Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY **0620/02**

Paper 2

October/November 2006

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials required.

READ THESE INSTRUCTIONS FIRST

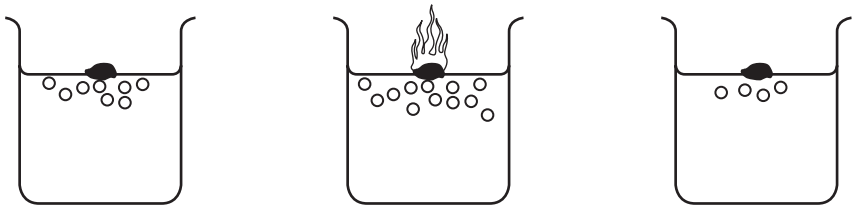
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
The number of marks is given in brackets [ ] at the end of each question or part questions.
A copy of the Periodic Table is printed on page 20.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **18** printed pages and **2** blank pages.

1 When Group I elements react with water, hydrogen gas is given off.
The diagram shows the reaction of lithium, potassium and sodium with water.



A **B** **C**

(a) Which **one** of these elements **A**, **B** or **C** is lithium?

..... [1]

(b) **(i)** Balance the equation for the reaction of sodium with water by completing the left-hand side.

$$\text{.....Na} + \text{.....}H_2O \longrightarrow 2NaOH + H_2$$

[1]

(ii) Apart from fizzing, describe **two** things that you would **see** when sodium reacts with water.

.....

.....

..... [2]

(iii) After the sodium had reacted with the water, the solution was tested with red litmus paper.
What colour did the litmus paper turn?
Give a reason for your answer.

colour .....

reason ..... [2]

(iv) Which of the following statements about sodium are true?
Tick **two** boxes.

It is made by reducing sodium oxide with carbon. ☐

It reacts with chlorine to form sodium chloride. ☐

It reacts readily with oxygen. ☐

It only conducts electricity when molten. ☐

[2]

(c) Rubidium also reacts with water. How does the speed of reaction of rubidium with water compare with that of potassium with water?

.....

[1]

(d) Sodium has only one stable isotope whereas potassium has several isotopes.

(i) What do you understand by the term *isotopes*?

.....

.....

[1]

(ii) How many protons does sodium have in its nucleus?
Use the Periodic Table to help you.

.....

[1]

(iii) How many electrons are there in an atom of potassium?

.....

[1]

(iv) Uranium has many isotopes. One of these is uranium-235 (^{235}U).
What is the main use of this isotope of uranium?

.....

[1]

2 Copper can be extracted by heating copper carbonate with carbon.

(a) The copper carbonate breaks down into copper oxide and releases a gas. Complete the equation for this reaction.

$CuCO_3 \longrightarrow CuO + ...$ [1]

(b) The copper oxide then reacts with the carbon.

$$2CuO + C \xrightarrow{\text{heat}} 2Cu + CO_2$$

(i) Complete the following sentences using words from the list.

endothermic **exothermic** **halogen** **metal**

neutralised **oxidised** **reduced**

In this reaction copper oxide is ..... to copper.

The copper obtained is a pinkish-brown .....

The reaction is ..... because heat is absorbed. [3]

(ii) State the name of the substance which is oxidised during this reaction.

..... [1]

(iii) How would you test for the carbon dioxide given off in this reaction?

test .....

result ..... [2]

(c) Describe a test for aqueous copper ions and state the result.

.....

.....

..... [3]

(d) Carbon is in Group IV of the Periodic Table.

(i) Draw a diagram to show how the electrons are arranged in an atom of carbon.

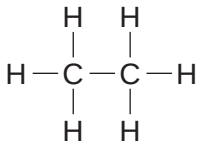
[1]

(ii) To which Period in the Periodic Table does carbon belong?

..... [1]

(e) Organic compounds contain carbon and hydrogen.

(i) To which homologous series does the organic compound **A** belong?



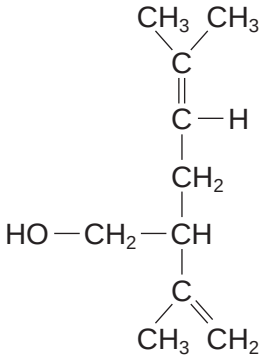
compound **A**

..... [1]

(ii) State the name of compound **A**.

..... [1]

3 Lavandulol is found in lavender plants. The formula of lavandulol is shown below.



(a) Put a ring around the alcohol functional group in this formula.

[1]

(b) Is lavandulol a saturated or unsaturated compound?
Give a reason for your answer.

