Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0099322737

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **October/November 2018**

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.

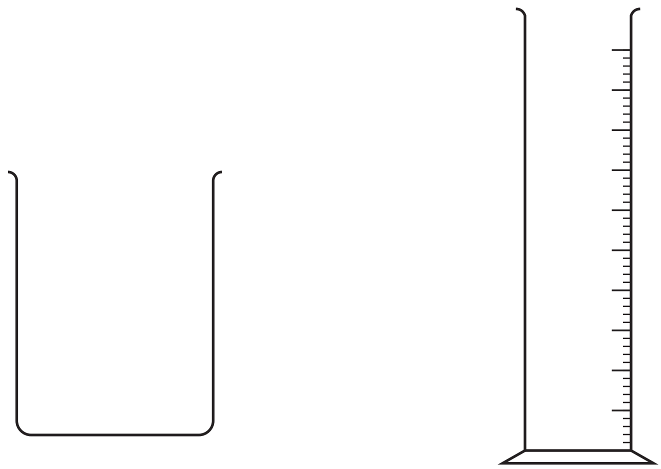
This document consists of **13** printed pages and **3** blank pages.

DC (ST/SG) 147884/3

CAMBRIDGE
International Examinations

[Turn over

1 State the names of the apparatus shown.



A

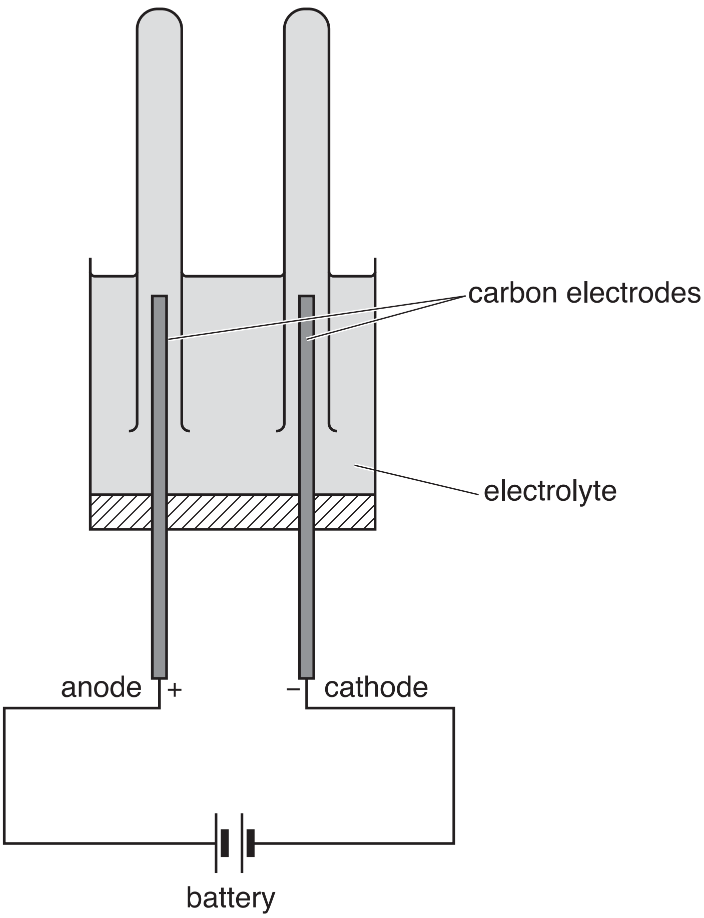
B

A ....

B ....

[2]

2 A student uses the apparatus shown for two electrolysis experiments.



(a) Complete the table.

electrolyte	name of product at the anode (+)	observations at the anode (+)	name of product at the cathode (–)	observations at the cathode (–)
concentrated aqueous potassium bromide	bromine			bubbles of colourless gas
concentrated aqueous copper(II) chloride	chlorine		copper	

[4]

(b) Give a test and observation to identify chlorine gas.

test ....

observation ....

[2]

[Total: 6]

3 Calcium carbonate reacts with dilute hydrochloric acid.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

A student investigates how the rate of this reaction changes as the temperature increases.

The student carries out five experiments, each at a different temperature. For each experiment, he reacts a fixed mass of small pieces of calcium carbonate with an excess of dilute hydrochloric acid. He measures the time taken for all the calcium carbonate to react.

(a) State one variable, other than the concentration of the hydrochloric acid and the temperature, that is likely to affect the rate of this reaction.

