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.

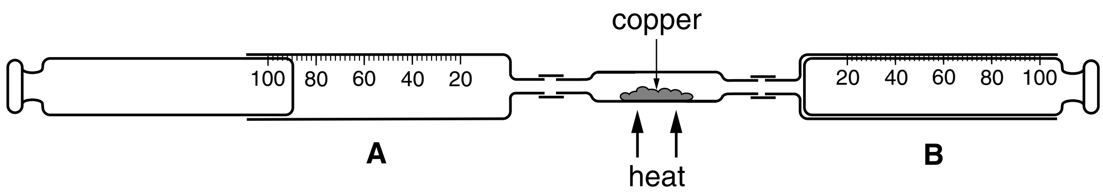
You should use names, not symbols, when describing all reacting chemicals and the products formed.

Mathematical tables are available.

FOR EXAMINER'S USE

For Examiner's Use

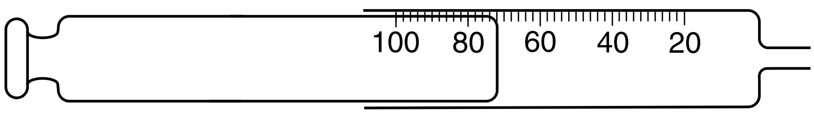
1 A student found the composition of air using the apparatus shown below.



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.

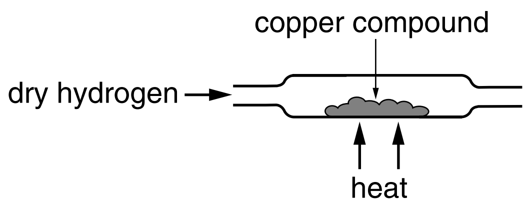
name ....

formula ....

colour ....

[6]

(b) The tube containing the copper compound was removed from the syringes. The 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; Cl, 35.5.)

answer ....

explanation ....

....

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. ☐

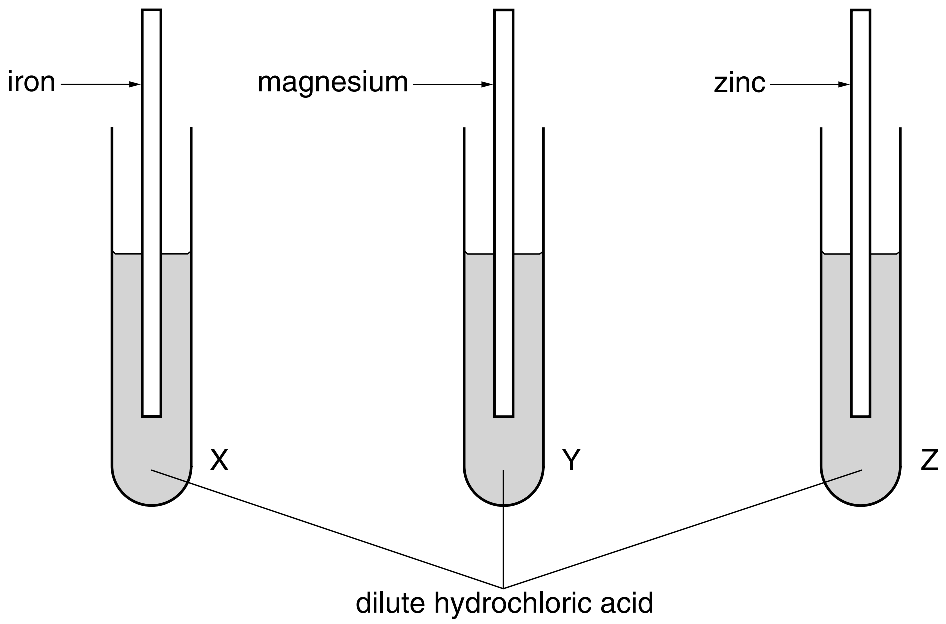
(b) The production of carbon dioxide in a solution was indicated by effervescence. ☐

