UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0501706038

SCIENCE **5124/03**

Paper 3 Chemistry **October/November 2010**

1 hour 15 minutes

Candidates answer on the Question Paper

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.
DO **NOT** WRITE ON ANY BARCODES.

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 paper provided and, if necessary, continue on separate answer paper.

A copy of the Periodic Table is printed on page 16.

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.

For Examiner's Use	
Section A	
Section B	
Total	

This document consists of **13** printed pages and **3** lined pages.

Section A

For Examiner's Use

Answer **all** the questions.

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

1 Choose one metallic element and one non-metallic element. Complete Table 1.1 with these two elements.

Table 1.1

	name	chemical symbol	**one** physical property
metallic element			
non-metallic element			

[6]

2 The boxes in Fig. 2.1 contain descriptions of five different substances, **A**, **B**, **C**, **D** and **E**. Decide whether each substance should be classified as an element, compound or mixture. Show your decision by ticking (✓) the correct box for each substance in Fig. 2.2.

For Examiner's Use

A
this solid melts on heating to a yellow liquid that cannot be made into a simpler substance

B
this liquid contains different atoms and boils at exactly 100 °C

C
no heat is exchanged when this powder is formed from its component parts

D
when this coloured liquid is distilled, a colourless liquid is collected

E
the different atoms in this colourless gas have a constant ratio

Fig. 2.1

substance	element	compound	mixture
A			
B			
C			
D			
E			

Fig. 2.2

[5]

3 Table 3.1 describes properties of two different solutions. Complete the table.

For Examiner's Use

Table 3.1

solution	colour when mixed with Universal Indicator solution	**one** product of the reaction with ammonium carbonate
hydrochloric acid		
aqueous sodium hydroxide		

[4]

4 Forensic scientists use paper chromatography to compare the inks from five different bank notes with the ink used to make legal bank notes.

The results are shown as a chromatogram in Fig. 4.1.

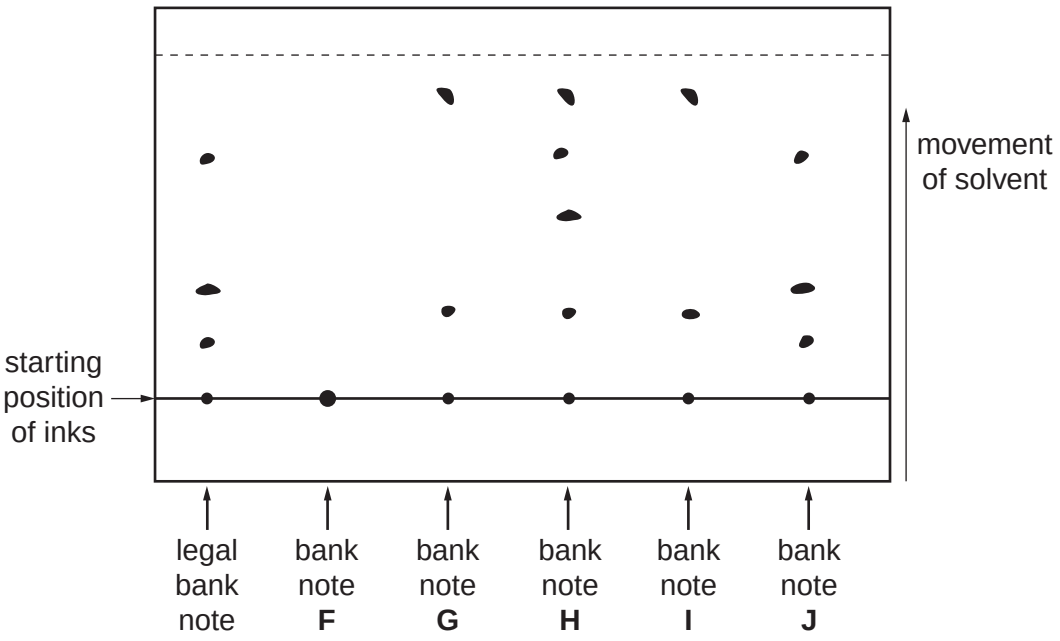

Fig. 4.1

(a) Draw the apparatus that could be used to produce this chromatogram.