....[1]

(b) The student is asked to control the temperature of each experiment so that it remains constant for the whole time that the calcium carbonate and dilute hydrochloric acid are reacting.

Method

For each experiment the student:

- measures out a suitable volume of dilute hydrochloric acid and pours it into a beaker
- places a thermometer in the acid
- heats the acid with a Bunsen burner
- stops heating when the required temperature is reached
- adds a weighed sample of calcium carbonate to the acid
- starts the clock
- stops the clock when all the calcium carbonate has reacted
- records the reaction time.

(i) This method does **not** keep the reaction mixture at constant temperature throughout the experiment. Explain why.

....

....[1]

(ii) Suggest how the method can be improved so that the reaction mixture is at constant temperature throughout the experiment.

....

....[1]

(c) The improved method was carried out at different temperatures. The results are shown.

experiment	temperature /°C	reaction time /s
1	20	120
2	30	70
3	40	130
4	50	15
5	60	2

(i) Which experiment has an anomalous reaction time?

....[1]

(ii) What can the student do to check if the result is anomalous?

....[1]

(iii) How does the rate of the reaction change as the reaction time decreases?

....[1]

(iv) Which of the five experiments has the greatest rate of reaction?

....[1]

(v) Describe how the rate of the reaction changes with the temperature of the acid.

....[1]

(d) Another student does the reaction at 80 °C.

Why would it be difficult to measure the reaction time accurately at this temperature?

....[1]

[Total: 9]

4 A student is provided with three bottles: one contains dilute hydrochloric acid, another contains aqueous sodium sulfite and the third contains aqueous sodium sulfate.

The student is provided with magnesium ribbon, aqueous barium nitrate and dilute nitric acid **but no other chemicals**. The student has access to all the apparatus normally found in a school laboratory.

For each of the three bottles, describe a test and its positive result to identify the contents of the bottle. Chemical equations are not required.

....

....

....

....

....

....

....

....

....

....

....

[3]

5 A student determines the percentage of iron in a powdered sample of impure iron by a titration method.

(a) The student adds the sample of impure iron to a previously weighed beaker which is then reweighed.

mass of beaker + impure iron = 39.36 g

mass of beaker = 37.52 g

Calculate the mass of impure iron used in the experiment.

.... g [1]

(b) An excess of dilute sulfuric acid is added to the beaker containing impure iron. The sulfuric acid reacts with the iron.

$$Fe(s) + 2H^+(aq) \rightarrow Fe^{2+}(aq) + H_2(g)$$

The impurities do not react with or dissolve in the sulfuric acid.

(i) What is meant by an *excess* of dilute sulfuric acid?

....[1]

(ii) The student suggests that the beaker should be heated to make the iron react faster.

What safety precaution should be taken when heating the beaker? Explain your answer.

safety precaution ....

explanation ....

....
[2]

(iii) What else could the student do to increase the rate of the reaction in the beaker?

....[1]

(c) The insoluble impurities are separated from the aqueous solution. The aqueous solution is transferred from a beaker to a volumetric flask and made up to 250 cm^3 with water. This is solution **P**.

(i) Suggest a method of separating the insoluble impurities from the aqueous solution.

....[1]

(ii) Suggest how the student should ensure that **all** the solution is transferred to the volumetric flask.

....

....[2]

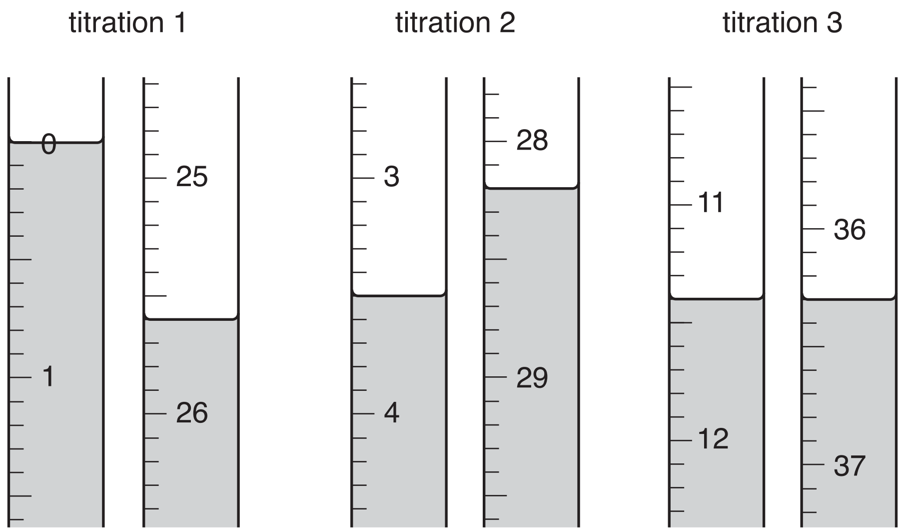
(d) The student transfers 25.0 cm^3 of **P** into a conical flask using a pipette.

