	Centre Number	Candidate Number
Candidate Name ______________________		

CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CHEMISTRY 5070/4

PAPER 4 Alternative to Practical **MAY/JUNE SESSION 2002**

1 hour

Candidates answer on the question paper.
No additional materials are required.

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You should use names, not symbols, when describing all reacting chemicals and the products formed.

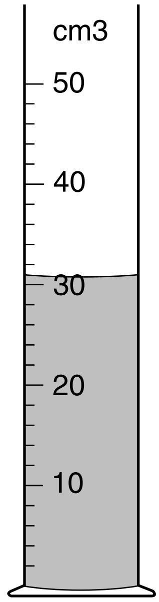
FOR EXAMINER'S USE

This question paper consists of 12 printed pages.

SJF2131/PW S09047/3

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

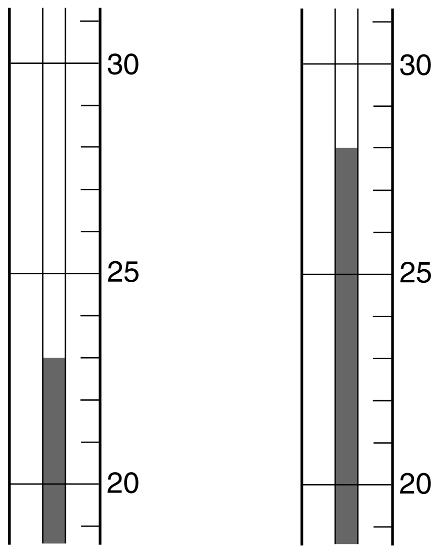
1 What is the volume of liquid, to the nearest cm^3, in the measuring cylinder?



…………………… cm^3 [1]

2 Approximately 4 g of solid potassium hydroxide was added to 100 cm^3 of water. The temperature changed.

The diagrams below show the temperature of the water before and after the potassium hydroxide was added.



T_1(before) T_2(after)

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

temperature T_2 after	°C
temperature T_1 before	°C
change in temperature	°C

[2]

(b) What type of reaction does this temperature change show?

.... [1]

(c) **(i)** A piece of litmus paper was placed in the potassium hydroxide solution.

What colour was the litmus paper in the potassium hydroxide solution?

....

(ii) How would you determine the pH of the solution?

....

(iii) Suggest a value for the pH of the solution.

....

[3]

(d) Suggest another metal hydroxide that would give similar results to those of potassium hydroxide.

.... [1]

3 The fertiliser ammonium nitrate contains nitrogen. It has the formula NH_4NO_3.

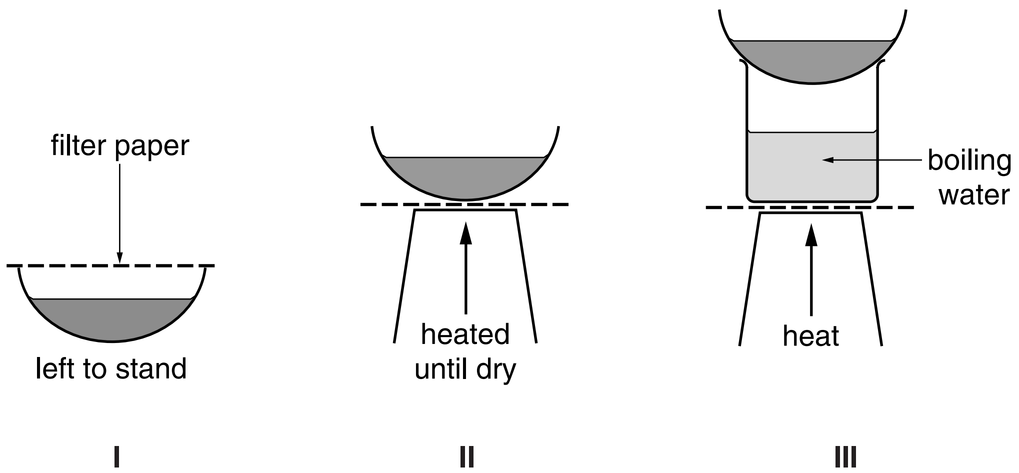
It can be made by adding an acid to aqueous ammonia.

