Centre Number	Candidate Number

Candidate Name _____

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Joint Examination for the School Certificate and General Certificate of Education Ordinary Level

CHEMISTRY 5070/4

PAPER 4 Alternative to Practical

OCTOBER/NOVEMBER SESSION 2002

1 hour

Candidates answer on the question paper.
Additional materials:
Mathematical tables and/or calculator

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.
Mathematical tables are available.

FOR EXAMINER'S USE

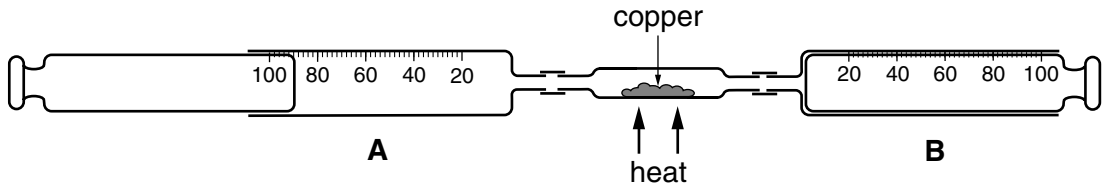
This question paper consists of 14 printed pages and 2 blank pages.

SP (SJF2133/PW) S09049/5

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

[Turn over

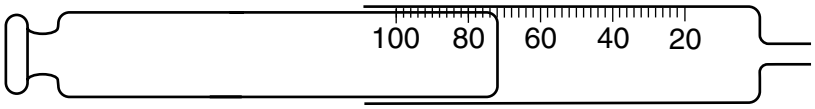
1 A student found the composition of air using the apparatus shown below.



Syringe **A** contained 90 cm^3 of air. The air was forced over heated copper into syringe **B**. The air was then forced back into syringe **A**.

The process was repeated several times until the volume of gas forced back into syringe **A** was constant.

The diagram below shows the volume of gas in syringe **A** after the experiment had finished.



(a) (i) Name the main gas remaining in syringe **A**.

.....

(ii) What is the volume of gas remaining in syringe **A**?

.....

(iii) Calculate the percentage of this gas in the original sample of air.

.....

(iv) During the experiment copper formed a compound.

Give the name, formula and colour of this compound.

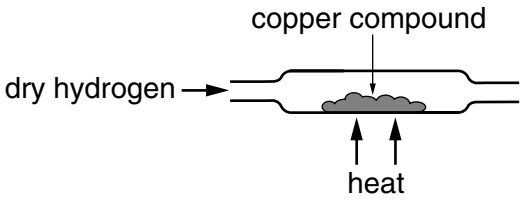
name .....

formula .....

colour .....

[6]

(b) The tube containing the copper compound was removed from the syringes. The copper compound was heated and dry hydrogen gas was passed over it.



(i) Name the two products of the reaction between hydrogen and the copper compound.

.....

(ii) What is the function of hydrogen in this reaction?

.....

(iii) Give a test and result to confirm the presence of hydrogen.

test .....

result .....

[4]

2 Silver iodide may be made by the reaction between aqueous potassium iodide and aqueous silver nitrate.

A student added 50 cm^3 of 1.0 mol/dm^3 potassium iodide to 30 cm^3 of 2.0 mol/dm^3 silver nitrate.

$$KI(aq) + AgNO_3(aq) \longrightarrow KNO_3(aq) + AgI(s)$$

(a) (i) Describe what was seen during the reaction.

.....

(ii) How could the silver iodide be removed from the mixture?

..... [3]

(b) (i) Which of the reagents potassium iodide or silver nitrate was in excess? Explain your answer.

answer .....

explanation .....

.....

.....

(ii) Calculate the mass of silver iodide formed (A_r: Ag, 108; I, 127.)

..... [5]

(c) The student did another experiment to make silver chloride by adding 50 cm^3 of 1.0 mol/dm^3 potassium chloride to 30 cm^3 of 2.0 mol/dm^3 silver nitrate,

(i) Describe the appearance of the silver chloride

on forming, ...

on standing for a few minutes. .....

.....

