Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

4822287704 6

CHEMISTRY **5070/41**

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.

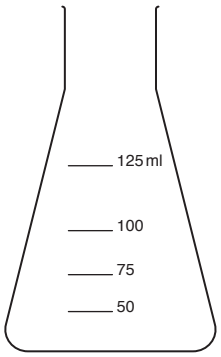
Answer **all** questions.
Write your answers in the spaces provided in the Question Paper.
Electronic calculators may be used.

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.

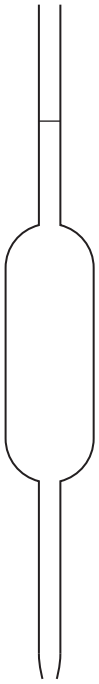
This document consists of **13** printed pages and **3** blank pages.

CAMBRIDGE
International Examinations

1 Give the names of the apparatus shown.



P



Q

P .....

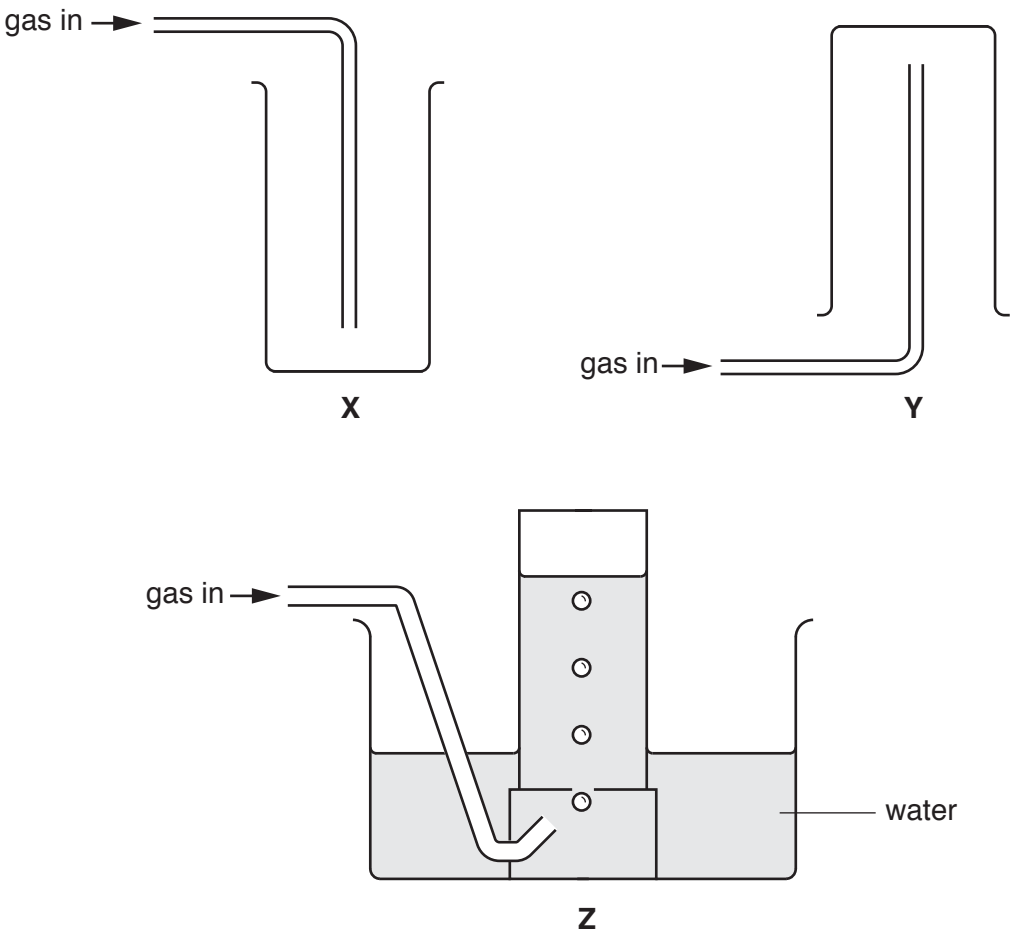
Q .....

[2]

2 Three gases **A**, **B** and **C** have the properties shown in the table.

gas	density	solubility in water	appearance
A	more dense than air	soluble	colourless
B	less dense than air	soluble	brown
C	more dense than air	insoluble	colourless

(a) Some apparatus used to collect gases is shown.



Which apparatus, **X**, **Y** or **Z**, is most suitable to collect each gas?

gas **A** .....

gas **B** ..... [2]

(b) Gas **C** can be collected using apparatus **Z**.

(i) State why apparatus **Z** is more suitable than apparatus **Y** to collect gas **C**.

.....[1]

(ii) State why apparatus **Z** is more suitable than apparatus **X** to collect gas **C**.

