

8 A student was required to determine the value of x in the formula of the acid H_xA, by titrating an aqueous solution of the acid **S** with aqueous sodium hydroxide **T**.

S is 0.0450 mol/dm^3 aqueous acid, H_x**A**.

T is 0.0800 mol/dm^3 aqueous sodium hydroxide.

(a) 25.0 cm^3 of **T** was transferred into a conical flask.

Which piece of apparatus was used for this measurement?

.... [1]

(b) A few drops of methyl orange indicator were added.

What was the colour of the solution in the conical flask?

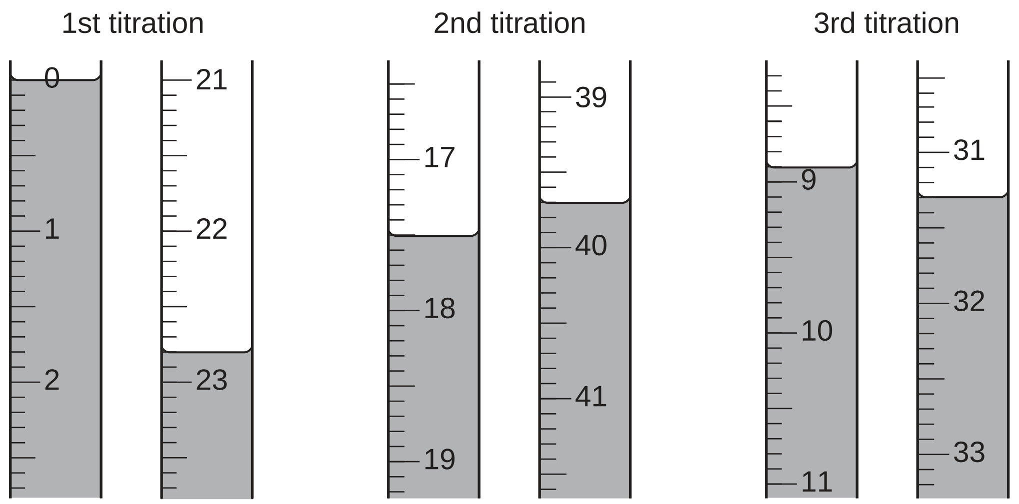
....

A burette was filled with **S**, which was run into the conical flask until an end-point was reached.

What was the colour of the solution in the flask when the end-point was reached?

.... [1]

Three titrations were done. The diagrams below show parts of the burette with the liquid levels at the beginning and end of each titration.



(c) Use the diagrams to complete the following table.

For Examiner's Use

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

Summary

Tick (✓) the best titration results.
Using these results, the average volume of **S** was

.... cm^3. [4]

(d) **S** is 0.0450 mol/dm^3 H_x**A**.
Using your answer to **(c)** calculate the number of moles of acid H_x**A** in the average volume of **S**.

.... moles [1]

(e) **T** is 0.0800 mol/dm^3 sodium hydroxide.
Calculate the number of moles of sodium hydroxide in 25.0 cm^3 of **T**.

.... moles [1]

(f) Using your answers to **(d)** and **(e)** calculate the number of moles of sodium hydroxide which react with one mole of H_x**A**.

.... moles [1]

(g) Using your answer to **(f)**, deduce the value of x in the formula H_x**A**.

.... [1]

(h) **(i)** Using your answer to **(g)**, suggest the chemical formula of an acid represented by H_x**A**.

For Examiner's Use

.... [1]

(ii) Write an equation for the reaction between the acid suggested in **(h)(i)** and sodium hydroxide.

[1]

[Total: 12]

9 **V** is a mixture of two compounds which together contain four ions.
The following table shows the tests a student did on **V**.
Any gas produced was tested.
Complete the table by describing the conclusion in test **(a)**, the observations in test **(b)** and the tests and observations in both **(c)** and **(d)**.