(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, ☐

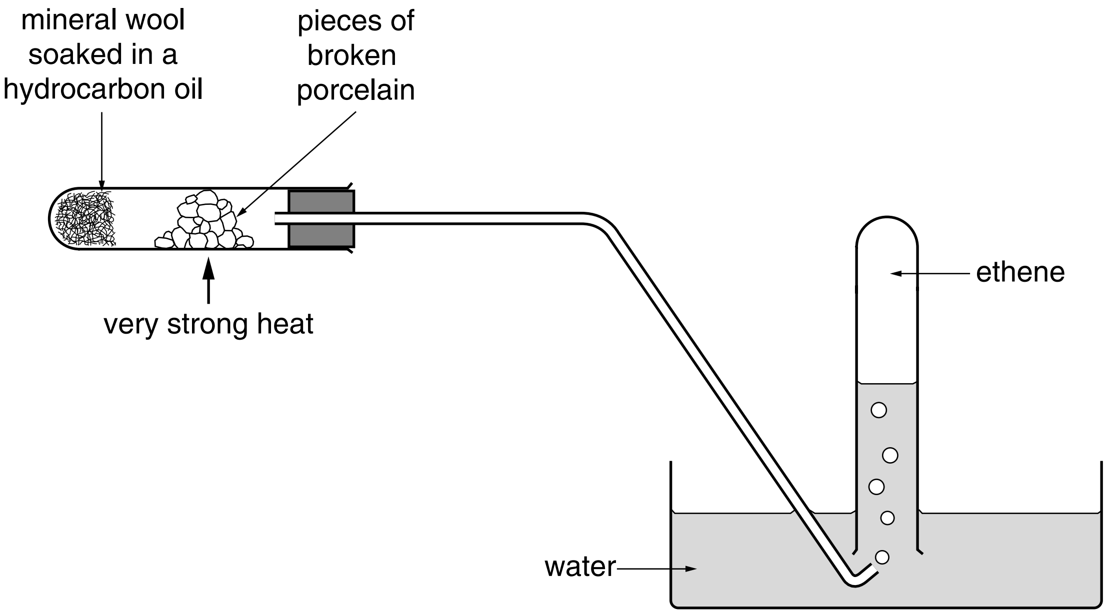
(c) Y and Z only, ☐

(d) X and Y and Z. ☐

[1]

For Examiner's Use

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



The reaction is an example of

(a) cracking, ☐

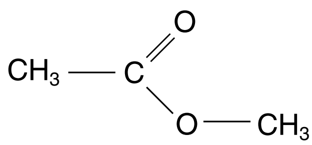
(b) oxidation, ☐

(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.

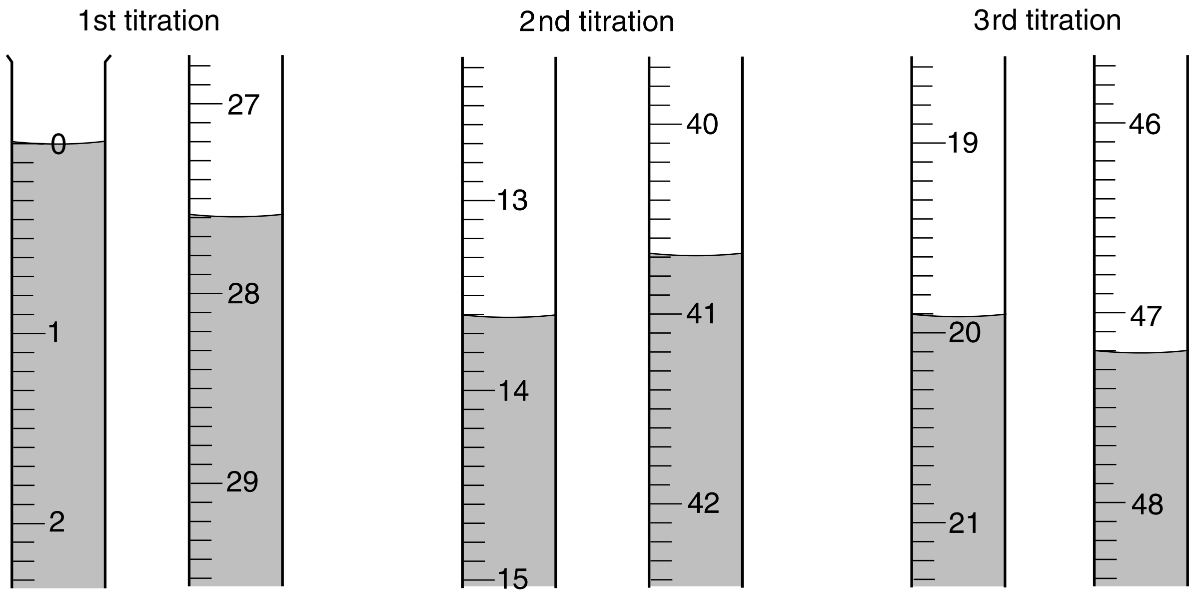
Phenolphthalein is colourless in acid and red in alkali.