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

name ....

formula .... [1]

(b) **(i)** Which of the diagrams **I**, **II** or **III** shows the best way to make large crystals of ammonium nitrate?



....

(ii) How can these crystals be separated from the solution?

....
[2]

(c) **(i)** Calculate the mass of nitrogen contained in 160 g of ammonium nitrate, NH_4NO_3 (A_r: N, 14; H, 1; O, 16.)

.... g

(ii) What is the volume of this mass of nitrogen at r.t.p.? (One mole of a gas occupies 24 dm^3 at r.t.p.)

.... dm^3

[4]

(d) Ammonium nitrate contains the ions NH_4^+ and NO_3^-.

Give a chemical test for each of these ions.

NH_4^+

test ....

....

observation ....

....

NO_3^-

test ....

....

observation ....

.... [5]

For questions 4 to 8 inclusive, place a tick against the best answer.

4 A student obtained pure water from aqueous sodium chloride.

Which method was used?

(a) chromatography ☐

(b) distillation ☐

(c) evaporation ☐

(d) titration ☐

[1]

5 A small amount of glucose was dissolved in some water and the boiling point was determined.

The boiling point was

(a) 96 °C, ☐

(b) 98 °C, ☐

(c) 100 °C, ☐

(d) 102 °C. ☐

[1]

For Examiner's Use

6 A student did an experiment to decompose hydrogen peroxide.

$$2H_2O_2(aq) \xrightarrow{MnO_2(s)} 2H_2O(l) + O_2(g)$$

He repeated the experiment using manganese(IV) oxide as a catalyst.

Which of the following observations was correct?

(a) The manganese(IV) oxide was used as an aqueous solution. ☐

(b) The catalyst increased the yield of oxygen. ☐

(c) The mass of manganese(IV) oxide decreased as the experiment proceeded. ☐

(d) The catalyst increased the rate of decomposition. ☐

[1]

7 A student prepares a salt by mixing two aqueous solutions.

A white precipitate is formed. The two solutions can be

(a) copper(II) sulphate and sodium hydroxide. ☐

(b) sodium chloride and silver nitrate. ☐

(c) potassium chloride and sodium nitrate. ☐

(d) iron(II) chloride and sodium hydroxide. ☐

[1]

8 The presence of an alkene is confirmed by its reaction with aqueous bromine.

1 mol of alkene reacts with 1 mol of bromine Br_2.

In an experiment 4.2 g of an alkene reacts completely with 16 g of bromine.
(A_r: C, 12; H, 1; Br, 80.)

The alkene is

(a) C_2H_4 ☐

(b) C_2H_6 ☐

(c) C_3H_6 ☐

(d) C_3H_8 ☐

[1]

For Examiner's Use

9 A student determined the concentration of H^+ (aq) ions in an acid, by titration with aqueous sodium carbonate.

Solution **R** is 0.100 mol/dm^3 aqueous sodium carbonate.

25.0 cm^3 of **R** was transferred into a flask.

(a) Which is the best piece of apparatus to transfer 25.0 cm^3 of **R** into the flask?

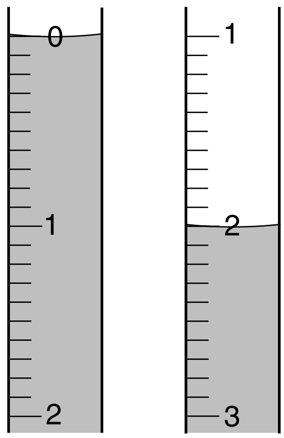
.... [1]

A few drops of methyl orange indicator were added to the flask. The acid was run into the flask from a burette until an end point was reached.

(b) What was the colour change of the methyl orange at the end-point?

The colour changed from .... to .... [1]

(c) The diagrams below show the liquid levels in the burette before and after the titration.



