Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY **0620/02**

Paper 2

May/June 2006

1 hour 15 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
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.
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	
1	
2	
3	
4	
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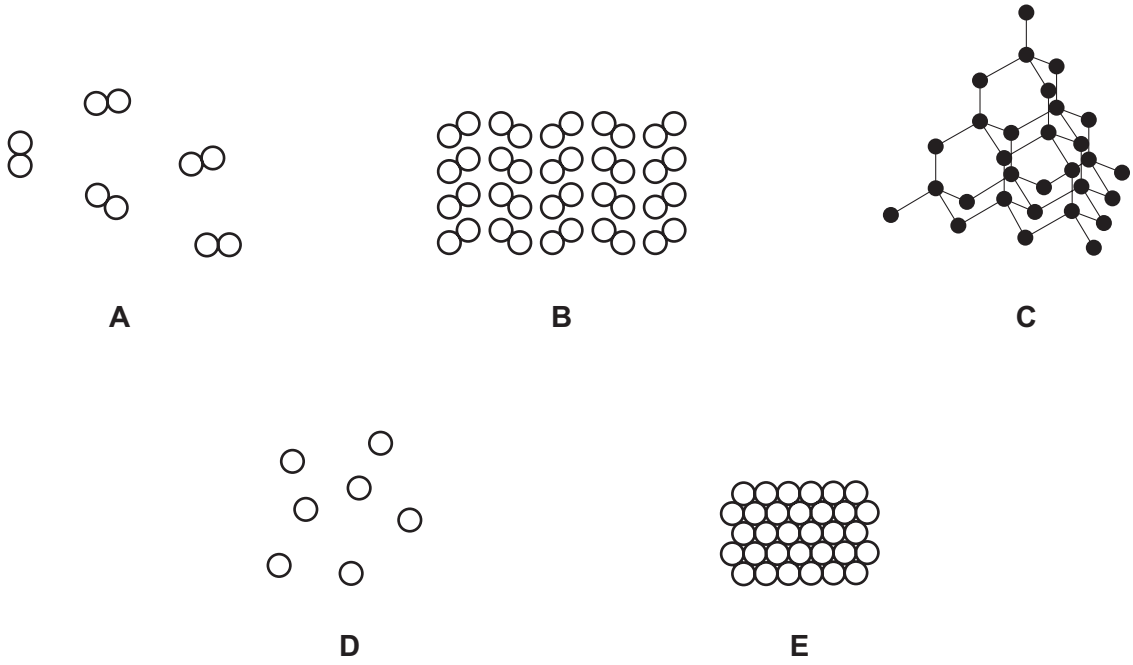
6	
Total	

This document consists of **15** printed pages and **1** blank page.

1 The diagram shows models of various elements.



(a) Define the term *element.*

.....

..... [1]

(b) Which **one** of the models **A** to **E** represents a solid containing diatomic molecules?

..... [1]

(c) Which **two** of the models **A** to **E** represent gases?

..... and ..... [1]

(d) (i) Which **one** of the models **A** to **E** represents diamond?

..... [1]

(ii) State the name of the element present in diamond.

..... [1]

(iii) State a use of diamond other than in jewellery.

..... [1]

(e) Structure **E** is a metal. State **three** physical properties which are characteristic of all metals.

.....

.....

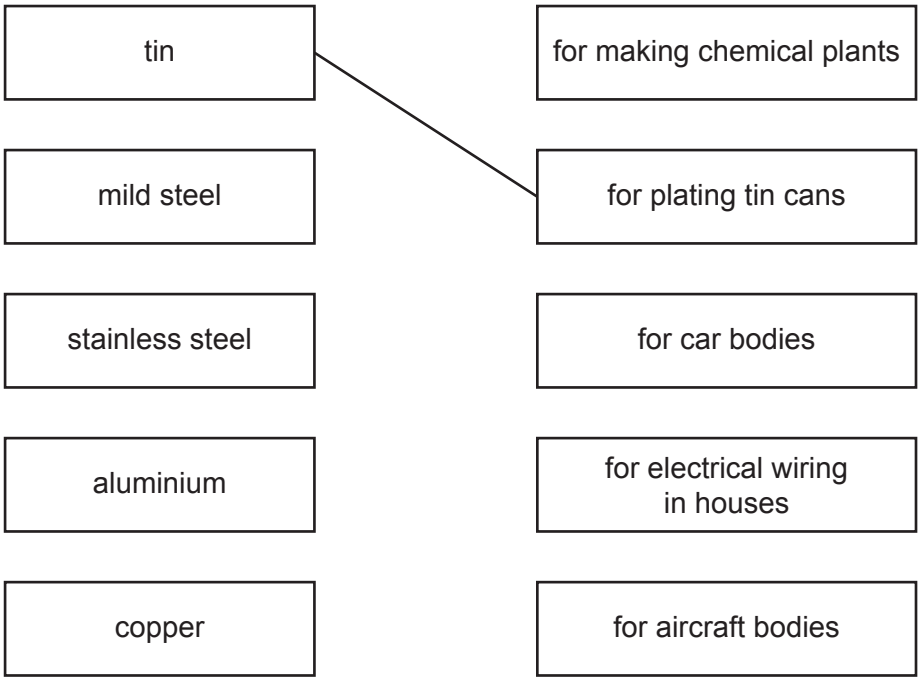
..... [3]

