Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

9280327505

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **May/June 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.
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 (LK/AR) 89254/3

CAMBRIDGE
International Examinations

[Turn over

1 **(a)** A student heats a small piece of magnesium ribbon in a crucible for several minutes. Some magnesium oxide is produced.

(i) Describe the appearance of the magnesium before heating.

....[1]

(ii) Construct the equation for this reaction.

....[1]

(b) When magnesium is added to dilute sulfuric acid a gas is produced.

Name the gas and give a test and observation to identify this gas.

name ....

test and observation

....[2]

(c) **(i)** Describe what is seen when magnesium oxide is added to excess dilute sulfuric acid.

....[1]

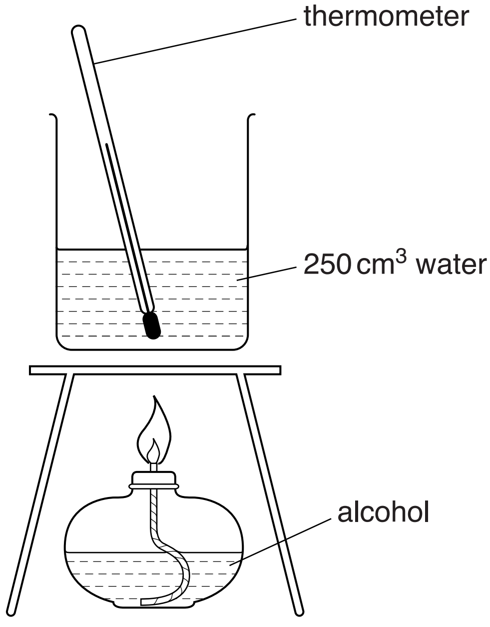
(ii) Construct the equation for this reaction.

....[1]

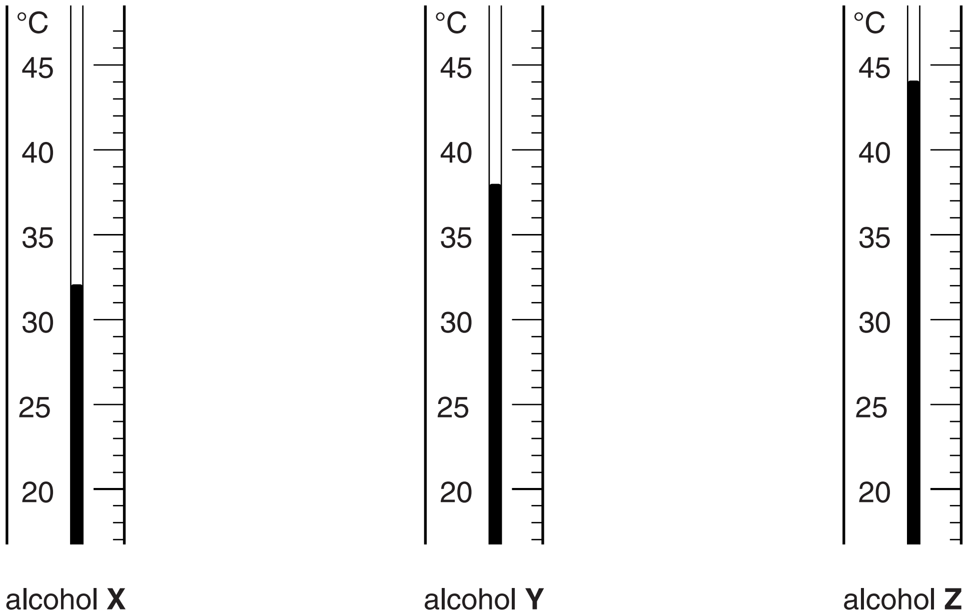
[Total: 6]

2 A student uses the apparatus shown to find the energy released by the combustion of each of three alcohols, **X**, **Y** and **Z**.

In each experiment 0.1 mol of alcohol is burnt and the initial temperature of the water is 20 °C.



(a) **(i)** The diagrams show parts of the thermometer stem giving the temperature of the water after 0.1 mol of each alcohol is burnt.



Use the thermometer readings to complete the following table and calculate the rise in temperature in each experiment.

	alcohol **X**	alcohol **Y**	alcohol **Z**
final temperature / °C			
initial temperature / °C	20	20	20
rise in temperature / °C			

[2]

(ii) Deduce from these results what type of reaction is taking place.