After looking at this result the student decided to dilute the acid. Explain why.

.... [1]

(d) The student made solution **P** by diluting 10.0 cm^3 of the acid to 100 cm^3 in a graduated flask.

The student poured away the acid that was left in the burette.

Before refilling with solution **P**, which two liquids did the student use to wash out the burette?

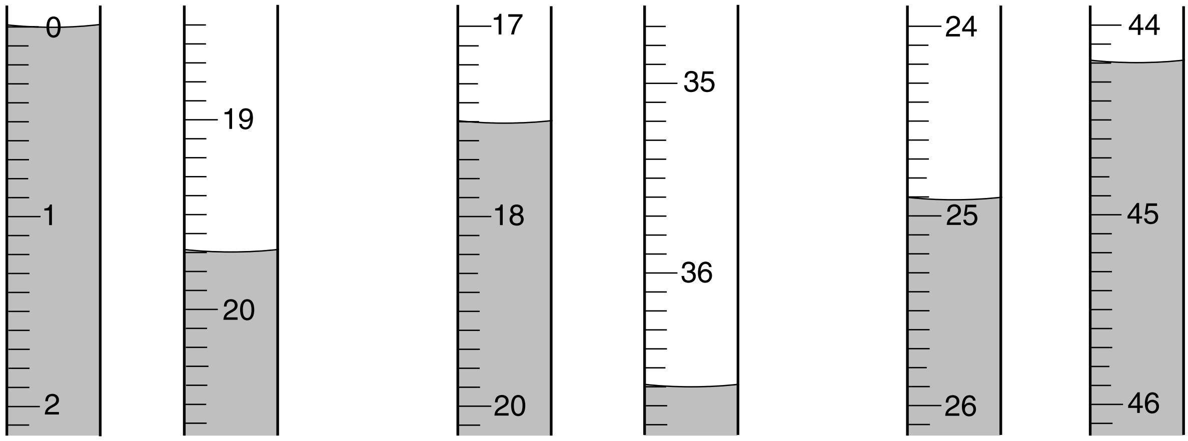
1st liquid ....

2nd liquid .... [2]

[Turn over

For Examiner's Use

(e) Three titrations were done using the solution **P**. The diagrams below show part of the burette at the beginning and end of each titration.



Using the diagrams, complete the following 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** required was …………………… cm^3. [4]

(f) Calculate the number of moles of sodium carbonate in 25.0 cm^3 of 0.100 mol/dm^3 sodium carbonate, solution **R**.

…………………… moles [1]

Carbonate ions CO_3^{2-} react with H^+(aq) ions according to the following equation

$$2H^+(aq) + CO_3^{2-}(aq) \longrightarrow H_2O(l) + CO_2(g)$$

(g) Calculate the number of moles of H^+(aq) ions in the average volume of solution **P**.

…………………… moles [1]

For Examiner's Use

(h) Calculate the concentration of H^+(aq) ions in mol/dm^3 in solution **P**.

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

(i) Using the information in **(d)** and your answer to **(h)**, calculate the concentration of H^+(aq) ions in the original acid solution.

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

10 The following table shows the tests a student did on compound **V** and the conclusions made from the observations. Complete the table by describing these observations and suggest the test and observation which led to the conclusion from test 4.