(f) Metals are sometimes mixed with other elements in order to change their properties.

(i) What is the name given to a mixture of metals with other elements?

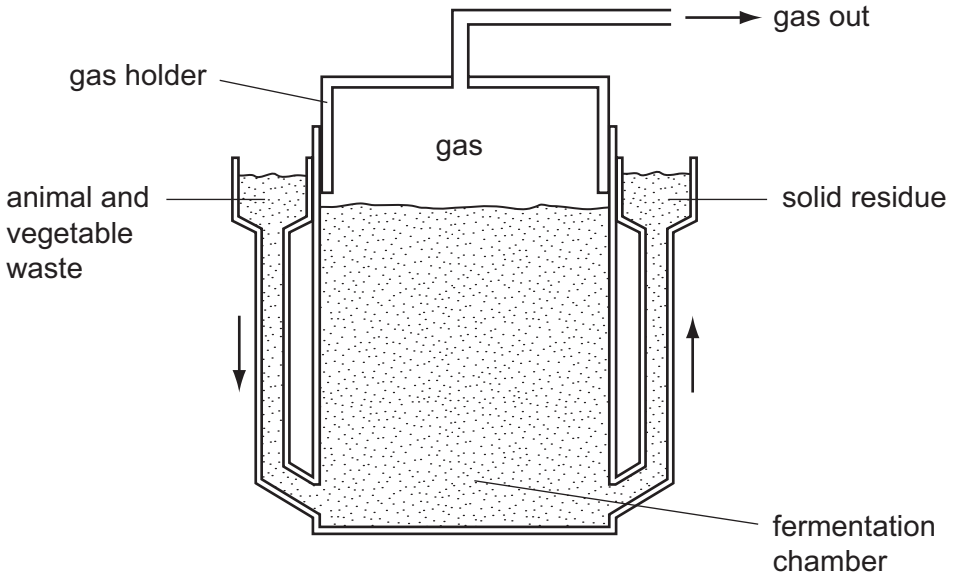
..... [1]

(ii) Match up the metals in the boxes on the left with their uses on the right. The first one has been done for you.



[4]

2 The diagram shows a biogas digester. Animal and vegetable waste is fermented by bacteria. The gas produced is a mixture of mainly carbon dioxide and methane.



(a) State the name given to the energy-releasing process in which organisms use food and produce carbon dioxide.

.....

[1]

(b) Hydrogen is also produced during the fermentation.
The hydrogen reacts with the carbon dioxide to form methane and oxygen.

(i) Complete the equation for this reaction.

$$CO_2 + 2H_2 \longrightarrow \text{.....} + \text{.....}$$

[2]

(ii) Suggest a use for the methane produced in this reaction.

.....

[1]

(iii) Describe the arrangement and motion of the molecules in methane gas.

arrangement .....

motion .....

[2]

(iv) State the name of the homologous series to which methane belongs.

.....

[1]

(v) Which **one** of the following compounds belongs to the same homologous series as methane?
Tick one box.

C_2H_4	C_2H_6	CH_3OH	CH_3CO_2H
☐	☐	☐	☐

[1]

(c) Which **one** of the following equations **A**, **B**, **C** or **D** describes fermentation?

A $CH_4 + H_2O \longrightarrow CO + 3H_2$

B $C_6H_{12}O_6 + 6O_2 \longrightarrow 6H_2O + 6CO_2$

C $C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$

D $C_6H_{14} \longrightarrow C_4H_{10} + C_2H_4$

..... [1]

(d) Many of the reactions occurring in the biogas digester are catalysed by enzymes.

(i) Suggest where the enzymes come from.