....[1]

(b) When analysed, alcohol **Y** is found to contain 60.0% carbon, 13.3% hydrogen and 26.7% oxygen by mass. Its relative formula mass is 60.
[A_r: C, 12; H, 1; O, 16]

(i) Calculate the empirical formula and hence the molecular formula of **Y**.

empirical formula ....

molecular formula .... [2]

(ii) Using your answers to **(a)(i)** and **(b)(i)** suggest the formula for **X** and the formula for **Z**, giving reasons for your choices.

X ....

Z ....

reasons ....

....[3]

(c) The student oxidises alcohol **Y** to make a carboxylic acid.

(i) Name and give the structure of this acid.

name ....

structure .... [1]

(ii) Suggest both the name of an oxidising agent that can be used and the colour change of the mixture that is seen during the reaction.

oxidising agent ....

The colour changes from .... to .... [2]

(d) Give the name and structure of the ester which may be prepared by reacting alcohol **Y** with the acid produced in **(c)(i)**.

name ....

structure .... [2]

[Total: 13]

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

3 Which apparatus should a student use to measure 25.0 cm^3 of a liquid?

(a) beaker ☐

(b) conical flask ☐

(c) measuring cylinder ☐

(d) pipette ☐

[Total: 1]

4 Water containing a little dilute sulfuric acid is electrolysed using carbon electrodes.

If 20 cm^3 of oxygen is produced at the positive electrode, what volume of hydrogen is produced at the negative electrode?

(a) 10 cm^3 ☐

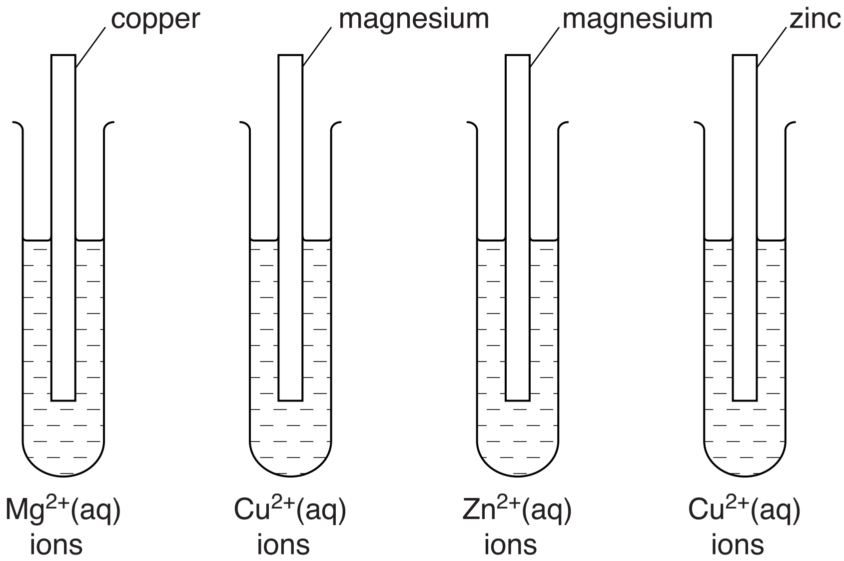
(b) 20 cm^3 ☐

(c) 30 cm^3 ☐

(d) 40 cm^3 ☐

[Total: 1]

5 Four tubes are arranged as in the diagrams. Each tube contains a piece of metal immersed in an aqueous solution of ions of one of the other two metals.



In a total of how many tubes is a coating formed on the piece of metal?

(a) 1

(b) 2

(c) 3

(d) 4

[Total: 1]

6 A small piece of sodium is placed on the surface of water. The sodium reacts and a solution is produced.

Which of the following is **not** correct?

(a) The piece of sodium moves around the surface.

(b) A gas is evolved which relights a glowing splint.

(c) The resulting solution turns litmus blue.

(d) The temperature of the water increases.