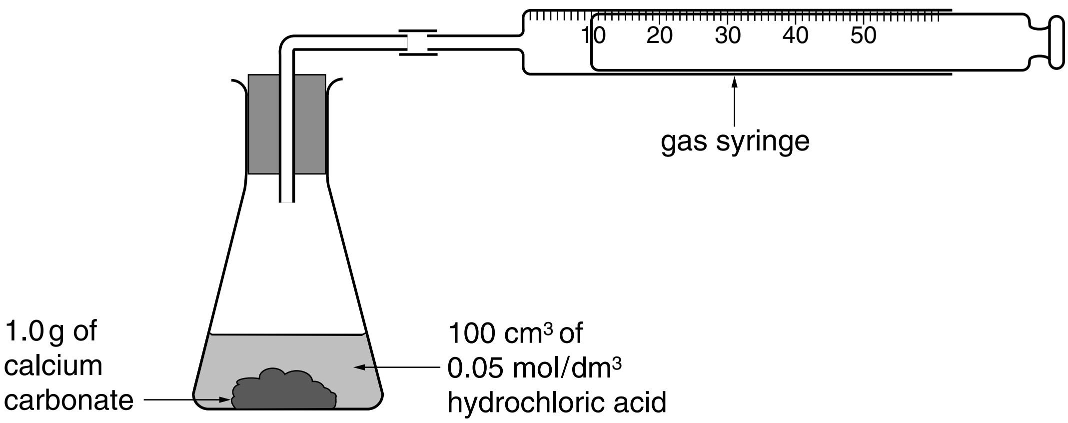
Test	*Observation*	*Conclusion*
1 **V** was dissolved in water and the solution divided into three parts for tests 2, 3 and 4.		**V** is not a compound of a transition metal.
2 **(a)** To the first part, aqueous sodium hydroxide was added until a change was seen. **(b)** An excess of aqueous sodium hydroxide was added to the mixture from **(a)**.		**V** may contain Ca^{2+} ions.
3 To the second part, an equal volume of aqueous ammonia was added until a change was seen.		The presence of Ca^{2+} ions is confirmed.
4		**V** contains SO_4^{2-} ions.

Conclusion: The formula for the compound **V** is .... [9]

11 Calcium carbonate reacts with hydrochloric acid according to the equation

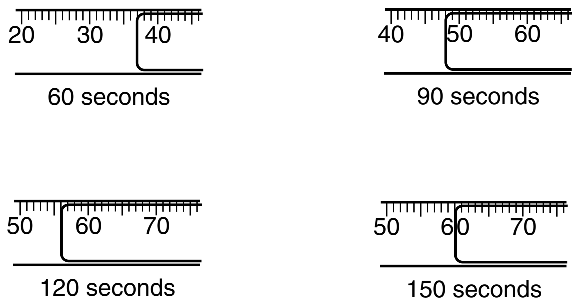
$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$$

A student investigated the rate of this reaction using the apparatus shown below. Experiments 1 and 2 were done using small lumps of calcium carbonate.



In experiment 1, 100 cm^3 of 0.05 mol/dm^3 hydrochloric acid was added to 1.0 g (an excess) of solid calcium carbonate in the flask. The volume of carbon dioxide was recorded every 30 seconds. This was experiment 1.

The diagrams below show the volumes of carbon dioxide produced after 60, 90, 120 and 150 seconds. Record these volumes in the table below.



In experiment 2, 50 cm^3 of 0.100 mol/dm^3 hydrochloric acid was added to 1.0 g calcium carbonate.

The results are shown in the table.