.....[1]

[Total: 4]

3 The reaction between aqueous sodium thiosulfate, $Na_2S_2O_3(aq)$, and dilute hydrochloric acid produces a pale yellow precipitate of sulfur. This makes the reaction mixture turn cloudy.

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + S(s) + SO_2(g) + H_2O(l)$$

A student investigates how the rate of this reaction changes with the concentration of aqueous sodium thiosulfate.

For each experiment, the student:

- mixes the two solutions in a beaker
- places a card with a cross on it behind the beaker
- measures the time taken for the cross to become invisible when viewed from the other side of the beaker.

(a) The experiments are done in a fume cupboard. Suggest why.

.....[1]

(b) In each experiment:

- the concentration of aqueous sodium thiosulfate is changed
- the concentration of dilute hydrochloric acid is kept constant.

All other variables likely to affect the rate of reaction are kept constant.

(i) State one variable, other than concentration, that is likely to affect the rate of reaction.

.....[1]

(ii) How would you prevent the variable in **(b)(i)** from changing during each experiment?

.....[1]

(c) The concentration of aqueous sodium thiosulfate is changed in each experiment by changing the volume of 0.50 mol / dm^3 sodium thiosulfate used, and adding water to make the same total volume. The results are shown in the table.

(i) Complete the table by inserting the two missing volumes.

experiment	volume of 0.50 mol / dm^3 aqueous sodium thiosulfate / cm^3	volume of water / cm^3	volume of dilute hydrochloric acid / cm^3	time taken for cross to become invisible / s
1	10	35	5	150
2	20	25	5	90
3	30	15	5	65
4	40		5	40
5	45	0		30

[2]

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

.....[1]

(iii) How do the results in the table show that the rate of reaction increases as the concentration of sodium thiosulfate increases?

.....

.....[2]

(d) In experiment 1, the beaker contains 10 cm^3 of 0.50 mol/dm^3 sodium thiosulfate.

(i) Calculate the number of moles of sodium thiosulfate in the beaker.

..... moles [1]

(ii) What is the total volume of the liquids in experiment 1?

..... cm^3 [1]

(iii) Calculate the concentration of sodium thiosulfate in the beaker at the start of experiment 1.

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

(e) At the end of the experiment, sulfur dioxide gas is still being produced by the reaction.

Give a test and observation to identify sulfur dioxide gas.

test .....

observation .....
[2]

[Turn over

(f) Another student suggested that the sulfur dioxide produced in the reaction would dissolve in the water and produce an aqueous solution containing sulfite ions, SO_3^{2-}.

Give a test and result to show the presence of sulfite ions, SO_3^{2-}, in the aqueous solution.

(You do **not** need to state how you would identify any gases evolved in the test.)

test .....

result .....
[2]

[Total: 15]

4 Crystals of ethanedioic acid have the formula $H_2C_2O_4.xH_2O$. A student attempts to determine the value of x by titration.

(a) The student adds a sample of the ethanedioic acid crystals to a previously weighed beaker which is then reweighed.

mass of beaker + crystals	=	39.526 g
mass of beaker	=	38.720 g

Calculate the mass of the crystals used in the experiment.

..... g [1]

(b) The crystals in the beaker are dissolved in water. State two ways of making the crystals dissolve as quickly as possible.

1. .....

2. .....
[2]

(c) The solution in the beaker is transferred to a volumetric flask and made up to 250 cm^3 with water. This is solution **D**.

Suggest how the student should make sure that **all** the solution in the beaker is transferred to the volumetric flask.

.....[1]

(d) 25.0 cm^3 of **D** is transferred into a conical flask using a pipette.

Why is a pipette used instead of a measuring cylinder?

.....[1]

(e) The student titrates the sample of **D** in the conical flask with 0.0100 mol / dm^3 potassium manganate(VII).