..... [1]

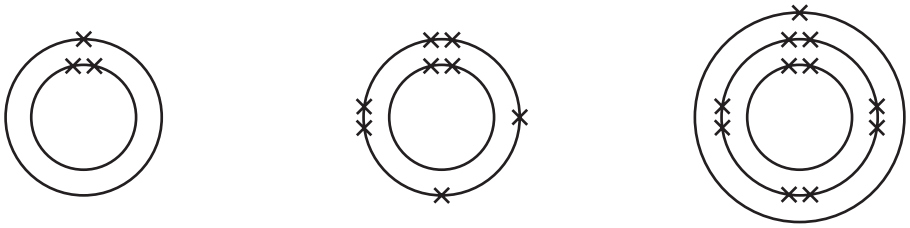
(ii) Define the term *catalysis*.

..... [1]

(e) The solid residue from the biogas digester can be used as a fertiliser.
State the names of **two** non-metallic elements found in fertilisers which are needed for plant growth.

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

3 The electronic structures of various atoms are shown below.



A **B** **C**

D **E**

(a) (i) Which **one** of these structures **A** to **E** represents a noble gas?

..... [1]

(ii) Which **two** of these structures represent atoms from the same Group of the Periodic Table?

..... and ..... [1]

(iii) Which **one** of these structures represents an atom with an atomic number of 8?

..... [1]

(iv) Which **one** of these structures forms a stable ion by gaining one electron?

..... [1]

(v) Which **one** of these structures is in Period 3 of the Periodic Table?

..... [1]

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

chlorine	**diamond**	**high**	**low**	**sharing**
sodium	**strong**	**transfer**	**weak**	

Covalent bonds are formed by the .....of pairs of electrons. Simple covalent molecules such as .....and bromine have ..... melting points. Giant covalent structures such as .....have many .....bonds and have high melting points. [5]

(c) The simplest covalent molecule is hydrogen.

(i) Draw a diagram to show how the electrons are arranged in a hydrogen molecule.

[1]

(ii) Describe a test for hydrogen.

test .....

result ..... [2]

4 Coal gas is made by heating coal in the absence of air.
The table shows the composition of coal gas.

name of gas	% of gas in coal gas
hydrogen	50
methane	30
carbon monoxide	7
carbon dioxide	4
nitrogen	4
ethene	3
oxygen	2

(a) (i) Which element in this table is a highly flammable gas?

..... [1]

(ii) Which compound in the table is an alkene?

..... [1]

(iii) Which compound in the table turns limewater milky?

..... [1]

(b) Describe a test you can use to distinguish between ethene and methane.

test .....

result with ethene .....

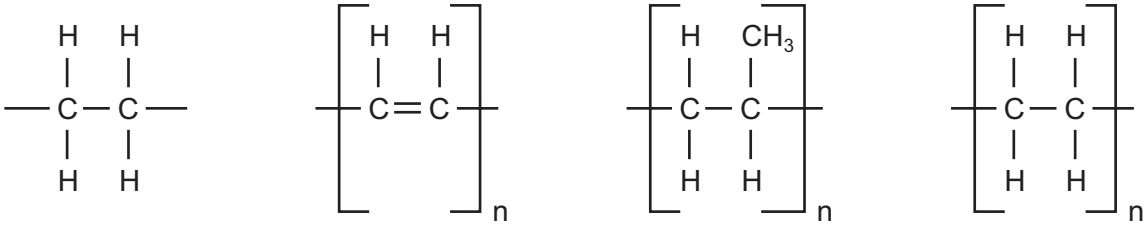
result with methane ..... [3]

(c) Molecules of ethene can react with each other to make poly(ethene).

(i) What is the name given to this type of reaction?

..... [1]

(ii) Which formula below best represents a molecule of poly(ethene)?
Tick one box.



☐ ☐ ☐ ☐

[1]

(d) Ethene can be manufactured by breaking down hydrocarbons into smaller molecules using high temperatures and a catalyst.
State the name given to this type of reaction.

..... [1]

(e) A liquid is also formed when coal is heated in the absence of air.
This liquid contains a high percentage of ammonia.

(i) Describe a test for ammonia.

test .....

result ..... [2]

(ii) Ammonia has the formula NH_3.
Calculate the relative molecular mass of ammonia.