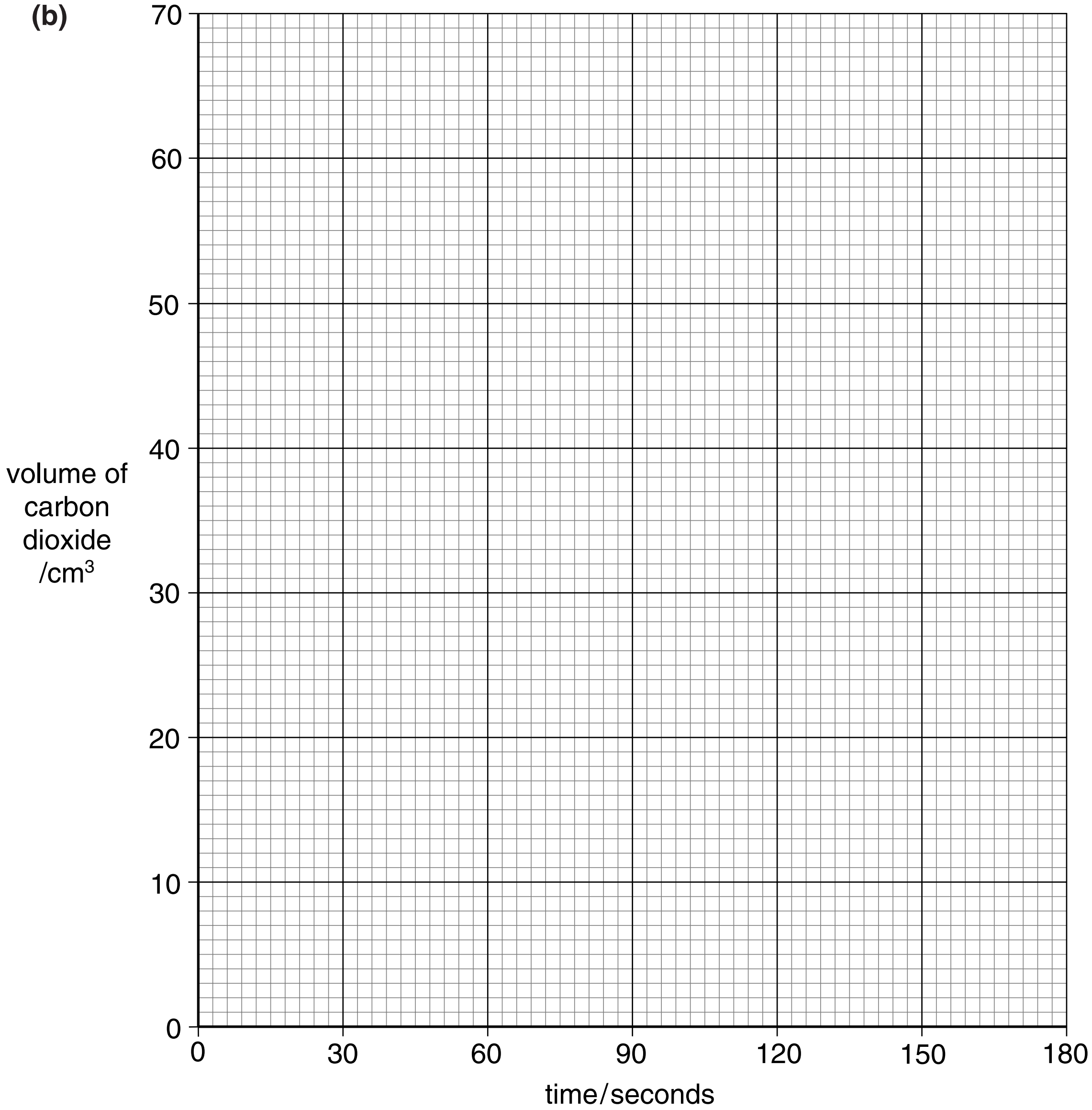
(a)

time / seconds	volume of carbon dioxide / cm^3	
	experiment 1	experiment 2
30	21	32
60		48
90		57
120		60
150		60
180	60	60

[2]

Plot the volume of carbon dioxide against time on the grid below. For each experiment connect the points with a smooth curve. Label the curves **1** (experiment 1) and **2** (experiment 2).

(b)



[3]

Use the graphs to answer the following questions.

(c) Why was the volume of gas the same in each experiment?

.... [1]

(d) At which point in experiment 1 was the rate the greatest?

Explain your answer.

START MIDDLE END

Tick the correct answer.

Explanation.

....

.... [2]

(e) After how many seconds in each experiment has half the total volume of carbon dioxide been produced?

Experiment 1 .... seconds

Experiment 2 .... seconds [2]

(f) Experiment 3 was done using 1.0 g of powdered calcium carbonate and 50 cm^3 of 0.100 mol/dm^3 hydrochloric acid.

Draw a line on your graph to represent the results of this experiment and label it **3**. [2]

(g) Experiment 4 was done using 50 cm^3 of 0.100 mol/dm^3 nitric acid with 1.0 g of calcium carbonate.

What was the final volume of carbon dioxide produced?

60 cm^3 120 cm^3 180 cm^3 240 cm^3

Tick the correct answer. [1]