UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **October/November 2013**

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.
Electronic calculators may be used.
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.

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

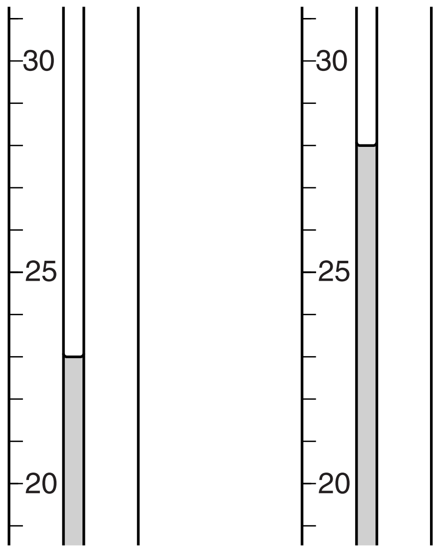
DC (CW/SW) 58061/4

UNIVERSITY *of* CAMBRIDGE
International Examinations

[Turn over

1 Approximately 4 g of sodium hydroxide is added to 100 cm^3 of water. A thermometer is used to measure the temperature of the liquid both before and after the addition of sodium hydroxide.
The diagrams below show parts of the thermometer stem giving the two temperatures.

For Examiner's Use



T_1(before) T_2(after)

(a) Complete the table and calculate the change in temperature.

temperature T_2 after sodium hydroxide is added / °C	
temperature T_1 before sodium hydroxide is added / °C	
change in temperature / °C	

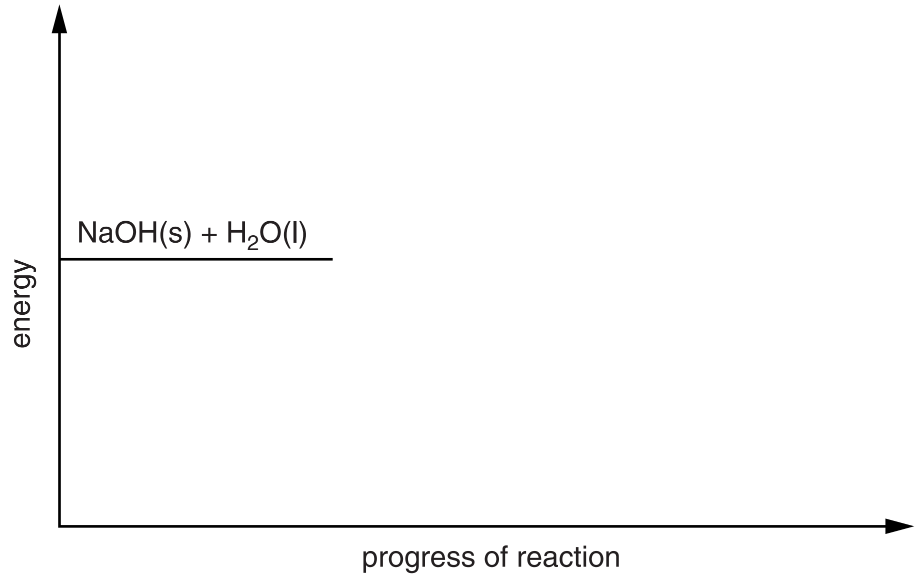
[2]

(b) **(i)** What type of process does this temperature change suggest has taken place?

.... [1]

(ii) Complete the energy profile diagram for sodium hydroxide dissolving in water. On your diagram label

- the products,
- the enthalpy change, ΔH.



[2]

(c) (i) If aqueous litmus is added to aqueous sodium hydroxide, what colour is the resulting solution?

.... [1]

(ii) How can the pH of aqueous sodium hydroxide be determined?

.... [1]

(iii) Suggest a value for the pH of aqueous sodium hydroxide.

.... [1]

[Total: 8]

2 The fertiliser ammonium nitrate is a source of nitrogen.
It has the formula NH_4NO_3.
It can be made by adding an acid to aqueous ammonia.