(ii) Was the mass of silver chloride more than, the same or less than the mass of silver iodide in **(b)(ii)**? Explain your answer. (A_r: Ag, 108; C*l*, 35.5.)

answer .....

explanation .....

.....

..... [4]

For questions **3** - **6** inclusive, place a tick against the best answer.

3 A student did some experiments involving carbon dioxide.

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

(a) Carbon dioxide was produced by the reaction between calcium carbonate and dilute hydrochloric acid. ☐

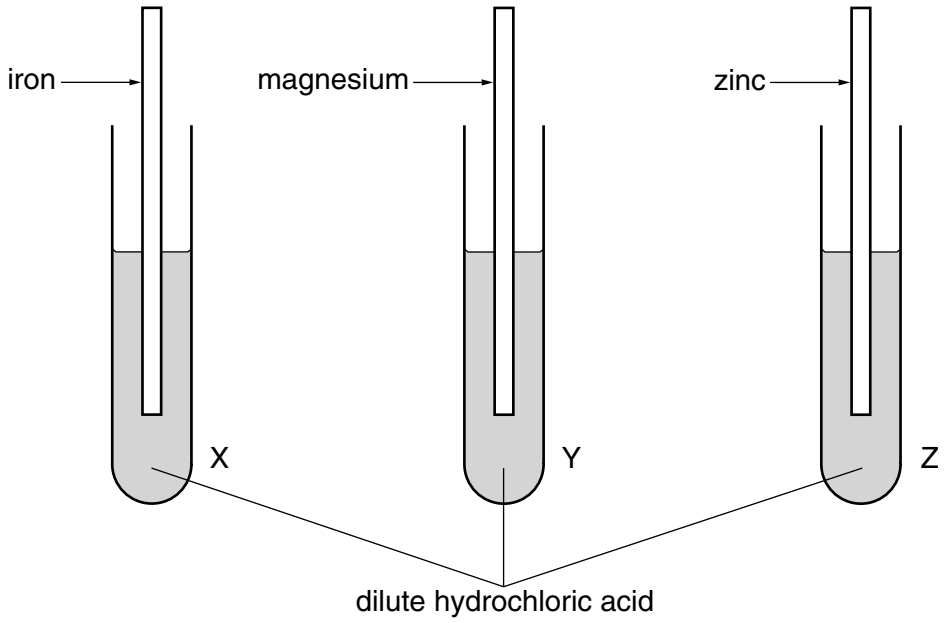
(b) The production of carbon dioxide in a solution was indicated by effervescence. ☐

(c) A solution of carbon dioxide in water turned red litmus blue. ☐

(d) Carbon dioxide turned lime water milky. ☐

[1]

4 A student placed each of three metals in tubes containing dilute hydrochloric acid.



In which tubes was hydrogen produced?

