Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

SCIENCE **5124/03, 5126/03**

Paper 3 Chemistry

October/November 2004

1 hour 15 minutes

Additional Materials: Answer paper

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 a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer any **two** questions.
Write your answers on the lined pages provided and, if necessary, continue on separate answer paper.

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.
A copy of the Periodic Table is printed on page 12.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **10** printed pages and **2** lined pages.

Section A

Answer **all** the questions.

Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 contains the descriptions of **six** substances. Name the substances that fit these descriptions.

description	name
(a) a metal that forms brass when alloyed with copper	
(b) a fuel that powers heavy road vehicles	
(c) a liquid that is formed by the fermentation of sugar	
(d) an element that is used to disinfect contaminated water	
(e) an element that is light and strong and used to make aircraft parts	
(f) a compound that is added to iron ore and coke in the blast furnace	

Fig. 1.1 [6]

2 Paper chromatography was used to investigate a series of dyes **A**, **B**, **C**, **D**, **E**, **F** and **G**. The resulting chromatogram is shown in Fig. 2.1.

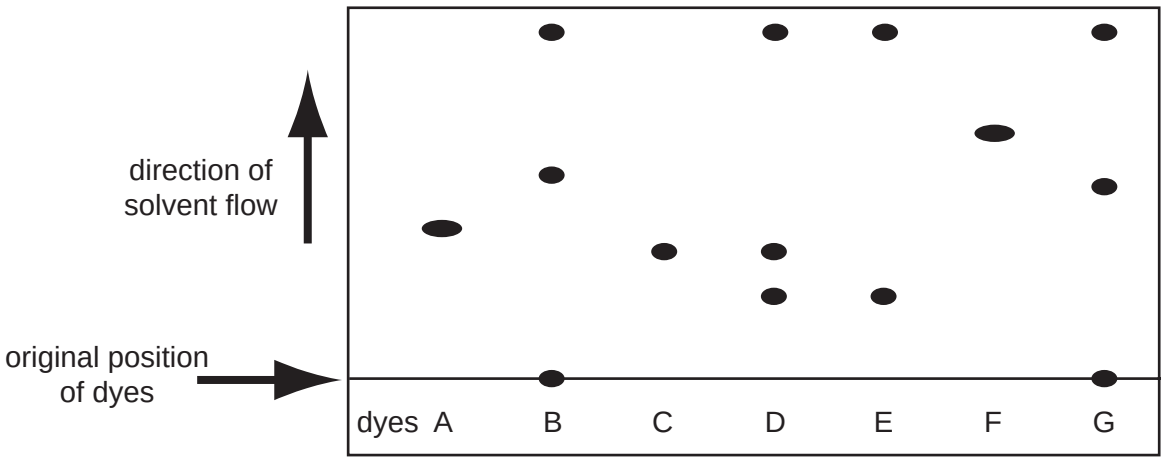

Fig. 2.1

(a) Suggest the name of a suitable solvent. .....[1]

(b) Which dyes are pure substances? .....[1]

(c) Which **two** dyes are the same? .....[1]

(d) Which dye is a mixture of **C** and **E**? .....[1]

3 **(a)** Define the *relative molecular mass* of a compound.

.....

.....[2]

(b) Six hydrocarbons are identified by the letters **H**, **I**, **J**, **K**, **L** and **M**. Fig. 3.1 shows how the relative molecular masses of these hydrocarbons vary with the number of carbon atoms in each of their molecules. Five of these hydrocarbons are in the same homologous series.