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(a) Name and give the formula of this acid.

name ....

formula .... [1]

(b) Describe briefly how crystals of ammonium nitrate can be made from aqueous ammonium nitrate.

....

....

....[3]

(c) **(i)** Calculate the mass of nitrogen contained in 1000 g of ammonium nitrate.
[A_r: H,1; N,14; O,16]

.... g [2]

(ii) What volume would the mass of nitrogen calculated in **(i)** occupy in the gaseous state at room temperature and pressure?
[One mole of a gas occupies 24 dm^3 at room temperature and pressure.]

.... dm^3 [1]

(d) Name and give the formula of another ammonium salt which may be used as a fertiliser.

name ....

formula .... [1]

(e) Give both the formula and a test for the ammonium ion.

formula ....

test ....

observation ....[3]

[Total: 11]

In questions **3** to **6** inclusive, place a tick (✓) in the box against the correct answer.

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3 Which method can be used to obtain pure water from aqueous sodium chloride?

(a) chromatography ☐

(b) distillation ☐

(c) evaporation ☐

(d) titration ☐

[Total: 1]

4 Which is the best apparatus for transferring 25.0 cm^3 of a liquid from one flask to another during a titration experiment?

(a) beaker ☐

(b) burette ☐

(c) measuring cylinder ☐

(d) pipette ☐

[Total: 1]

5 A student does an experiment to decompose hydrogen peroxide.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

He repeats this experiment using solid manganese(IV) oxide as a catalyst.

Which observation regarding the use of manganese(IV) oxide is correct?

(a) The rate of decomposition of hydrogen peroxide increases. ☐

(b) The manganese(IV) oxide reacts with hydrogen peroxide. ☐

(c) The total volume of oxygen produced in the reaction increases. ☐

(d) The mass of manganese(IV) oxide decreases. ☐

[Total: 1]

6 The presence of an alkene is confirmed by its reaction with aqueous bromine.
1 mole of alkene reacts with 1 mole of bromine, Br_2.

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In an experiment 8.4 g of an alkene reacts completely with 32 g of bromine.
[A_r: H,1; C,12; Br, 80]

The alkene is

(a) C_2H_4. ☐

(b) C_3H_6. ☐

(c) C_4H_8. ☐

(d) C_5H_{10}. ☐

[Total: 1]

7 A student determines the percentage of iron in iron wire by titration with 0.0200 mol / dm^3 potassium manganate(VII), $KMnO_4$.

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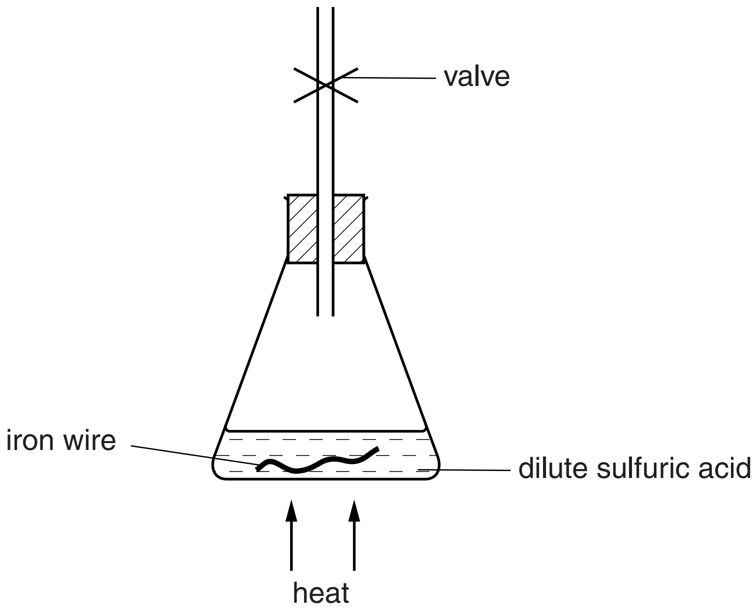
(a) A piece of iron wire is added to a previously weighed container which is then reweighed.

mass of container + iron wire	=	8.59 g
mass of container	=	6.94 g

Calculate the mass of iron wire used in the experiment.