For Examiner's Use

[2]

(b) Which of the bank notes **F**, **G**, **H**, **I** and **J**

(i) is **not** a forgery,

.....

(ii) are printed with identical inks,

.....

(iii) is printed with ink containing four solvent-soluble dyes?

.....

[3]

(c) Use your knowledge of bank notes to suggest why water would probably **not** be a suitable solvent to use for this chromatography.

.....

.....[1]

For Examiner's Use

5 **(a)** An element has an atomic number of 9.

(i) Write the electronic structure of an atom of the element.

.....

(ii) Explain how the electronic structure shows that this is a non-metal.

.....

(iii) What is the charge on an ion of this element?

.....

[3]

(b) Table 5.1 gives the particles in the nuclei of five different atoms, **K**, **L**, **M**, **N** and **O**.

Table 5.1

letter (not chemical symbol)	**K**	**L**	**M**	**N**	**O**
particles in each nucleus	3 protons 3 neutrons	4 protons 5 neutrons	5 protons 5 neutrons	5 protons 6 neutrons	6 protons 7 neutrons

Which letter or letters from **K**, **L**, **M**, **N** or **O** best represent

(i) the nucleus of an atom with an atomic number of six,

.....

(ii) the nucleus of an atom with a relative atomic mass of six,

.....

(iii) two nuclei from different isotopes of the same element?

.....

[3]

6 **(a)** Table 6.1 includes some organic reactions. Fill in the boxes. The first has been completed for you as an example.

For Examiner's Use

Table 6.1

	organic compounds	types of reaction	products
example	ethene	*reduction* ⟶	ethane
(i)	ethene	polymerisation ⟶	.....
(ii)	ethanol	..... ⟶	ethanoic acid
(iii)	ethanol + ethanoic acid	esterification ⟶	.....

[3]

(b) Ethene has a low boiling point and is a gas at room temperature. It consists of covalently bonded molecules. Explain why the boiling point of ethene is low.

.....

.....

.....[2]

7 Magnesium carbonate and dilute sulfuric acid react to produce a gas. Data to determine the rate of this reaction are collected using the apparatus shown in Fig. 7.1.

For Examiner's Use

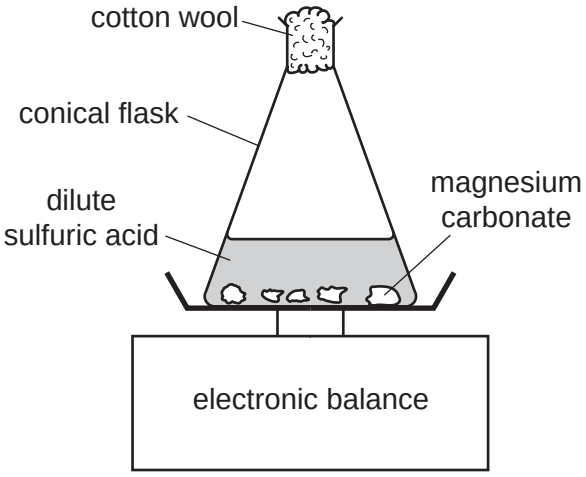

Fig 7.1

(a) What is the purpose of the cotton wool in the mouth of the conical flask?

.....[1]

(b) The reading on the electronic balance is taken every minute and used to plot the graph shown in Fig. 7.2.