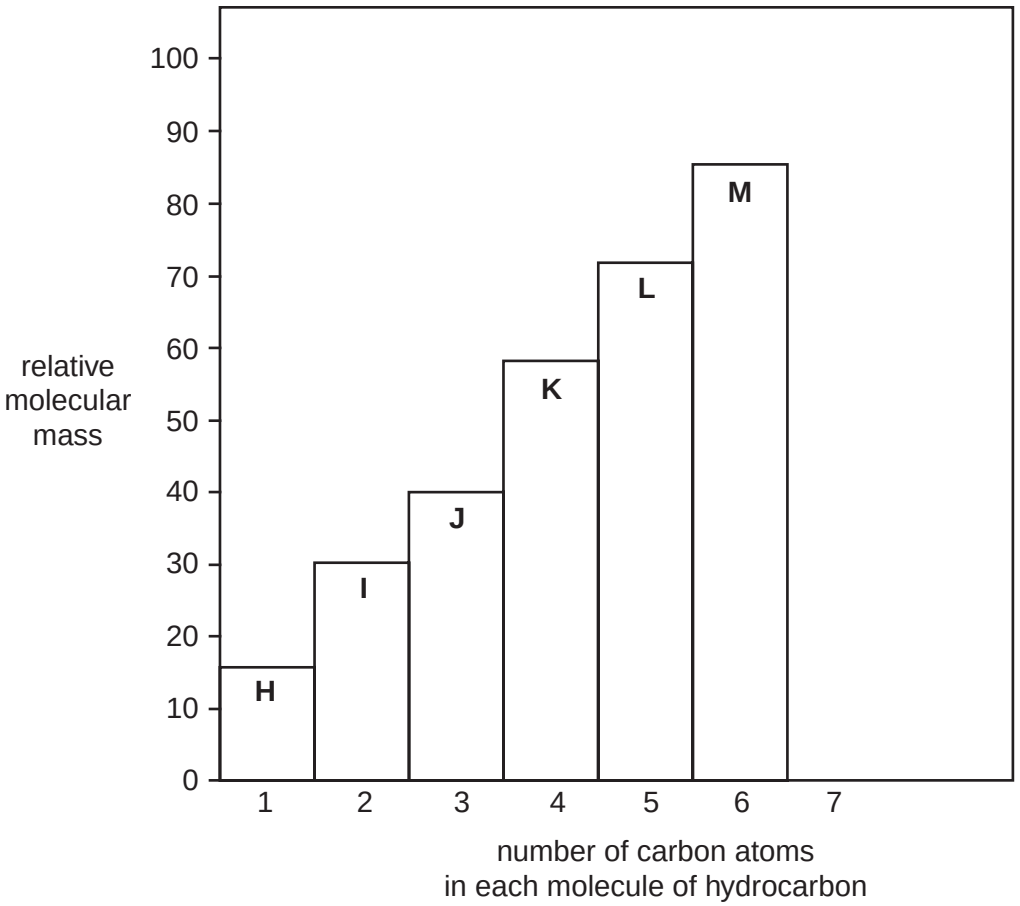

Fig. 3.1

(i) Hydrocarbon **H** has a relative molecular mass of 16. Suggest the name of this hydrocarbon.

[Relative atomic masses: A_r: H, 1; C, 12]

.....

(ii) Which **one** of the hydrocarbons is not a member of the same homologous series as the other **five**?

.....

(iii) Add to Fig. 3.1 the block for the next hydrocarbon in the homologous series.

(iv) Suggest a physical property of the hydrocarbons that changes with increasing number of carbon atoms.

.....

[4]

4 The following are labels that describe the **contents** of four different bottles.

Content of bottle **N**. Coloured white. Only some parts dissolve in an excess of water.	Content of bottle **O**. All its identical molecules when burnt in air form carbon dioxide and water.
Content of bottle **P**. Has a constant composition. Contains several different atoms.	Content of bottle **Q**. When burnt in air, only water is formed.

Classify the contents of each bottle and draw a **circle** around either **element**, or **compound**, or **mixture**.

(a) Substance in bottle **N**: element compound mixture [1]

(b) Substance in bottle **O**: element compound mixture [1]

(c) Substance in bottle **P**: element compound mixture [1]

(d) Substance in bottle **Q**: element compound mixture [1]

5 The ionic equation for the reactions between zinc and copper(II) sulphate solution is shown below.

$$Cu^{2+}(aq) + Zn(s) \rightleftharpoons Cu(s) + Zn^{2+}(aq)$$

(a) What is the meaning of the following symbols?

(i) (aq) .....