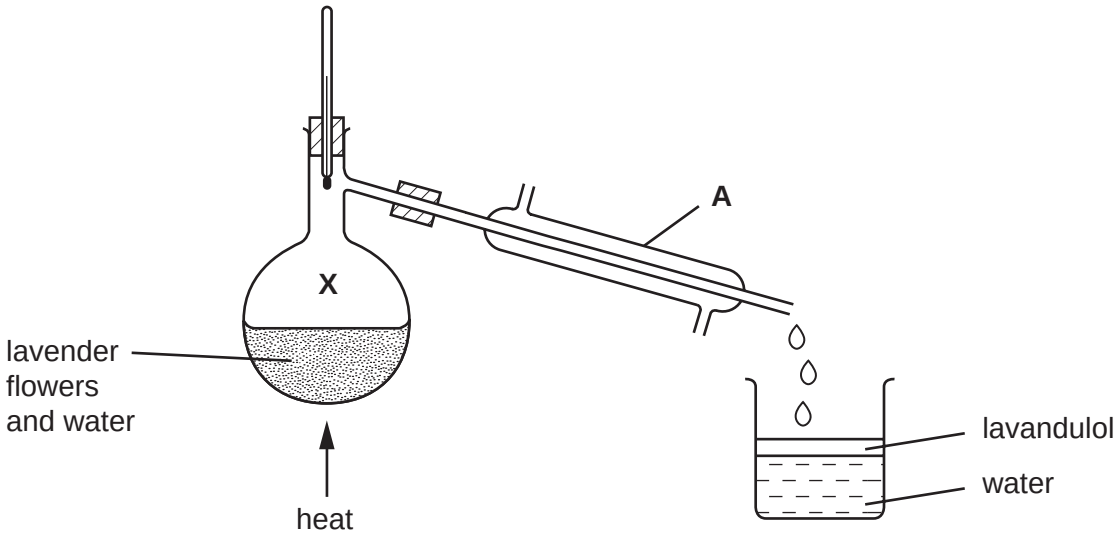
.....

..... [1]

(c) State the names of the **two** products formed when lavandulol is burnt in excess oxygen.

..... and ..... [2]

(d) Lavandulol can be extracted from lavender flowers by distillation using the apparatus shown below. The lavandulol is carried off in small droplets with the steam.



(i) State the name of the piece of apparatus labelled **A**.

.....[1]

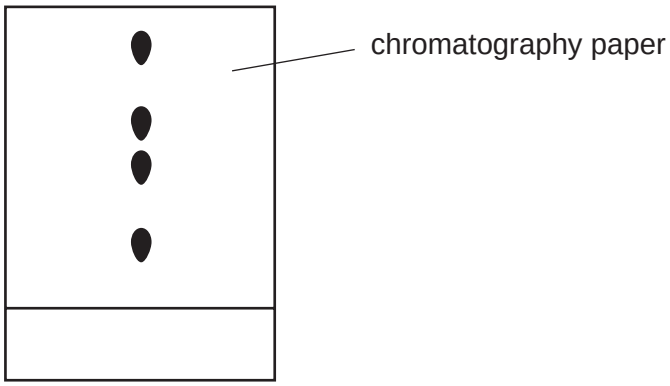
(ii) What is the temperature of the water at point **X** in the diagram?

.....[1]

(iii) The lavandulol and water are collected in the beaker.
What information in the diagram shows that lavandulol is less dense than water?

.....[1]

(e) Lavender flowers contain a variety of different pigments (colourings).
A student separated these pigments using paper chromatography.
The results are shown in the diagram below.



(i) Put an **X** on this diagram to show where the mixture of pigments was placed at the start of the experiment. [1]

(ii) How many different pigments have been separated?

.....[1]

(iii) Draw a diagram to show how the chromatography apparatus was set up.
On your diagram label
- the solvent
- the origin line

[1]

(iv) During chromatography, the solvent evaporates and then diffuses throughout the chromatography jar.
What do you understand by the term *diffusion*?

.....

..... [1]

(v) Ethanol can be used as a solvent in chromatography.
Draw the formula for ethanol showing all atoms and bonds.

[1]

(vi) Which of the following statements about ethanol are true?
Tick **two** boxes.

It is a carboxylic acid. ☐

It is a product of the fermentation of glucose. ☐

It is an unsaturated compound. ☐

It is formed by the catalytic addition of steam to ethene. ☐

[1]

4 This question is about compounds.

(a) What do you understand by the term *compound*?

.....

..... [1]

(b) Complete the table below to show the formulae and uses of some compounds.

compound	relative number of atoms present	formula	use
calcium oxide	Ca = 1 O = 1	CaO	
sodium chloride	Na = 1 C*l* = 1		table salt
calcium carbonate	Ca = 1 C =1 O = 3		
		NH_4NO_3	in fertilizers

[6]

(c) Calculate the relative formula mass of NH_4NO_3.