[Total: 1]

7 Calcium hydroxide reacts with hydrochloric acid according to the equation shown.

$$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$$

Which of the following solutions of hydrochloric acid will produce 1.11g of calcium chloride when reacted with excess calcium hydroxide?
[M_r: $CaCl_2$, 111]

(a) 25 cm^3 of 0.200 mol / dm^3 of hydrochloric acid ☐

(b) 50 cm^3 of 0.400 mol / dm^3 of hydrochloric acid ☐

(c) 75 cm^3 of 0.050 mol / dm^3 of hydrochloric acid ☐

(d) 100 cm^3 of 0.100 mol / dm^3 of hydrochloric acid ☐

[Total: 1]

8 'Lawn sand' is sand mixed with iron(II) sulfate and ammonium sulfate. It is used to promote the growth of grass.

A student determines the percentage by mass of iron in a sample of lawn sand, **L**, using 0.0200 mol / dm^3 aqueous potassium manganate(VII), solution **P**.

(a) A sample of **L** is added to a previously weighed beaker which is then reweighed.

mass of beaker + **L** = 38.04 g
mass of beaker = 21.93 g

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

.... g [1]

(b) 100 cm^3 of dilute sulfuric acid is added to the beaker containing **L** and stirred well.
Sand is insoluble.

The sand is removed from the mixture. How could this be done?

....[1]

The remaining solution is transferred to a volumetric flask and made up to 250 cm^3 with distilled water. This is solution **M**.

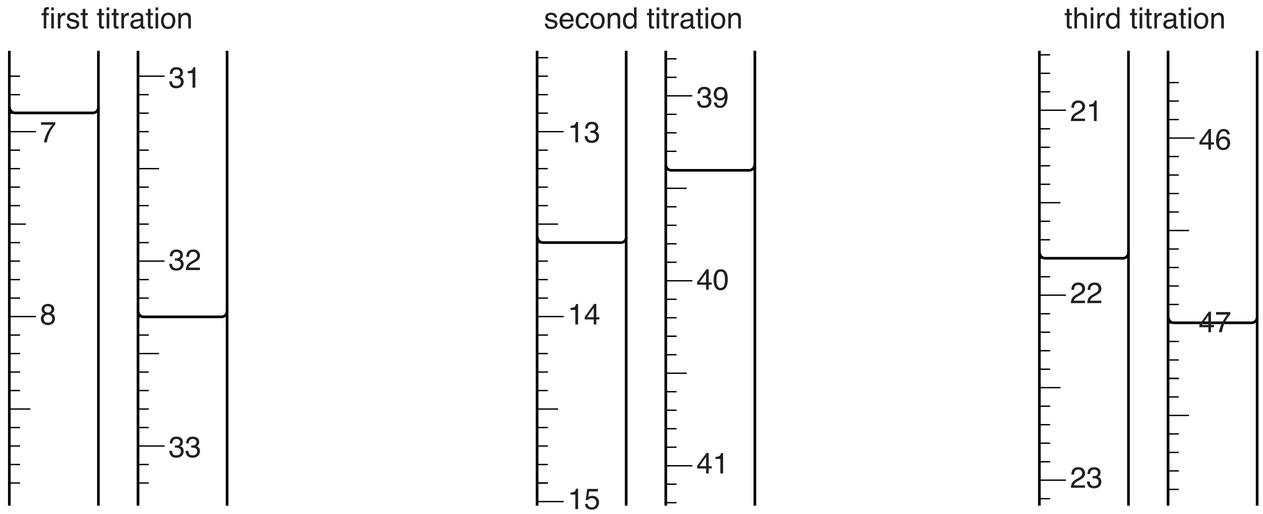
25.0 cm^3 of **M** is transferred into a conical flask.

Solution **P** is put into a burette and run into the conical flask containing **M** until **P** is just in excess.

(c) What is the colour of the solution in the conical flask

- before **P** is added, ...
- when **P** is just in excess? .... [1]

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



Use the diagrams to complete the table.

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

Summary

Tick (✓) the best titration results.

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

.... cm^3. [4]

(e) **P** is 0.0200 mol / dm^3 aqueous potassium manganate(VII).

Calculate the number of moles of potassium manganate(VII) in the average volume of **P** in **(d)**.

.... moles [1]

(f) **One** mole of potassium manganate(VII) reacts with **five** moles of Fe^{2+}.