.... g [1]

(b) The iron wire is placed in a conical flask as shown in the diagram below.
Dilute sulfuric acid is added to react completely with all the iron in the wire.
The iron in the wire is oxidised to Fe^{2+} ions.
The valve allows the gas to escape but does not allow air into the flask.



(i) Suggest why it is necessary to prevent air entering the apparatus.

.... [1]

(ii) Name and give a test for the gas produced during the reaction.

name ....

test .... [2]

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(c) When all the iron has reacted, the contents of the conical flask are transferred to a volumetric flask.
The solution is made up to 250 cm^3 with distilled water.
This is solution **P**.

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

A burette is filled with 0.0200 mol / dm^3 potassium manganate(VII) which is added to the conical flask.

What is the colour of **P**

(i) before the addition of aqueous potassium manganate(VII),

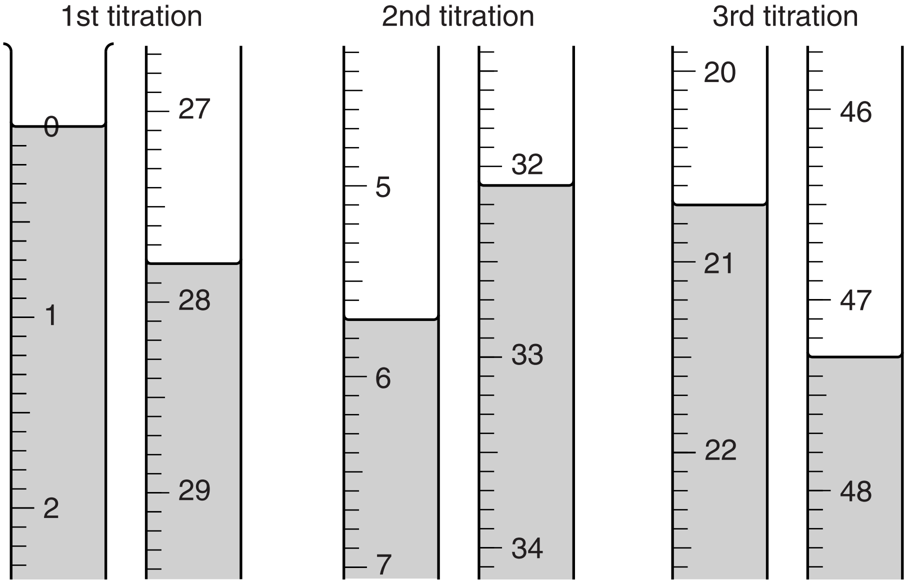
....

(ii) at the end-point?

....

[2]

(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 results table.

titration number	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of 0.0200 mol / dm^3 potassium manganate(VII) added / cm^3			
best titration results (✓)			

Summary:

Tick (✓) the best titration results.

Using these results, the average volume of 0.0200 mol / dm^3 potassium manganate(VII) is

.... cm^3. [4]

(e) Calculate the number of moles of potassium manganate(VII) in the average volume of 0.0200 mol / dm^3 $KMnO_4$.

.... moles [1]

(f) Five moles of Fe^{2+} ions react with one mole of $KMnO_4$.

Calculate the number of moles of Fe^{2+} ions in 25.0 cm^3 of **P**.

.... moles [1]

(g) Calculate the number of moles of Fe^{2+} ions in 250 cm^3 of **P**.

.... moles [1]

(h) Calculate the mass of iron in 250 cm^3 of **P**.
[A_r: Fe, 56]

.... g [1]

(i) Using your answers to **(a)** and **(h)**, calculate the percentage by mass of iron in the sample of iron wire.