For Examiner's Use

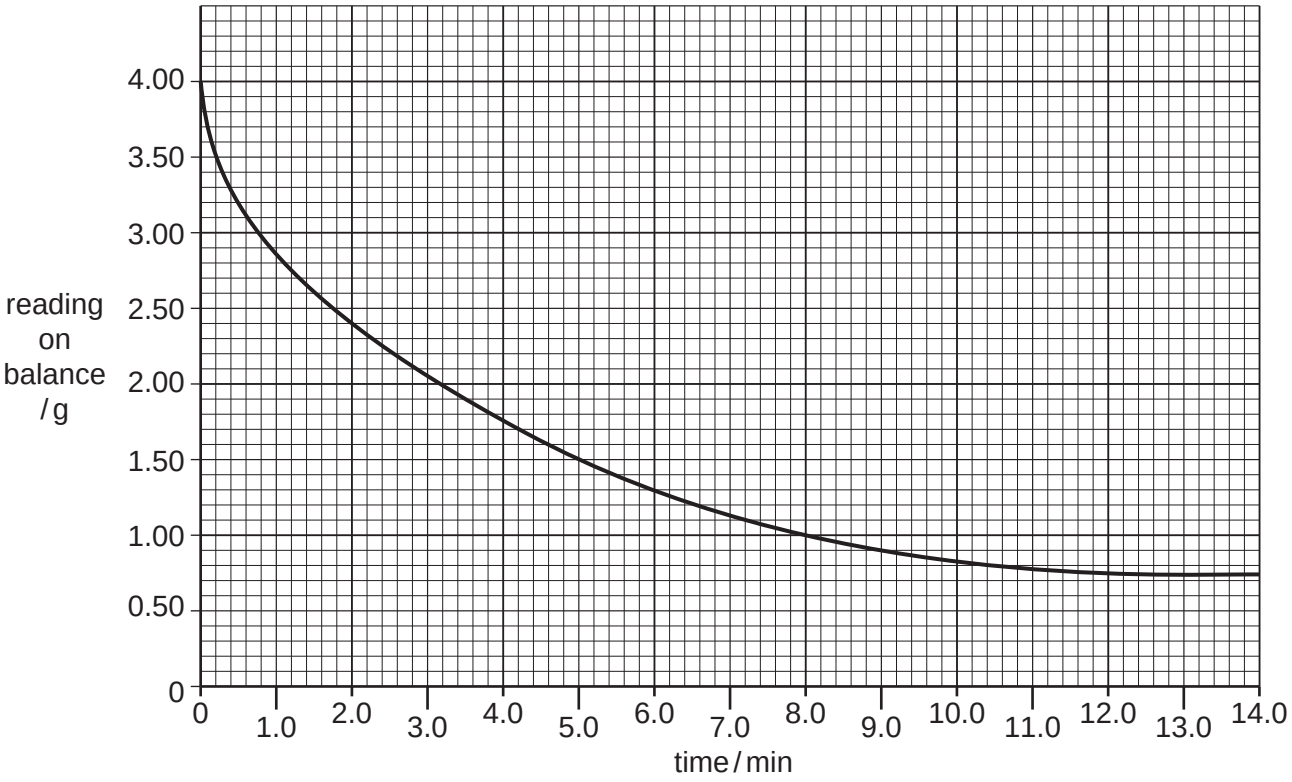

Fig. 7.2

(i) Why does the reading on the electronic balance decrease over the first few minutes?

.....

(ii) What can you tell from the graph about the rate of this reaction during its first 14 minutes?

.....

.....

(iii) Calculate from the graph the fall in mass over the first 8 minutes of the reaction.

.....

(iv) Calculate the average rate of reaction over the first 8 minutes in grams per minute.

..... g / min
[5]

For Examiner's Use

8 Students give their own special symbols to five **metallic** elements. All five metals are in the same group of the Periodic Table. The special symbols are shown in Fig. 8.1. The order of chemical reactivity of these metals is also shown.

	increasing order of chemical reactivity →				
special symbols given by students	**Aa**	**Bb**	**Cc**	**Dd**	**Ee**

Fig. 8.1

The students know

1. the group of the Periodic Table in which these metals are placed,

2. that chlorine, C*l*, combines with the metal they had given the special symbol **Aa**.

As a result they give the compound so formed the formula **Aa**C*l*.