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

.... moles [1]

(g) Calculate

(i) the number of moles of Fe^{2+} in 250 cm^3 of **M**,

.... moles [1]

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

.... g [1]

(h) Using your answers to **(a)** and **(g)(ii)**, calculate the percentage by mass of iron in **L**.

.... % [1]

(i) Lawn sand also contains ammonium sulfate, $(NH_4)_2SO_4$, which is a nitrogenous fertiliser.

(i) Calculate the percentage by mass of nitrogen in ammonium sulfate.
[A_r: N, 14; H, 1; S, 32; O, 16]

.... % [2]

(ii) Name another compound which can be used as a nitrogenous fertiliser.

.... [1]

[Total: 15]

9 The table shows the tests a student does on compound **V**.

Complete the table by stating the conclusion in test **(a)**, the observations in tests **(b)** and **(c)** and suggest both the test and observation that lead to the conclusion in test **(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)** 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+}, Ca^{2+} or Zn^{2+} ions. **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 Zn^{2+} ions in **V** is confirmed.
(d)		**V** contains NO_3^- ions.

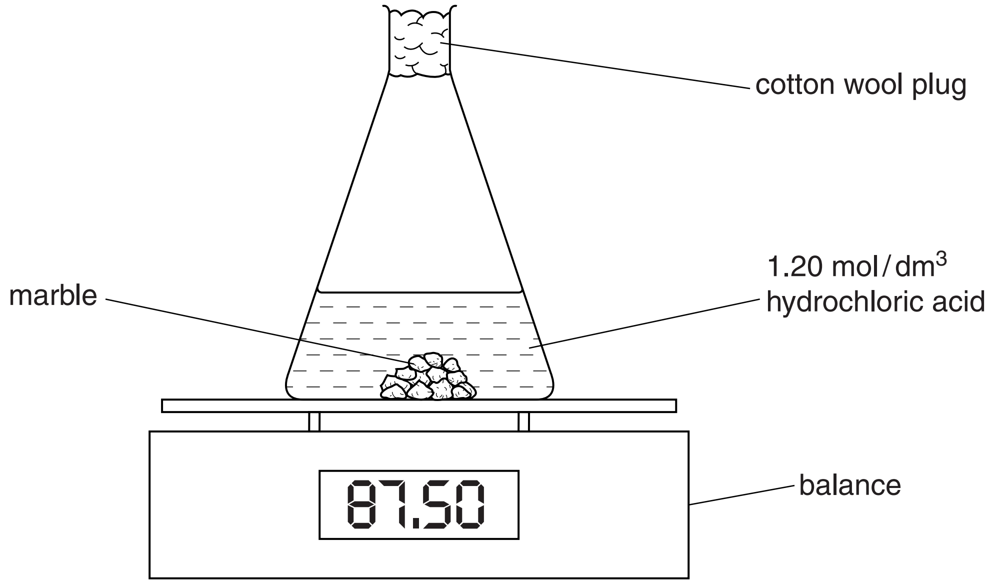
[Total: 8]

10 A student uses the apparatus shown to investigate the reaction between marble ($CaCO_3$) and hydrochloric acid.

10.0 g of marble lumps (an excess) are added to 30.0 cm^3 of 1.20 mol / dm^3 hydrochloric acid contained in a flask.

The mass of the flask and contents is recorded every 30 seconds. This is experiment **1**.

The experiment is repeated using the same mass of marble but finely powdered instead of lumps. The volume and concentration of the hydrochloric acid used is unchanged. This is experiment **2**.



(a) The results of the two experiments are recorded in the table.

Complete the table by calculating the total change in mass at each time for both experiments.

time / s	experiment **1** (lumps)		experiment **2** (powder)	
	mass of flask and contents / g	total change in mass / g	mass of flask and contents / g	total change in mass / g
0	87.50	0.00	87.50	0.00
30	87.22	0.28	87.02	0.48
60	87.02	0.48	86.83	0.67
90	86.87		86.74	
120	86.77		86.69	
150	86.69		86.69	
180	86.69		86.69	

[2]