(a) X and Y only, ☐

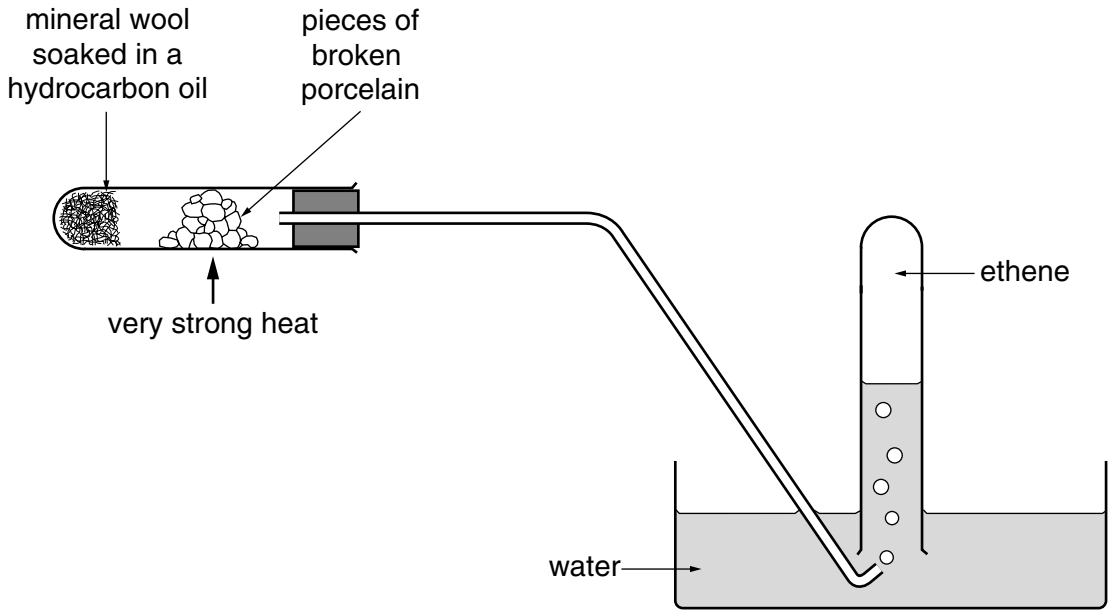
(b) X and Z only, ☐

(c) Y and Z only, ☐

(d) X and Y and Z. ☐

[1]

5 A student prepared ethene from a hydrocarbon oil using the apparatus shown below.



The reaction is an example of

(a) cracking, ☐

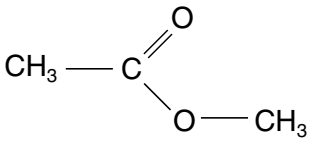
(b) oxidation, ☐

(c) polymerisation, ☐

(d) saturation. ☐

[1]

6 An ester has the structural formula shown below.



It can be prepared by the reaction between:

(a) methanol and methanoic acid. ☐

(b) methanol and ethanoic acid. ☐

(c) ethanol and methanoic acid. ☐

(d) ethanol and ethanoic acid. ☐

[1]

7 Substance **F** is a fertiliser containing ammonium sulphate.

A student determined the mass of ammonia produced from a sample of **F**.

He added the sample to a previously weighed container which he re-weighed.

Mass of container and **F**	=	10.44 g
Mass of container	=	8.68 g
Mass of **F**	=	

(a) Calculate the mass of **F** used in the experiment.

..... g [1]

The sample was placed in a beaker and 50.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide (an excess) was added.

The mixture was heated until the following reaction was complete.

$$(NH_4)_2SO_4(aq) + 2NaOH(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(l) + 2NH_3(g)$$

The reaction was complete when all the ammonia was evolved.

(b) Describe a chemical test for ammonia.

test .....

result ..... [1]

The remaining mixture, which contained excess sodium hydroxide, was transferred to a graduated flask and made up of 250 cm^3 with distilled water. This was solution **G**.

25.0 cm^3 of **G** was transferred to a titration flask and a few drops of phenolphthalein indicator was added.

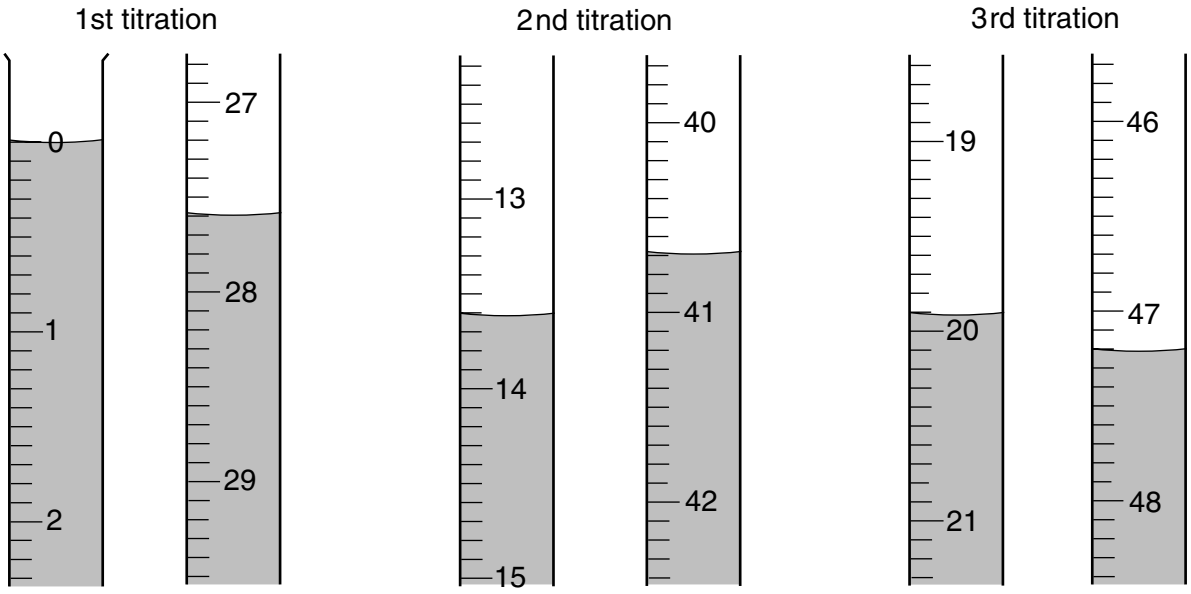
0.100 mol/dm^3 hydrochloric acid was added to **G** until an end-point was reached.