....% [1]

[Total: 15]

8 **V** is a compound which contains two ions.
Complete the table by adding the observations for tests **(a)**, **(b)** and **(c)** and the test and observation for test **(d)**.

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test	observations	conclusions
(a) **V** is dissolved in water and the resulting solution divided into three parts for tests **(a)**, **(b)** and **(c)**.		**V** is probably not a compound of a transition metal.
(b) **(i)** To the first part, aqueous sodium hydroxide is added until a change is seen. **(ii)** An excess of aqueous sodium hydroxide is added to the mixture from **(i)**.		 **V** may contain Al^{3+} or Zn^{2+} ions.
(c) **(i)** To the second part, aqueous ammonia is added until a change is seen. **(ii)** An excess of aqueous ammonia is added to the mixture from **(i)**.		 The presence of Al^{3+} ions is confirmed.
(d)		**V** contains SO_4^{2-} ions.

Conclusion: the formula of **V** is ....

[Total: 8]

9 A constant current is passed through aqueous copper(II) sulfate using inert electrodes as shown in the diagram below.

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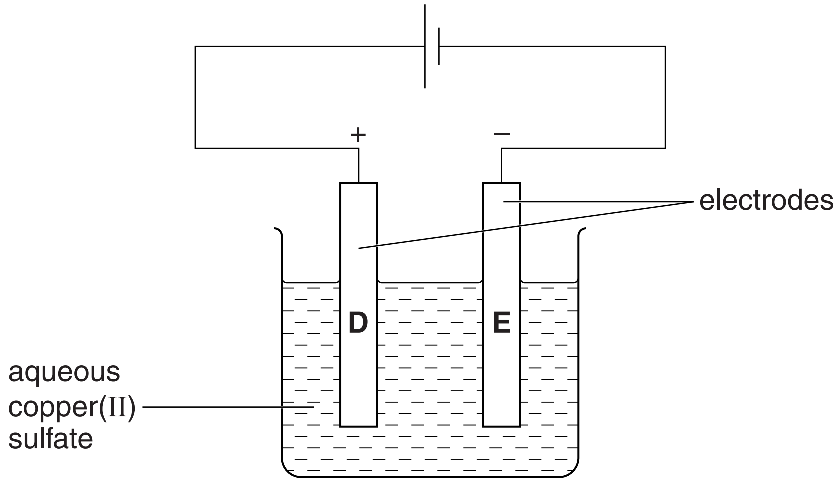
Copper is deposited at one of the electrodes.



(a) Name a suitable material for the inert electrodes.

.... [1]

(b) At which electrode is copper deposited?

.... [1]

(c) What is seen at the other electrode?