Solution **Q** is 0.0200 mol / dm^3 potassium manganate(VII).

The student fills a burette with **Q** and runs it into the conical flask until the end-point is reached.

The student does three titrations.

(i) The diagrams show parts of the burette with the liquid levels both at the beginning and at the 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 **Q** / cm^3			
best titration results (✓)			

Summary

Tick (✓) the best titration results in the table.

Using these best results, the average volume of **Q** is

.... cm^3. [4]

(ii) Give **two** reasons why the student does three titrations using 25.0 cm^3 of **P** in each, rather than carrying out one titration using 250 cm^3 of **P**.

reason 1 ....

reason 2 ....
[2]

(e) Calculate the number of moles of potassium manganate(VII) in the average volume of 0.0200 mol / dm^3 of aqueous potassium manganate(VII) in **(d)(i)**.

.... 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 **P**.

.... moles [1]

(g) Calculate the number of moles of Fe^{2+} 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 impure iron.

....% [1]

[Total: 19]

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6 Solid **L** is a mixture of two compounds. The compounds each contain a different cation but the same anion.

Complete the table.

Any gases given off should be named and identified by a suitable test and observation.

test	observation	conclusion	
(a) **L** is dissolved in water. The solution is divided into three parts for tests **(b)**, **(c)** and **(d)**.	A colourless solution is formed.		[1]
(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)**. **(iii)** The mixture from **(ii)** is warmed.		**L** may contain Al^{3+}, Ca^{2+} or Zn^{2+} ions. **L** contains Al^{3+} or Zn^{2+} ions. **L** contains NH_4^+ ions.	[4]
(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)**.		**L** may contain Al^{3+} or Zn^{2+} ions. **L** contains Zn^{2+} ions.	[2]
(d)		**L** contains Cl^- ions.	[3]

[Total: 10]

7 The reaction between aqueous lead(II) nitrate and aqueous potassium iodide produces a precipitate of lead(II) iodide.

$$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

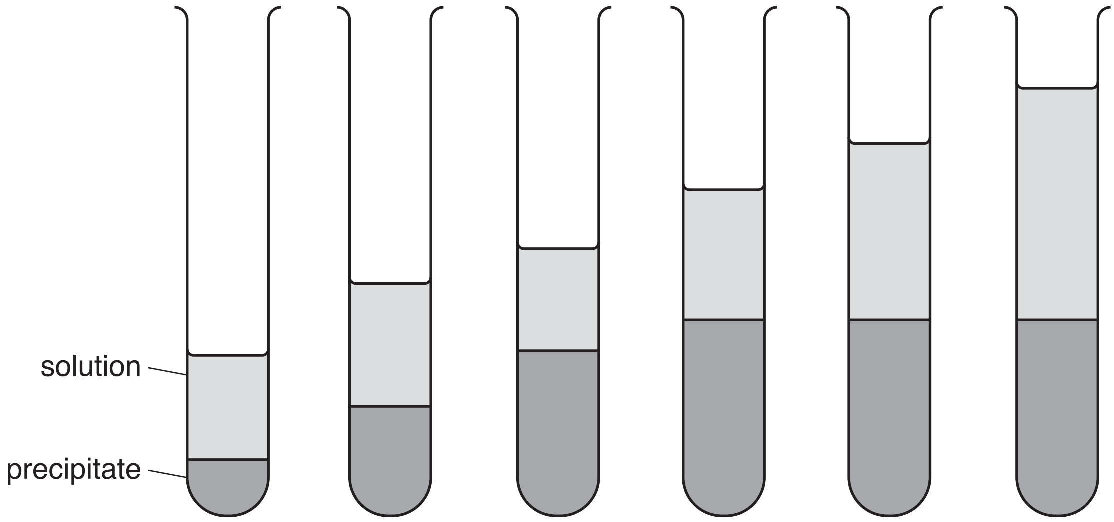
A student has two solutions.