(ii) (s) .....

[2]

(b) Use the equation to show that

(i) copper ions have been reduced,

.....

.....

(ii) zinc atoms have been oxidised.

.....

.....

[2]

(c) A student dropped a lump of zinc into dilute copper(II) sulphate solution.

(i) Suggest **one** way in which the student can make the reaction go faster.

.....

(ii) Explain why the rate of reaction will increase when he makes this change.

.....

.....

[2]

6 An atom of calcium, $^{40}_{20}Ca$, forms a calcium ion, Ca^{2+}. The ion contains protons, neutrons and electrons.

(a) Complete Fig. 6.1 to describe the particles in the calcium ion.

	number in one Ca^{2+} ion	electrical charge
proton		positive charge
neutron		
electron		

Fig. 6.1 [5]

(b) How does the formation of the calcium ion show that calcium is a metal?

.....

.....[1]

(c) How will another isotope of calcium

(i) differ from $^{40}_{20}Ca$,

.....

(ii) be the same as $^{40}_{20}Ca$?

.....[2]

7 **(a)** One dm^3 of a solution contains 80 g of sodium hydroxide, NaOH.

[Relative atomic masses: A_r: H, 1; O, 16; Na, 23]

Calculate the concentration of the solution in mol / dm^3.

.....

.....[2]

(b) If 80 g of sodium hydroxide is dissolved in water and then made up to 250 cm^3, what will be the concentration of the solution in g / dm^3?

.....[1]

(c) **(i)** Write the chemical equation for the reaction of sodium hydroxide with sulphuric acid, excluding state symbols.

.....

(ii) What volume of 1.0 mol / dm^3 sulphuric acid will react with 100 cm^3 of 2.0 mol / dm^3 sodium hydroxide?

.....

.....[3]

8 The solubility of a substance is the maximum mass that will dissolve in 100 g of water, so forming a saturated solution. Solubility depends upon temperature.

Fig. 8.1 contains a solubility curve for substance **V**. This shows how the solubility of substance **V** changes with temperature.

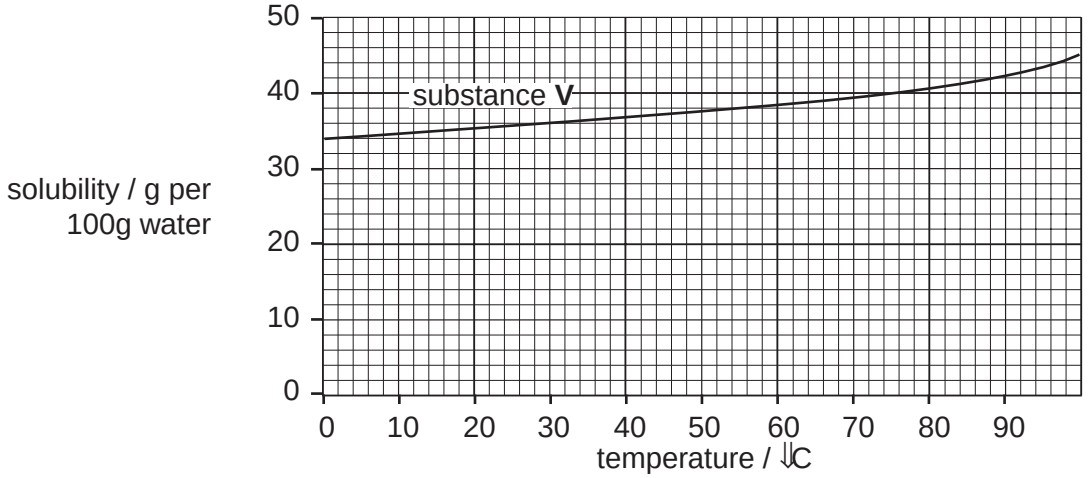

Fig. 8.1

(a) Fig. 8.2 shows the solubility of substance **W** at various temperatures.

solubility of **W** / g per 100 g of water	5	7	10	19	24	37	46
temperature / °C	10	20	30	50	60	80	90

Fig. 8.2

(i) Plot on Fig. 8.1 a solubility curve for substance **W**.