For Examiner's Use

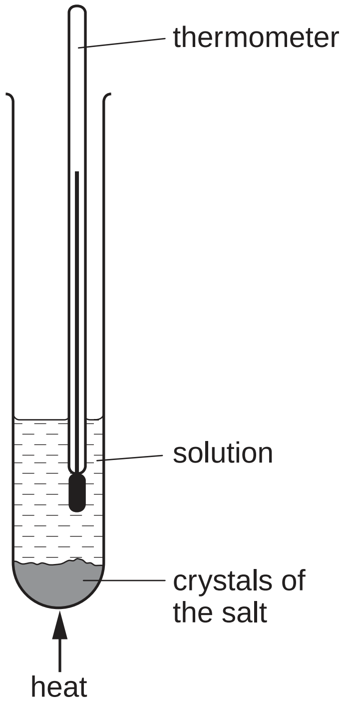
test	observations	conclusions
(a) **V** was dissolved in water and the resulting solution divided into three parts for tests **(b)**, **(c)** and **(d)**.	A coloured solution was produced.	
(b) **(i)** To the first part aqueous sodium hydroxide was added until a change was seen. **(ii)** An excess of aqueous sodium hydroxide was added to the mixture from **(i)**. **(iii)** The mixture from **(ii)** was heated.		**V** may contain Fe^{2+} ions. The presence of Fe^{2+} ions in **V** is confirmed. **V** contains NH_4^+ ions.
(c)		**V** contains SO_4^{2-} ions.
(d)		**V** contains Cl^- ions.

Suggest the formula for each of two compounds which could have been used to make up **V**.

.... and ....

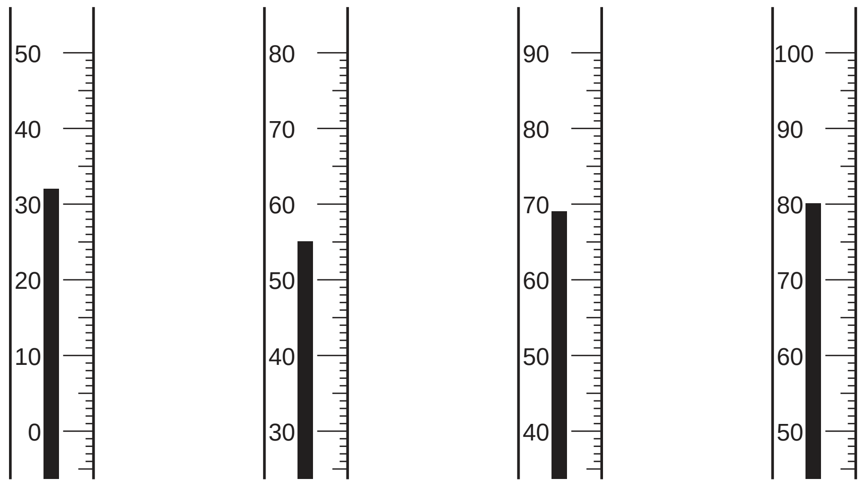
[Total: 13]

10 A student investigated the solubility in water of two salts, potassium chlorate(V) and sodium chloride.
She used the apparatus shown below.



10 g of water was transferred into a boiling-tube. To this 0.5 g of potassium chlorate(V) was added.
The tube and its contents were heated until all the solid dissolved. The tube was allowed to cool.
At the first sign of solid reappearing the temperature was noted.
The experiment was repeated using 1.0, 2.0, 3.0 and 4.0 g of potassium chlorate(V).

The diagrams below show parts of the thermometer stems giving the temperature at which the solid appeared.



1.0 g potassium chlorate(V) | 2.0 g potassium chlorate(V) | 3.0 g potassium chlorate(V) | 4.0 g potassium chlorate(V)

(a) Use the thermometer readings to complete the following table.

mass of potassium chlorate(V) in 10 g of water /g	0.5	1.0	2.0	3.0	4.0
temperature at which potassium chlorate(V) appears / °C	10				

[2]

