	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.

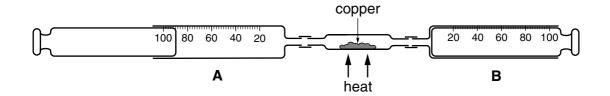
You should use names, not symbols, when describing all reacting chemicals and the products formed. Mathematical tables are available.

FOR EXAMINER'S USE					

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

[6]

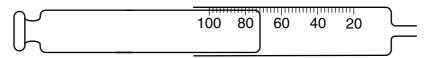
1 A student found the composition of air using the apparatus shown below.



Syringe  $\bf A$  contained 90 cm<sup>3</sup> of air. The air was forced over heated copper into syringe  $\bf B$ . The air was then forced back into syringe  $\bf A$ .

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

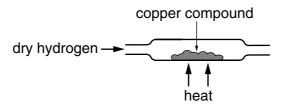
The diagram below shows the volume of gas in syringe **A** after the experiment had finished.



(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

5070/4 Nov02

**(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 hydrocompound.	ogen an	d the	copper
<i>(</i> ***)				
(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  $50\,\mathrm{cm^3}$  of  $1.0\,\mathrm{mol/dm^3}$  potassium iodide to  $30\,\mathrm{cm^3}$  of  $2.0\,\mathrm{mol/dm^3}$  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\	
	(ii)	Calculate the mass of silver iodide formed ( $A_r$ : Ag, 108; I, 127.)
		[5]
(c)		student did another experiment to make silver chloride by adding 50 cm <sup>3</sup> of mol/dm <sup>3</sup> potassium chloride to 30 cm <sup>3</sup> of 2.0 mol/dm <sup>3</sup> 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>(b)(ii)</b> ? Explain your answer. ( $A_r$ : Ag, 108; C $l$ , 35.5.)
		answer
		explanation
		[4]

5070/4 Nov02

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

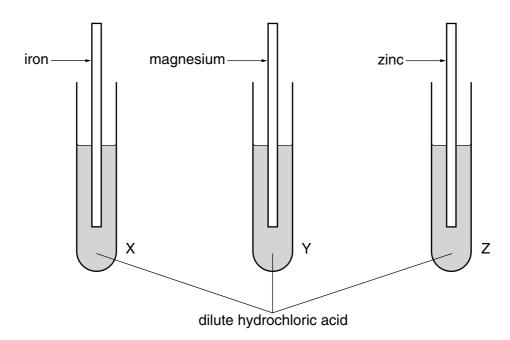
3 A student did some experiments involving carbon dioxide.

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.

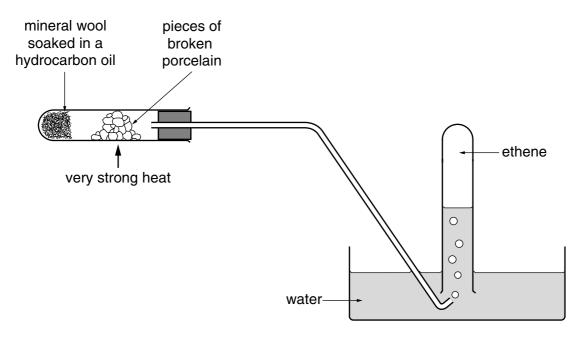


In which tubes was hydrogen produced?

- (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  $\mathbf{F} = 10.44 \,\mathrm{g}$ Mass of container  $= 8.68 \,\mathrm{g}$ Mass of  $\mathbf{F} =$ 

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

..... g [1]

The sample was placed in a beaker and  $50.0\,\mathrm{cm^3}$  of  $1.00\,\mathrm{mol/dm^3}$  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.

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

 $25.0\,\mathrm{cm^3}$  of  $\mathbf{G}$  was transferred to a titration flask and a few drops of phenolphthalein indicator was added.