(a) (i) In which group of the Periodic Table must all these elements be placed?

.....

(ii) Choose from Fig. 8.1 the special symbol of the element which is most likely to be the first member of this group.

.....

(iii) Write the formula for the compound formed between this element and oxygen.

.....

[3]

(b) (i) Suggest the name of the element given the special symbol **Bb** by the students.

.....

(ii) How would you expect this element to react with water?

.....

(iii) Use the special symbol **Bb** to write a chemical equation for this reaction with water. State symbols are not required.

.....

[4]

Section B

Answer any **two** questions.

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

9 **(a)** Briefly describe how lime (calcium oxide) is manufactured and give one of its uses. Include a chemical equation, with state symbols, in your description. [5]

(b) Fig. 9.1 describes some of the reactions of calcium oxide.

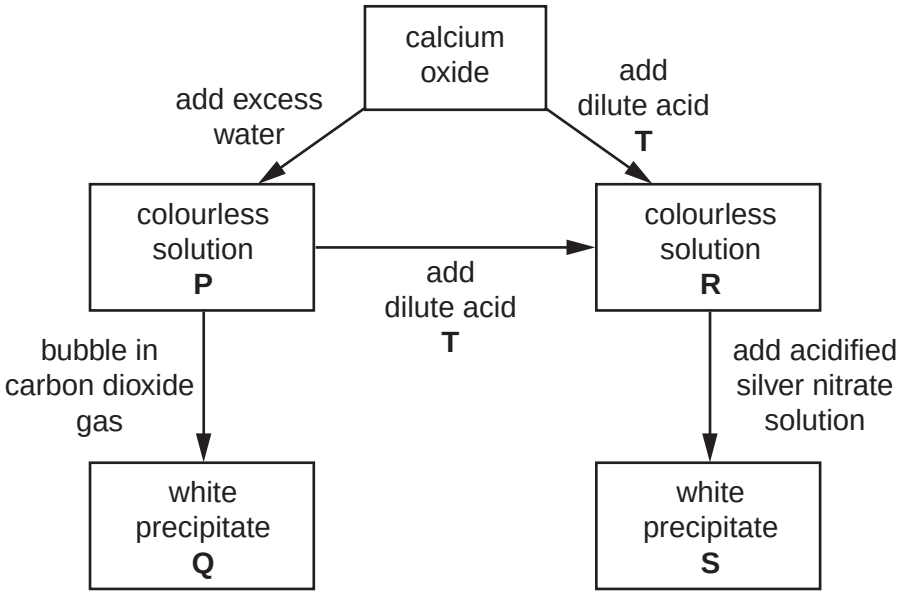

Fig. 9.1

Identify substances **P**, **Q**, **R**, **S** and **T**. [5]

10 **(a)** Burning fossil fuels, such as coal, can produce sulfur dioxide and carbon monoxide. Explain how these two pollutant gases are formed and state their harmful effects. [6]

(b) A coal contains 2% by mass of sulfur. What mass and volume of sulfur dioxide are formed when 100 grams of this coal are burned completely in air?

[Relative atomic masses: A_r: O, 16; S, 32]

[The volume of one mole of any gas is 24 dm^3 at room temperature and pressure.] [4]

11 **(a)** Organic compounds form homologous series. Give the general characteristics of members of any homologous series. [3]

(b) **(i)** Draw the structure of an alkane with two carbon atoms in each molecule.

(ii) Calculate the percentage by mass of hydrogen in this alkane.

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

(iii) What substances are formed when this alkane burns in excess air?

Write an equation for the reaction. State symbols are required.

[7]

For Examiner's Use

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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 Sulfur 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	209 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 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	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	244 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	247 Bk Berkelium 97	251 Cf Californium 98	252 Es Einsteinium 99	257 Fm Fermium 100	258 Md Mendelevium 101	259 No Nobelium 102	260 Lr Lawrencium 103

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

Key: a X b — a = relative atomic mass; X = atomic symbol; b = atomic (proton) number

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