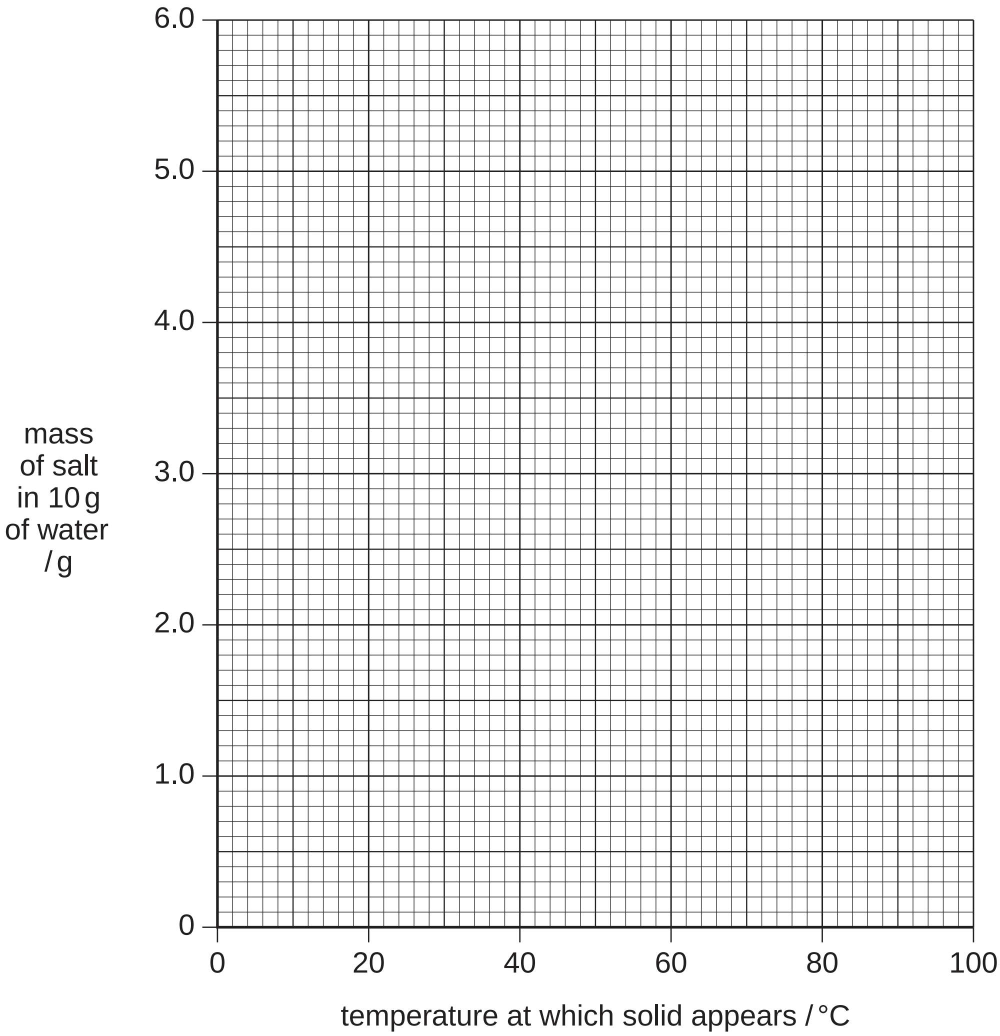
The experiment was repeated using sodium chloride, the results for which are shown in the following table.

mass of sodium chloride in 10 g of water /g	2.7	3.0	3.2	3.4
temperature at which sodium chloride appears/ °C	10	34	50	66

(b) Plot the results for both potassium chlorate(V) and sodium chloride on the grid below.

Join the points for potassium chlorate(V) with a smooth curve and those for sodium chloride with a straight line.

Extend each line in both directions so that at the lower ends each line crosses the vertical axis and at the upper ends the lines cross.



[4]

[Turn over

Use your graphs to answer the following questions.

For Examiner's Use

(c) What is the mass of each compound that dissolves in 10 g of water at 0 °C?

(i) potassium chlorate(V)

.... g [1]

(ii) sodium chloride

.... g [1]

(d) At what temperature is the solubility of each salt the same?

....°C [1]

(e) The solubility of a salt is defined as the maximum mass of salt that will dissolve in 100 g of water at a given temperature.

Calculate the solubility of both potassium chlorate(V) and sodium chloride at the temperature you have given in **(d)**.

.... g [1]

(f) The student was given two boiling-tubes, one containing 2.0 g of potassium chlorate(V) in 10.0 g of water, the other 2.0 g of sodium chloride in 10.0 g of water, both at a temperature of 40 °C.
The mixtures were stirred.
Use the information on your graph to describe the contents of each tube.

potassium chlorate(V) ....

....

sodium chloride ....

....
[2]

(g) By referring to your graphs compare the effect of increasing the temperature on the solubility of each salt.

....

.... [1]

[Total: 13]

BLANK PAGE

BLANK PAGE