(ii) At what temperature are the solubilities of substances **V** and **W** the same?

.....

(iii) Use your plot to estimate the temperature at which substance **W** has a solubility of 17 g per 100 g of water.

..... [4]

(b) Equal volumes of saturated solutions of **V** are **W** are cooled from 80 °C to 40° C. Will solution **W** deposit a **larger**, **equal**, or **smaller** mass of crystals than solution **V**?

.....[1]

Section B

Answer any **two** questions.

Write your answers on the lined pages provided and, if necessary, continue on separate answer paper.

9 **(a)** Name the reagents and give the essential conditions of the catalytic manufacture of ammonia, NH_3. Explain the purpose of the catalyst and write a chemical equation for the reaction. State symbols are not required. [7]

(b) Calculate the relative molecular mass of ammonia and determine the percentage of nitrogen by mass in a sample of pure ammonia. [3]

[Relative atomic masses: A_r: H, 1; N, 14]

10 **(a)** Write the name and formula of an ion found in

(i) every acid solution,

(ii) every alkaline solution.

[2]

(b) Fig. 10.1 gives the properties and reactions of several substances.

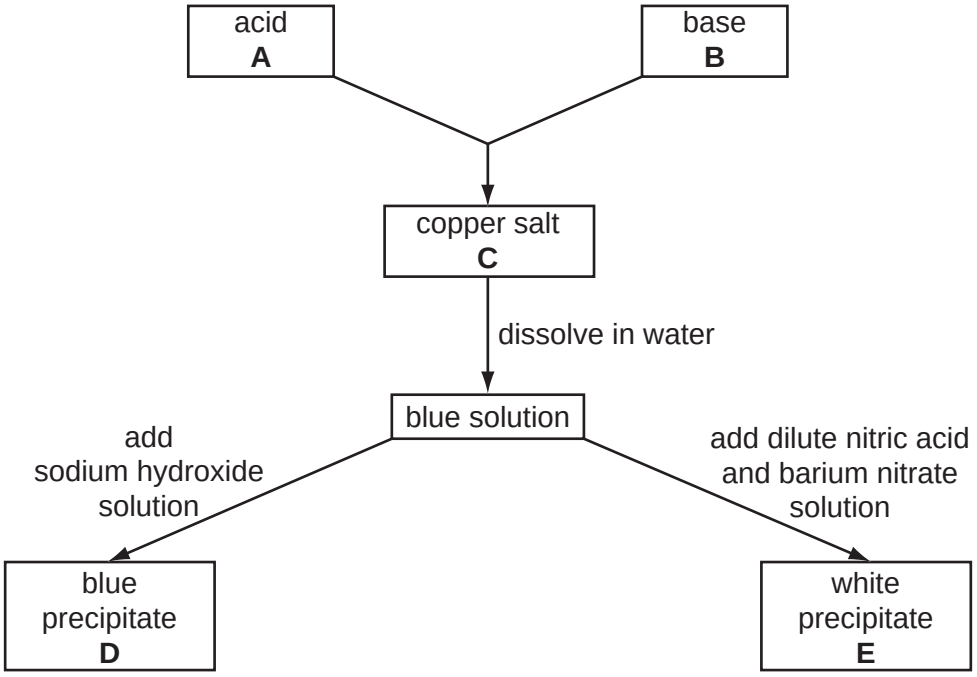

Fig. 10.1

Identify the following:

(i) blue precipitate **D**

(ii) white precipitate **E**

(iii) copper salt **C**

(iv) acid **A**

(v) base **B**

[6]

(c) Write a chemical equation for any **one** of the reactions in Fig. 10.1.
State symbols are not required. [2]

11 **(a)** Name **three** of the gases present in clean air. [3]

(b) A gas is cooled to a very low temperature.

(i) Name the two changes in state that will occur.

(ii) Describe how the movement, spacing and arrangement of the gas particles will change during this cooling.

[7]

DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 Radius 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.).