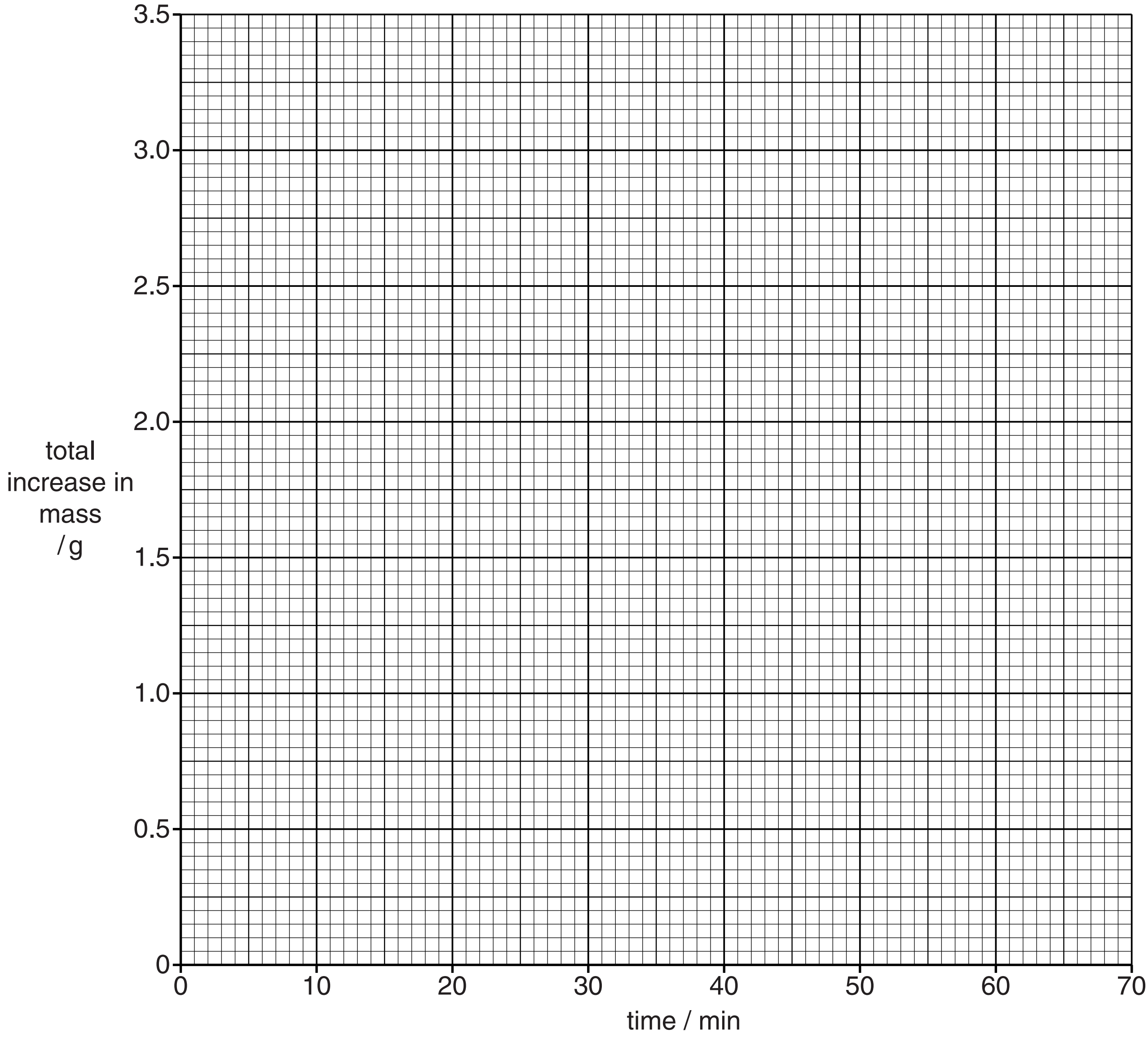
.... [1]

(d) **(i)** The electrode at which copper is deposited is removed at 10 minute intervals, washed, dried and weighed.
The results are shown in the table below.
Complete the table by calculating the total increase in mass after each 10 minute interval.

time / min	mass of cathode / g	total increase in mass / g
0	7.55	0.00
10	8.05	0.50
20	8.55	1.00
30	9.05	
40	9.55	
50	9.80	
60	9.80	
70	9.80	

[1]

(ii) Plot these results on the grid below.
Draw two intersecting straight lines through the points.



[3]

(iii) How long does it take for 1.60 g of copper to be deposited?

.... min [1]

(iv) How long does it take for all the copper to be deposited?

.... min [1]

(e) What is the colour of the electrolyte

(i) at the start of the experiment,

.... [1]

(ii) at the end of the experiment?

.... [1]

(f) The experiment is repeated using aqueous copper(II) sulfate of the same concentration as before but this time using copper electrodes.
The same current is passed for the same length of time.

Draw a line on your graph, labelled **S**, to show the result you would expect for this second experiment. [1]

(g) State and explain the colour of the electrolyte at the end of the experiment.

....

....[2]

[Total: 14]

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