G is an aqueous solution of potassium iodide of unknown concentration.

H is 1.0 mol/dm^3 lead(II) nitrate.

The student determines the concentration of **G** by adding different volumes of **H** to 4.0 cm^3 of **G** in a test-tube. In each case she allows the precipitate to settle, and then measures and records the height of the precipitate.

The diagrams and table show the results.



test-tube	1	2	3	4	5	6
volume of **H**/cm^3	2.0	4.0	6.0	8.0	10.0	12.0
height of precipitate/mm	7.5	14.5	22.0	26.0	26.0	26.0

(a) The student uses a burette to measure the volumes of **G** and **H**.

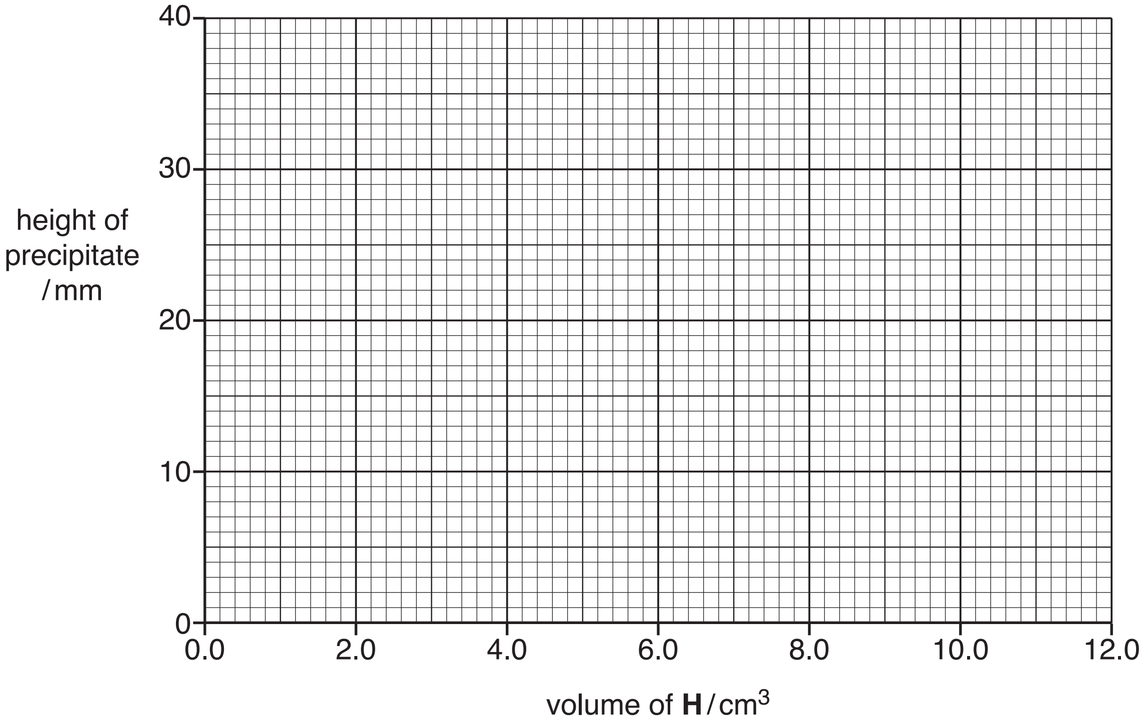
Why does the student use a burette instead of a measuring cylinder?

....[1]

(b) Why did the student stop at 12.0 cm^3 of **H** and not carry out further measurements using 14.0 cm^3 and 16.0 cm^3 of **H**?

....[1]

(c) Plot the results from the table on the grid and draw two intersecting straight lines through the points.



[3]

(d) Use your graph to determine:

(i) the height of the precipitate if 3.5 cm^3 of **H** is added to 4.0 cm^3 of **G**

....mm [1]

(ii) the volume of **H** that should be added to 4.0 cm^3 of **G** to produce a precipitate which is 20.0 mm in height

.... cm^3 [1]

(iii) the minimum volume of **H** that reacts completely with 4.0 cm^3 of **G**.

.... cm^3 [1]

(e) **H** is 1.0 mol / dm^3 lead(II) nitrate.

$$Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

Using your answer to **(d)(iii)** and the equation, calculate the concentration of the potassium iodide in solution **G**.

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

[Total: 11]

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