[1]

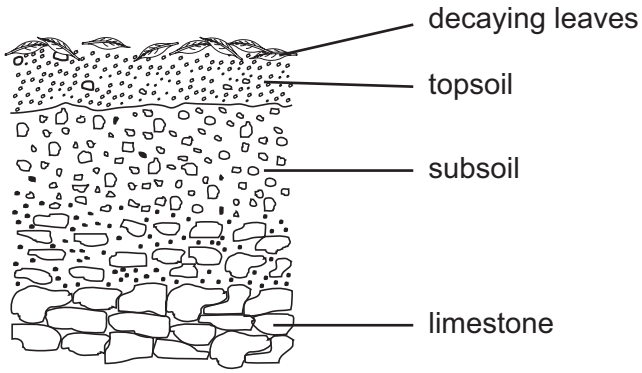
(f) Coal contains a small amount of sulphur.
Explain why burning coal is harmful to the environment.

.....

.....

..... [2]

5 The diagram shows a cross section of a soil.



(a) A student took 10 g of topsoil and shook it with 200 cm^3 of distilled water.

(i) How can the student separate the solids in the soil from the solution?

.....

[1]

(ii) The topsoil had a pH of 6.
Which of the following gives the best description of this pH?
Tick **one** box.

strongly acidic	☐
weakly acidic	☐
neutral	☐
weakly alkaline	☐

[1]

(b) The soil contained large amounts of calcium ions and carbonate ions.

(i) Use the information in the diagram to suggest where these ions came from.

..... [1]

(ii) Complete the word equation for the reaction of calcium carbonate with hydrochloric acid.

calcium carbonate + hydrochloric acid ⟶ calcium chloride + ... + ...

[2]

(c) The table shows the mass of each ion present in 200 cm^3 of soil solution.

ion	formula of ion	mass present/milligrams
calcium	Ca^{2+}	12
carbonate	CO_3^{2-}	20
iron(III)	Fe^{3+}	4
magnesium	Mg^{2+}	5
nitrate	NO_3^-	2
phosphate	PO_4^{3-}	1
others		6

(i) Which negative ion has the highest concentration in the soil solution?

..... [1]

(ii) Calculate the mass of iron(III) ions in one litre (1000 cm^3) of solution.

[1]

(iii) Which ion in the table will release ammonia when heated with aqueous sodium hydroxide and aluminium foil?

..... [1]

(iv) Describe a test for iron(III) ions.

test .....

result ..... [3]

(d) The air trapped in the soil has a different composition from the air in the atmosphere. The table shows the composition of the air in the soil.

gas	percentage of gas in soil air
carbon dioxide	2
nitrogen	82
oxygen	15
other gases	1

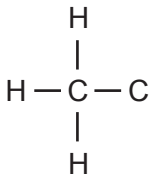
State how the composition of soil air compares with the composition of air in the atmosphere.

carbon dioxide .....

nitrogen .....

oxygen ..... [3]

(e) Decaying leaves produce ethanoic acid.
Complete the formula for ethanoic acid showing all atoms and bonds.



[1]

6 Iron is extracted from iron ore by heating the iron ore with coke and limestone.

(a) State the name of the ore from which iron is extracted.

.....

[1]

(b) The coke burns in a blast of hot air to form carbon monoxide.

(i) Complete the equation for this reaction.

$$.....C + O_2 \longrightarrow .....CO$$

[1]

(ii) State an adverse effect of carbon monoxide on human health if it were to escape from the blast furnace.

.....

[1]

(c) Near the top of the blast furnace, carbon monoxide reacts with iron ore.

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

(i) Write a word equation for this reaction.

[1]

(ii) What type of chemical reaction is the conversion of Fe_2O_3 to 2Fe?

.....

[1]

(d) The limestone is converted to calcium oxide and carbon dioxide by the intense heat in the furnace.

$$CaCO_3 \longrightarrow CaO + CO_2$$

(i) What type of chemical reaction is this?

..... [1]

(ii) Name a use of limestone other than in the blast furnace.

..... [1]

(iii) The calcium oxide reacts with silica and alumina in the iron ore.
The product of this reaction collects on top of the molten iron at the bottom of the furnace. What is the name of this product?
Put a ring around the correct answer.

bauxite **sand** **slag** **slaked lime**

[1]

(e) The iron obtained from the blast furnace contains the following impurities.

carbon **manganese** **phosphorus** **silicon**

(i) Which **one** of these elements is a transition element?

..... [1]

(ii) What type of oxide is phosphorus oxide?
Put a ring around the correct answer.

acidic **amphoteric** **basic** **neutral**

[1]

(iii) 50 tonnes of impure cast iron from the blast furnace contains 47 tonnes of iron. Calculate the percentage of the impurities in the cast iron.

[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.).