Phenolphthalein is colourless in acid and red in alkali.

(c) What was the colour change of the indicator at the end-point?

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

Three titrations were done. The diagrams below show parts of the burette at the beginning and end of each titration.



(d) Use the diagrams to complete the following table.

titration number	1	2	3
final reading / cm^3			
initial reading / cm^3			
volume of hydrochloric acid used / cm^3			
best titration results (✓)			

Summary:
Tick (✓) the best titration results. Using these results, the average volume of hydrochloric acid required was …… cm^3. [4]

(e) Calculate the number of moles of hydrochloric acid in the average volume of 0.100 mol/dm^3 hydrochloric acid in **(d)**.

..... [1]

(f) Using the equation

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Deduce the number of moles of sodium hydroxide in 25.0 cm^3 of solution **G**.

..... [1]

(g) Using your answer in **(f)** calculate the number of moles of sodium hydroxide in 250 cm^3 of solution **G**.

..... [1]

(h) Calculate the number of moles of sodium hydroxide in 50.0 cm^3 of 1.00 mol/dm^3 sodium hydroxide.

..... [1]

(i) By subtracting your answer in **(g)** from your answer in **(h)** calculate the number of moles of sodium hydroxide which reacted with the sample of **F**.

..... [1]

(j) Given that 1 mole of sodium hydroxide produces 17 g of ammonia.

Calculate

(i) the mass of ammonia produced from the original sample,

..... g NH_3

(ii) the mass of ammonia produced from 100 g fertiliser.

..... g NH_3 / 100 g fertiliser **F**
[2]

[Turn over

8 The following table shows the tests a student did on substance **S** 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 S was dissolved in water and the solution divided into three parts for tests 2, 3 and 4.		**S** 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)**.		**S** may contain Al^{3+} or Zn^{2+} ions.
3 **(a)** To the second part, aqueous ammonia was added until a change was seen. **(b)** An excess of ammonia was added to the mixture from **(a)**.		**S** contains Zn^{2+} ions
4		**S** contains Cl^{-} ions

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

9 The reaction between aqueous barium chloride and dilute sulphuric acid produces a white precipitate.

(a) Name and state the formula of this precipitate.

name .....

formula ..... [1]

A series of experiments was done to find the mass of precipitate produced.

Solution **J** is 1.00 mol/dm^3 barium chloride
Solution **K** is 1.00 mol/dm^3 sulphuric acid

10.0 cm^3 of **J** was put into each of six test tubes. Increasing volumes of **K** were added to each test tube. The mixtures were filtered and the precipitates were washed with water, dried and placed in a weighed container which was reweighed.

The table overleaf shows the results of these experiments.