[1]

5 The list shows part of the reactivity series.

strontium	more reactive
calcium	↑
magnesium	
iron	
copper	less reactive

(a) Calcium is manufactured by the electrolysis of molten calcium chloride.
Suggest why calcium is extracted by electrolysis.

.....

[1]

(b) Equal sized pieces of magnesium, strontium and calcium are placed in water. Some observations about these reactions are shown in the table.
Complete the box for strontium.

metal	observations
magnesium	Gives off a few bubbles of gas with hot water. Dissolves very slowly.
calcium	Gives off bubbles steadily with cold water. Dissolves slowly.
strontium	

[2]

(c) When water is added to calcium carbide, acetylene and calcium hydroxide are formed.
State a use for acetylene.

.....

[1]

(d) A solution of calcium hydroxide is alkaline.

(i) Complete and balance the equation for the reaction of calcium hydroxide with hydrochloric acid.

$$Ca(OH)_2 + 2HCl \longrightarrow CaCl_2 + ...$$

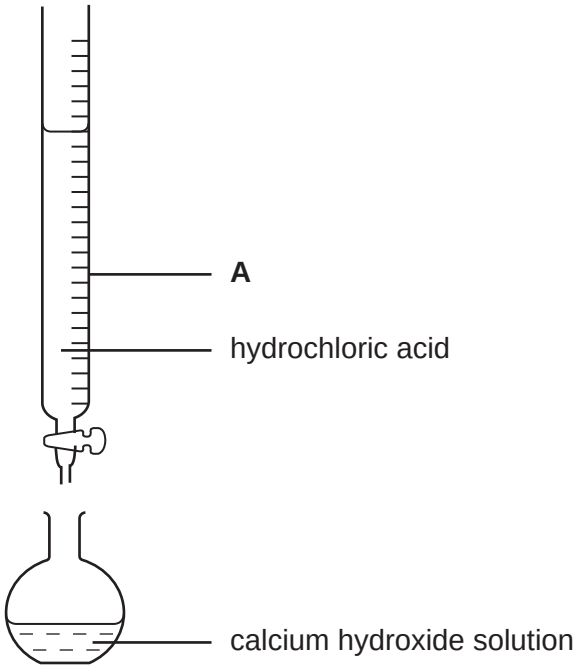
[1]

(ii) What type of chemical reaction is this?

.....

[1]

(e) A student used the apparatus shown below to calculate the concentration of a solution of calcium hydroxide.



(i) State the name of the piece of apparatus labelled **A**.

.....

[1]

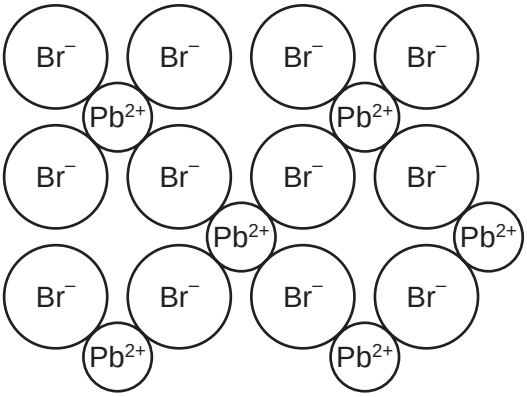
(ii) Describe how the pH of the solution in the flask changes as the hydrochloric acid is added.

.....

.....

[2]

6 The diagram shows the structure of lead bromide.



(a) What is the simplest formula for lead bromide?

.....

[1]

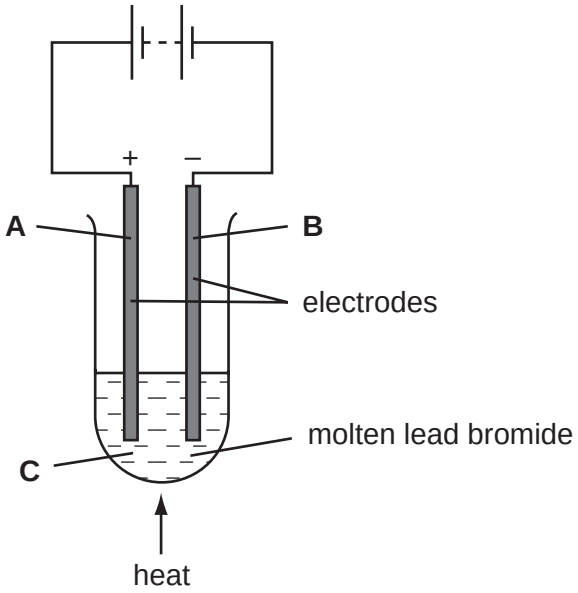
(b) What type of structure and bonding is present in lead bromide?
Choose **two** words from the following:

atomic covalent giant ionic metallic molecular

.....