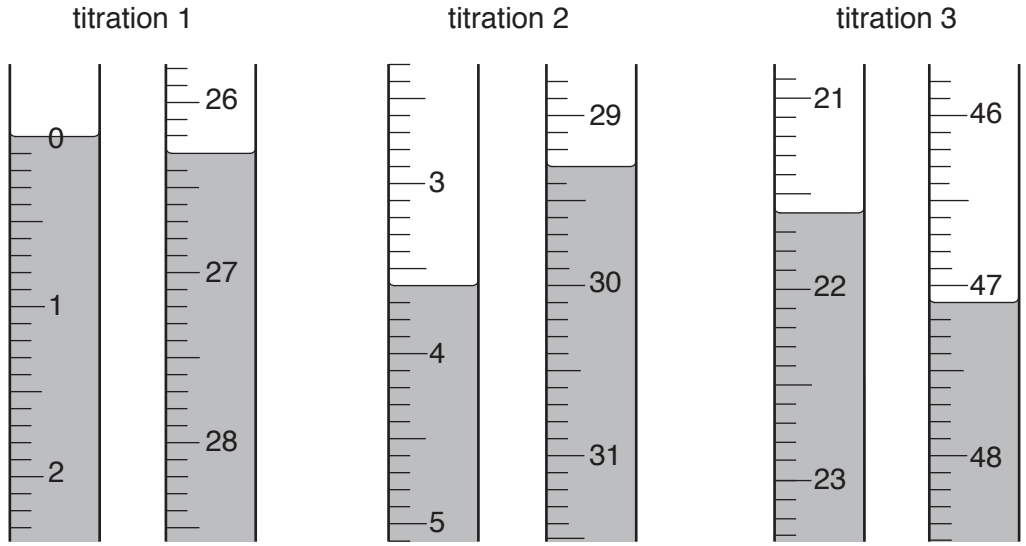
The aqueous potassium manganate(VII) is put into a burette and run into the conical flask until the end-point is reached.

(i) Ethanedioic acid is a reducing agent. Ethanedioic acid forms a colourless solution in water.

What is the colour change in the conical flask at the end-point of the titration?

from ..... to ..... [1]

(ii) 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 results table.

titration number	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of 0.0100 mol / dm^3 potassium manganate(VII) / cm^3			
best titration results (✓)			

Summary

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

Using these best results, the average volume of 0.0100 mol / dm^3 potassium manganate(VII) is

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

(f) Why is it necessary for this student to do three titrations instead of taking an average of the results of the first two titrations?

.....[1]

(g) Calculate the number of moles of potassium manganate(VII) in the average volume of 0.0100 mol / dm^3 potassium manganate(VII) in **(e)(ii)**.

..... moles [1]

(h) **Two** moles of potassium manganate(VII) react with **five** moles of ethanedioic acid, $H_2C_2O_4.xH_2O$.

Calculate the number of moles of $H_2C_2O_4.xH_2O$ in 25.0 cm^3 of **D**.

..... moles [1]

(i) Calculate the number of moles of $H_2C_2O_4.xH_2O$ in 250 cm^3 of **D**.

..... moles [1]

(j) Using your answers to both **(a)** and **(i)**, calculate the relative molecular mass of $H_2C_2O_4.xH_2O$.

relative molecular mass = ...[1]

(k) Using your answer to **(j)**, calculate the value of x in $H_2C_2O_4.xH_2O$.

[A_r: H, 1; C, 12; O, 16]

x = ...[2]

[Total: 17]

5 A student is provided with three bottles; one contains dilute hydrochloric acid, another contains aqueous sodium sulfate and the third contains ethanol.

The student is also provided with magnesium ribbon, acidified aqueous potassium manganate(VII) and aqueous barium nitrate (acidified with nitric acid). The student has access to all the apparatus normally found in a laboratory **but no other chemicals**.

For each of the three bottles, give a test with a positive result which identifies its contents. Chemical equations are not required.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

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

(a) An excess of dilute hydrochloric acid is added to **L**. Bubbles of carbon dioxide gas are given off and the solid dissolves completely, forming a colourless solution.

(i) What conclusion can be made from the fact that the solution is colourless?

.....[1]

(ii) Give a test and observation to identify carbon dioxide gas.

test .....

observation .....[2]

(iii) Identify the anion which reacts with hydrochloric acid to produce carbon dioxide gas.

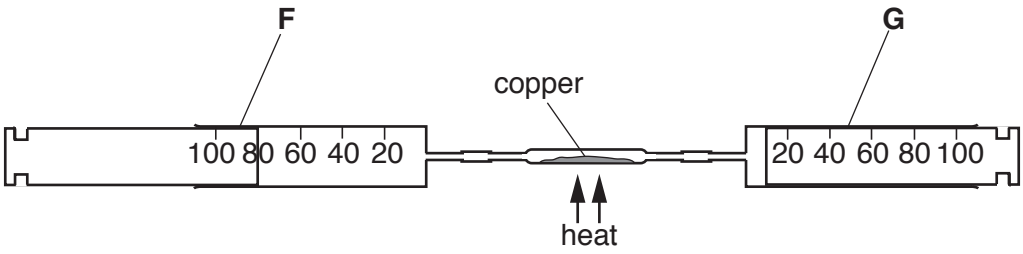
.....[1]

The colourless solution formed in **(a)** is divided into two parts for tests **(b)** and **(c)**. Complete the table.

	test	observation	conclusion	
(b) **(i)**	To the first part, in a test-tube, aqueous sodium hydroxide is added until a change is seen.	white precipitate		
(ii)	An excess of aqueous sodium hydroxide is added to the mixture from **(i)**.	insoluble in excess		[1]
(c)			**L** contains NO_3^- ions.	[4]

[Total: 9]

7 A student attempts to determine the percentage of oxygen in the air using the apparatus shown.



At the start of the experiment there is 90 cm^3 of air in the apparatus. The air is passed backwards and forwards between gas syringes **F** and **G** over the heated copper. This is repeated until the volume stops decreasing. The gas is allowed to cool to room temperature and the final volume is measured.