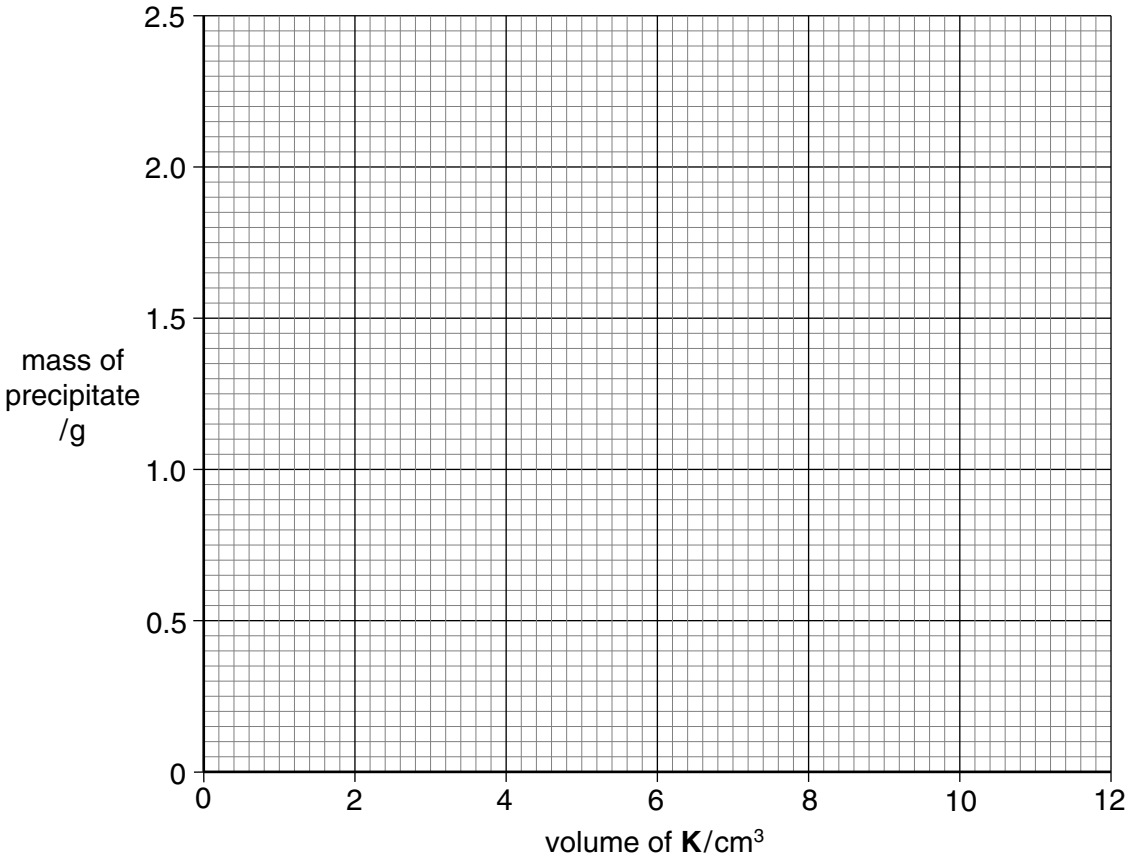
[Turn over

(b) Complete the final column to give the mass of the precipitate.

volume of **J** / cm^3	volume of **K** / cm^3	mass of empty container / g	mass of container and precipitate / g	mass of precipitate / g
10.0	2.0	3.50	3.97	0.47
10.0	4.0	3.50	4.43	
10.0	6.0	3.50	4.70	
10.0	8.0	3.50	5.36	
10.0	10.0	3.50	5.83	
10.0	12.0	3.50	5.83	

[2]

(c) Using the grid below, plot the mass of precipitate on the y-axis against the volume of **K** on the x-axis. Join the points with two straight lines.



[3]

(d) One of the results is incorrect. Circle the result on your graph and suggest what the correct mass of precipitate should be.

..... g [1]

(e) What volume of **K** would produce 1.60 g of precipitate?

..... cm^3 [1]

(f) Why was the mass of precipitate the same in the last two experiments?

.....

..... [1]

(g) The experiment was repeated using the volumes of **J** and **K** as shown in the table below. Using your results from the first experiment, complete the final column showing the mass of precipitate produced in each case.

volume of **J** / cm^3	volume of **K** / cm^3	mass of precipitate / g
2.0	2.0	
2.0	4.0	
2.0	6.0	

[2]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	0
							1 H Hydrogen 1									4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

a	a = relative atomic mass
X	X = atomic symbol
b	b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).