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

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

For Examiner's Use

Three titrations were done. The diagrams below show parts of the burette at the be
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 25 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]

8 The following table shows the tests a student did on substance **S** and the conclusions 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 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.

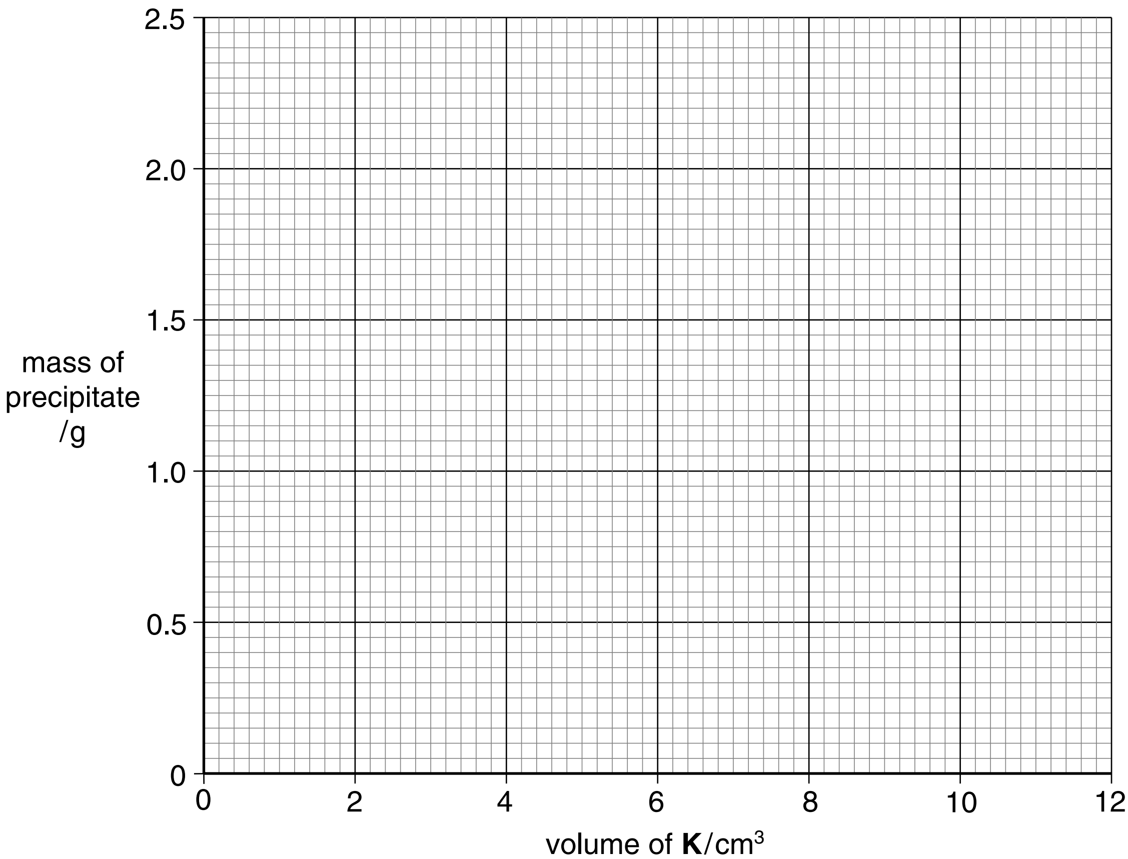
For Examiner's Use

(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]

For Examiner's Use

(d) One of the results is incorrect. Circle the result on your graph and suggest w... 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	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 1	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 9	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 7	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 5	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 7	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

8-71 Lanthanoid series
0-103 Actinoid series

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

ey

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

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