[2]

(c) Lead bromide is electrolysed using the apparatus shown below.



(i) Which letter, **A**, **B** or **C** represents the cathode?

.....

[1]

(ii) State the name of a metal which can be used for the electrodes.

..... [1]

(iii) Why does lead bromide have to be molten for electrolysis to occur?

.....

..... [1]

(iv) State the name of the products formed during this electrolysis;

at the anode, ...

at the cathode. ..... [2]

(d) A student bubbled chlorine gas through an aqueous solution of sodium bromide.

(i) Complete the equation for this reaction.

$$Cl_2 + 2NaBr \longrightarrow \text{.....} + 2NaCl$$

chlorine — sodium bromide — bromine — sodium chloride

[1]

(ii) What colour is the solution at the end of the reaction?

..... [1]

(iii) An aqueous solution of iodine does not react with a solution of sodium bromide. Explain why there is no reaction.

.....

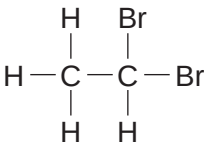
..... [1]

(e) Bromine becomes decolourised when it reacts with ethene.

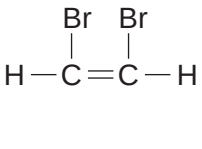
(i) Draw the structure of ethene showing all atoms and bonds.

[1]

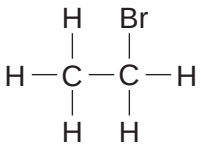
(ii) Which **one** of the following, **A**, **B**, **C** or **D**, shows the correct structure of the product formed when bromine reacts with ethene?



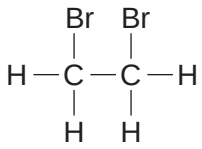
A



B



C



D

answer ..... [1]

7 The table gives some information about the properties of some metals.

metal	melting point /°C	colour of chloride
A	1890	pink
B	98	white
C	63	white
D	1535	brownish-black

(a) Which **two** of the metals **A** to **D** are transition metals?
Give a reason for your answer.

metals .....

reason ..... [2]

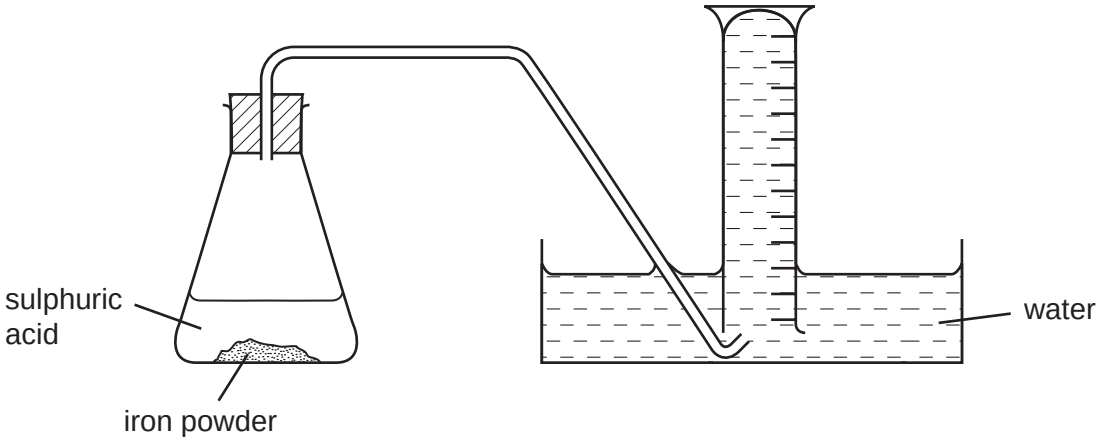
(b) When iron powder reacts with warm sulphuric acid, hydrogen is given off.

$$Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2$$

State the name of the salt made in this reaction.

..... [1]

(c) A student used the apparatus shown below for investigating the speed of the reaction between iron and sulphuric acid.



Describe how this apparatus can be used to investigate the speed of this reaction.

.....

.....

.....

..... [3]

(d) The student repeated the experiment with different concentrations of sulphuric acid.
In each experiment the mass of iron powder was the same and the temperature was kept at 30°C.
The results are shown in the table.

concentration of sulphuric acid / moles per dm^3	speed of reaction / cm^3 hydrogen per second
0.4	4.2
0.8	8.5
1.6	17.0

(i) Use the information in the table to help you work out how the speed of the reaction is affected by the concentration of sulphuric acid.

.....

.....

..... [2]

(ii) What will happen to the speed of the reaction if lumps of iron are used instead of iron powder?

..... [1]

(iii) What will happen to the speed of the reaction if it is carried out at 20°C rather than at 30°C?

.....

[1]

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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 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
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.).