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

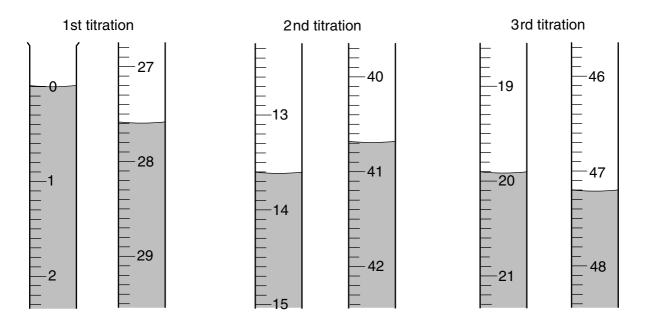
Phenolphthalein is colourless in acid and red in alkali.

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

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

Turn over

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 <sup>3</sup>			
initial reading / cm <sup>3</sup>			
volume of hydrochloric acid used / cm <sup>3</sup>			
best titration results (✓)			

Summary:

(e) Calculate the number of moles of hydrochloric acid in the average volume of 0.100 mol/dm<sup>3</sup> 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<sup>3</sup> of solution **G**.

.....[1]

(g)		ng your answer in <b>(f)</b> calculate the number of moles of sodium hydroxide in 250 cm <sup>3</sup> solution <b>G</b> .
		[1]
(h)		culate the number of moles of sodium hydroxide in 50.0 cm <sup>3</sup> of 1.00 mol/dm <sup>3</sup> sodium roxide.
		[1]
(i)		subtracting your answer in <b>(g)</b> from your answer in <b>(h)</b> calculate the number of moles codium hydroxide which reacted with the sample of <b>F</b> .
		[1]
(j)	Giv	en that 1 mole of sodium hydroxide produces 17 g of ammonia.
	Cal	culate
	(i)	the mass of ammonia produced from the original sample,
	(ii)	the mass of ammonia produced from 100 g fertiliser.
		g NH <sub>3</sub> / 100 g fertiliser <b>F</b> [2]

**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.		<b>S</b> is not a compound of a transition metal.
2	<ul><li>(a) To the first part, aqueous sodium hydroxide was added until a change was seen.</li><li>(b) An excess of aqueous sodium hydroxide was added to the mixture from (a).</li></ul>		<b>S</b> may contain Al <sup>3+</sup> or Zn <sup>2+</sup> ions.
3	<ul><li>(a) To the second part, aqueous ammonia was added until a change was seen.</li><li>(b) An excess of ammonia was added to the mixture from (a).</li></ul>		<b>S</b> contains Zn <sup>2+</sup> ions
4			<b>S</b> contains C <i>l</i> <sup>-</sup> ions

- **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<sup>3</sup> barium chloride Solution **K** is 1.00 mol/dm<sup>3</sup> sulphuric acid

 $10.0\,\mathrm{cm^3}$  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.

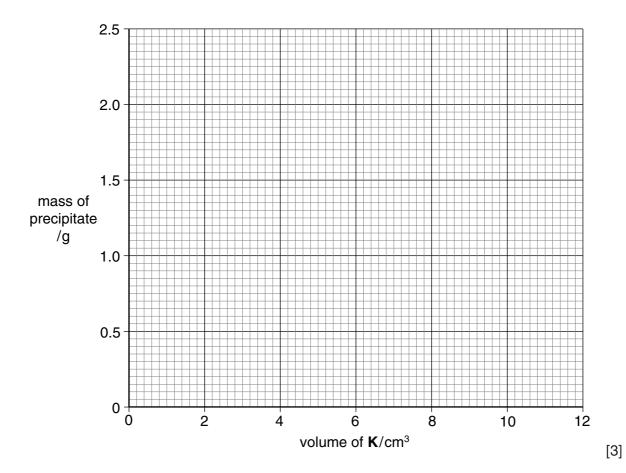
The table overleaf shows the results of these experiments.

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

volume of <b>J</b> / cm <sup>3</sup>	volume of <b>K</b> / cm <sup>3</sup>	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.



5070/4 Nov02

(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 <b>K</b> would produce 1.60 g of precipitate?
	cm <sup>3</sup> [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 $\bf J$ and $\bf K$ as shown in the table below. Using your results from the first experiment, complete the final column showing

volume of <b>J</b> / cm <sup>3</sup>	volume of <b>K</b> / cm <sup>3</sup>	mass of precipitate / g
2.0	2.0	
2.0	4.0	
2.0	6.0	

the mass of precipitate produced in each case.