The copper reacts with the oxygen in the air. An excess of copper is used.

(a) Why is an *excess* of copper used?

.....[1]

(b) Why is the gas allowed to cool to room temperature before measuring its final volume?

.....[1]

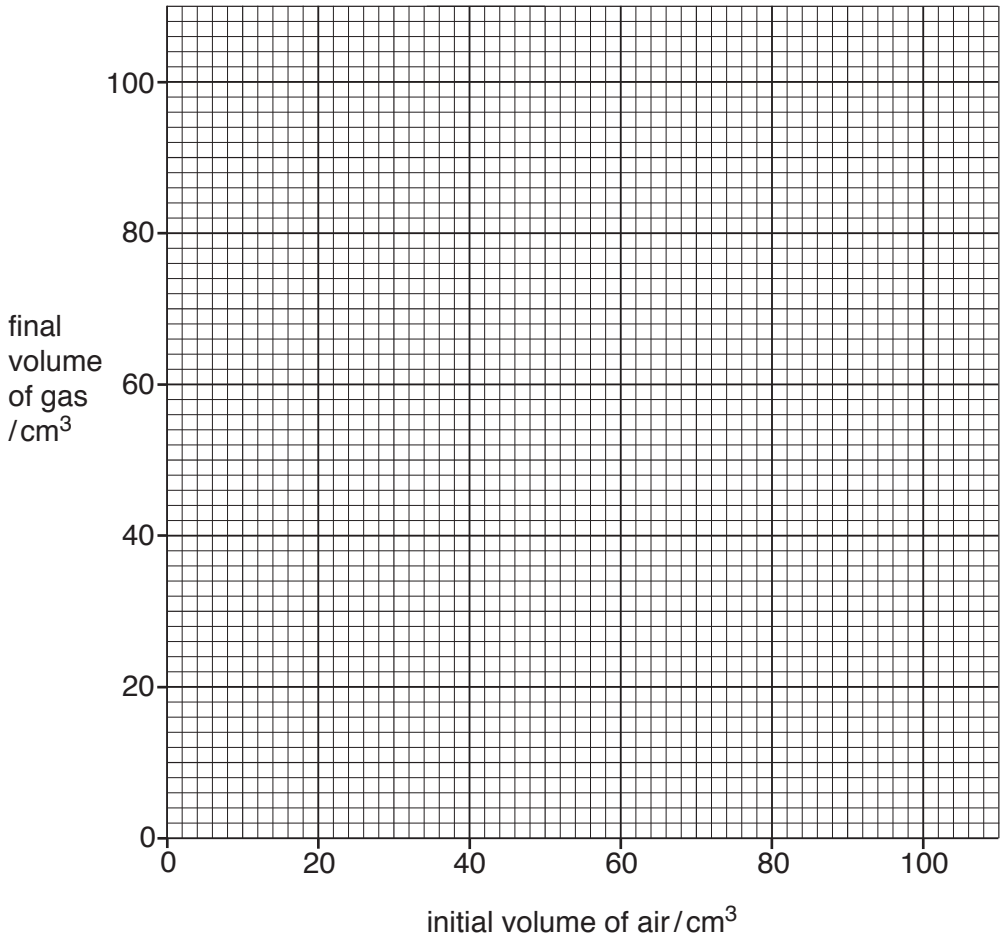
(c) The student repeats the experiment several times using different initial volumes of air in the apparatus. An excess of copper is used in each experiment.

The results are shown in the table.

initial volume of air / cm^3	final volume of gas / cm^3
90	71
70	55
60	52
50	39
40	31
20	16

(i) Plot the results on the grid and draw a line of best fit.

Extend the upper end of the line to the edge of the grid.



[3]

(ii) Draw a circle around the anomalous point on the graph. [1]

(iii) The anomalous result is not due to an error by the student in reading the volumes.

Suggest a reason why the anomalous result occurred.

.....[1]

(d) (i) Use your graph to determine the final volume of gas if the student uses 100 cm^3 as the initial volume of air.

..... cm^3 [1]

(ii) Using your answer to **(d)(i)**, calculate the percentage of oxygen in air. You must show your working.

.....% [1]

[Total: 9]

BLANK PAGE

BLANK PAGE

BLANK PAGE