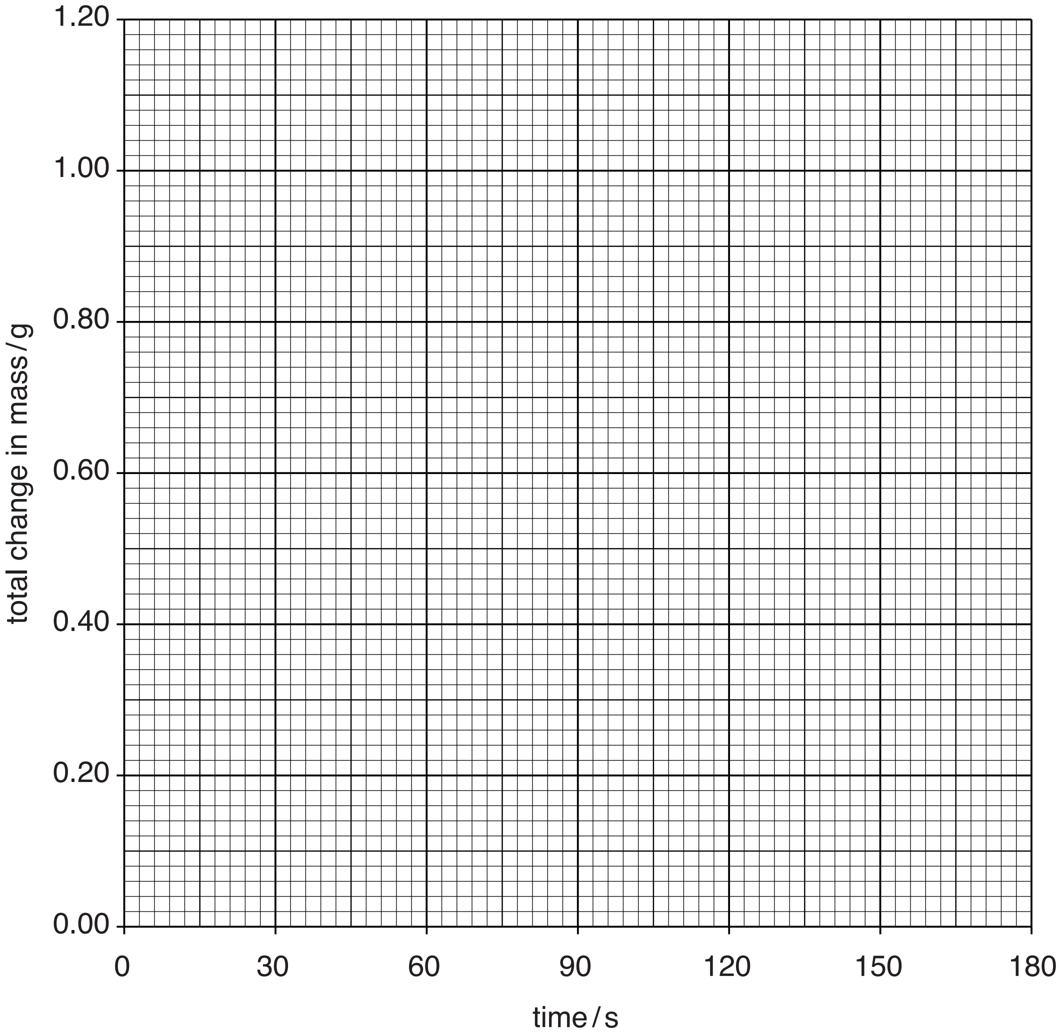
(b) Construct the equation for the reaction between calcium carbonate and hydrochloric acid.

....[1]

(c) Suggest why the mass of the flask and contents decreases as the reaction progresses.

....[1]

(d) Plot the points for each experiment on the grid.
Draw a smooth curve through each set of points.
Label the curves ‘experiment **1**’ and ‘experiment **2**’.



[3]

(e) Using your graph,

(i) what is the total change in mass in experiment **1** after 75 seconds,

.... g [1]

(ii) what is the mass of the flask and contents in experiment **2** after 45 seconds?

.... g [1]

(f) State and explain how the use of powdered marble rather than marble lumps in experiment **2** affects the rate of the reaction.

....

....

....[2]

(g) Using your equation in **(b)**, calculate the mass of marble that remains after reaction with $30\,cm^3$ of $1.20\,mol/dm^3$ hydrochloric acid.
[A_r: Ca, 40; C, 12; O, 16]

.... g [2]

[Total:13]

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