[2]

# **BLANK PAGE**

# **BLANK PAGE**

DATA SHEET
The Periodic Table of the Elements

		0	4 <b>He</b> lium	20 <b>Neon</b> 10	40 <b>Ar</b> Argon	84 <b>Krypton</b> 36	131 <b>Xe</b> Xenon 54	Radon 86	į
		IIV		19 Fluorine	35.5 <b>C1</b> Chlorine	80 <b>Br</b> Bromine 35	127 <b>I</b> lodine 53	At Astatine 85	į
		N		16 Oxygen	32 <b>S</b> Sulphur 16	79 <b>Se</b> Selenium 34	128 <b>Te</b> Tellurium	Po Polonium 84	5
		>		Nitrogen 7	31 Phosphorus	75 <b>AS</b> Arsenic 33	122 <b>Sb</b> Antimony 51	209 <b>Bi</b> Bismuth	
		N		12 <b>C</b> Carbon	28 <b>Si</b> licon	73 <b>Ge</b> Germanium	Sn Tin 50	207 <b>Pb</b> Lead	i c
		III		11 Boron 5	27 <b>A1</b> Aluminium 13	70 <b>Ga</b> Gallium 31	115 <b>In</b> Indium 49	204 <b>T.1</b> Thatlium	Ç
S						65 <b>Zn</b> Zinc 30	112 <b>Cd</b> Cadmium 48	201 <b>Hg</b> Mercury	5
ine Periodic I able of the Elements						64 Copper 29	108 <b>Ag</b> Silver 47	197 <b>Au</b> Gold	į
le oi the	Group					S9 Nickel 28	106 <b>Pd</b> Palladium 46	195 <b>Pt</b> Platinum 78	
odic i ab	G			٦		59 <b>Co</b> Cobalt 27	103 <b>Rh</b> Rhodium 45	192 <b>Ir</b> Indium 77	
ne Perio			T Hydrogen			56 Iron	Bu Ruthenium 44	190 <b>Os</b> Osmium 76	
						Manganese 25	Tc Technetium	186 <b>Re</b> Rhenium 75	;
						Cr Chromium 24	96 Molybdenu 42	184 <b>W</b> Tungsten 74	;
						51 V Vanadium 23	93 Nobium 41	181 <b>Ta</b> Tantalum 73	,
						48 Titanium	2 Zr Zirconium 40	178 <b>H</b> Hafnium 72	
						Scandium	89 <b>×</b>	139 <b>La</b> Lanthanum 57 *	Actinium + 89
		=		9 <b>Be</b> ryllium	24 Mg Magnesium 12	40 <b>Ca</b> Calcium	Sr Strontium	137 <b>Ba</b> Barium 56	226 <b>Ra</b> Radium 88
		_		7 <b>Li</b> thium	23 <b>Na</b> Sodium	39 <b>K</b> Potassium 19	85 <b>Rb</b> Rubidium 37	133 Cs Caesium 55	Francium 87

175 <b>Lu</b> Lutetium 71	<b>Lr</b> Lawrencium 103
173 <b>Yb</b> Ytterbium 70	No No belium
169 <b>Tm</b> Thulium	Md Mendelevium 101
167 <b>Er</b> Erbium 68	<b>Fm</b> Fermium 100
165 <b>Ho</b> Holmium 67	Es Einsteinium 99
162 <b>Dy</b> Dysprosium 66	<b>Californium</b> 98
159 <b>Tb</b> Terbium 65	<b>BK</b> Berkelium 97
Gd Gadolinium 64	Curium 96
152 <b>Eu</b> Europium 63	Am Americium 95
Samarium 62	<b>Pu</b> Plutonium
Pm Promethium 61	Np Neptunium 93
Neodymium 60	238 <b>U</b> Uranium
Praseodymium 59	Pa Protactinium 91
140 <b>Ce</b> Cerium 58	232 <b>Th</b> Thorium

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

b = proton (atomic) number

a = relative atomic massX = atomic symbol

а **×** 

Key

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