UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

* 0 7 1 0 0 1 9 5 7 8 *

CHEMISTRY **0620/22**

Paper 2 **May/June 2011**

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 need to use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

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.

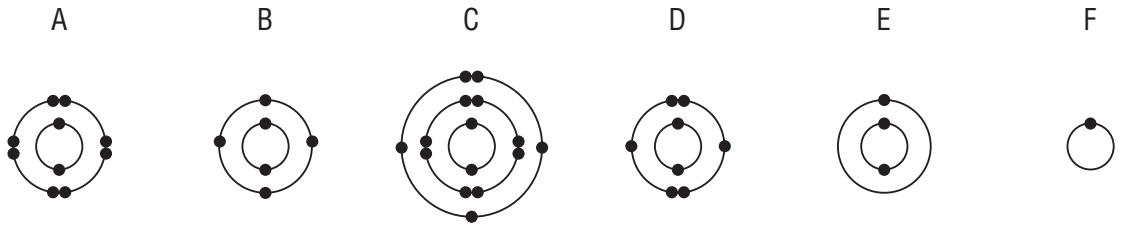
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Total	

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1 The diagram shows the electronic structures of six atoms.



(a) Answer the following questions by choosing from the structures **A**, **B**, **C**, **D**, **E** or **F**. You can use each structure once, more than once or not at all.

Which structure represents

(i) an atom in Period 3 of the Periodic Table, ☐

(ii) an atom containing six protons, ☐

(iii) an atom of a Group I metal, ☐

(iv) an atom of phosphorus, ☐

(v) an atom with six electrons in its outer shell, ☐

(vi) an atom with a complete outer shell of electrons? ☐

[6]

(b) Atoms **D** and **F** can combine to form a covalent molecule.

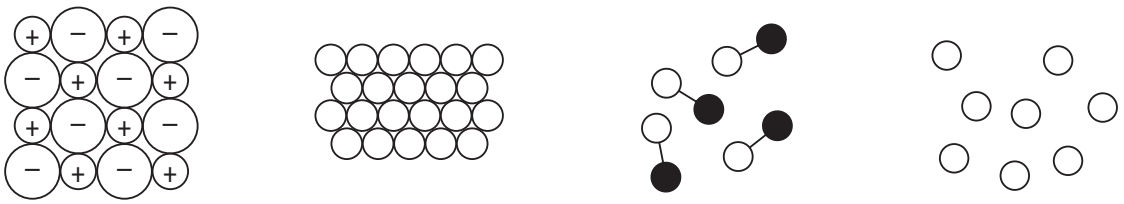
(i) Complete the following sentence using words from the list.

atoms **electrons** **ions** **neutrons** **solids**

A covalent bond is formed when a pair of ..... is shared between two ..... .

[2]

(ii) Which one of the following structures represents an ionic compound?
Tick **one** box.



☐ ☐ ☐ ☐

[1]

[Total: 9]

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2 Many metal oxides can be reduced with carbon.
The table shows the temperatures required to produce different metals from their oxides by heating with carbon.

reaction	temperature / °C
aluminium oxide → aluminium	2100
iron oxide → iron	425
nickel oxide → nickel	475
zinc oxide → zinc	925

(a) (i) Use the information in the table to arrange aluminium, iron, nickel and zinc in order of their reactivity.

least reactive → most reactive

[1]

(ii) Suggest why aluminium is extracted by electrolysis rather than by heating with carbon.

.....

..... [1]

(iii) State the name of the main ore of aluminium.

..... [1]

(b) Iron is extracted by heating iron ore with carbon in a blast furnace.

(i) Apart from iron ore and carbon (coke), state the names of **two** other raw materials used in the blast furnace for the extraction of iron.

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

(ii) Complete this equation for the reaction of iron(III) oxide with carbon.

$$Fe_2O_3 + ...CO \rightarrow .....Fe + 3CO_2$$

[2]

(iii) In the blast furnace, carbon dioxide reacts with red hot carbon to form carbon monoxide.

$$CO_2 + C \rightarrow 2CO$$

Which substance gets reduced during this reaction? Explain your answer.

.....

..... [2]

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(iv) State **one** adverse effect of carbon monoxide on health.

..... [1]

(v) The reaction between carbon dioxide and red hot carbon is endothermic.
What do you understand by the term *endothermic*?

..... [1]

(c) Iron is usually made into steel alloys.

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

.....

..... [1]

(ii) Mild steel is an alloy.
State **one** use of mild steel.

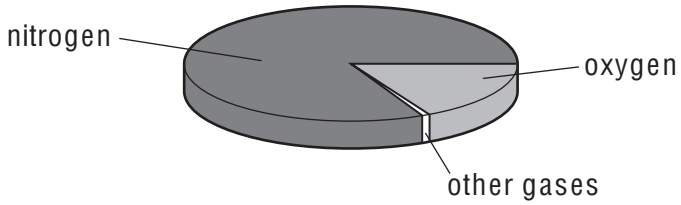
..... [1]

[Total: 13]

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3 The pie chart shows the composition of air.



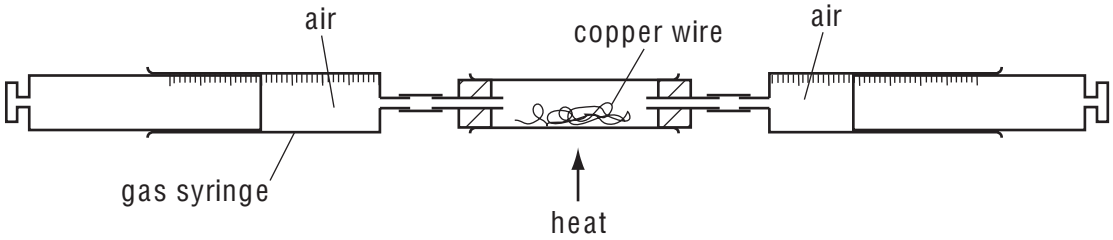
(a) (i) What is the percentage of nitrogen in the air?

..... [1]

(ii) Apart from nitrogen and oxygen, state the names of **two** gases present in unpolluted air.

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

(b) The percentage of oxygen in air can be found using the apparatus shown below.



Air is passed backwards and forwards over the heated copper using the syringes. The copper reacts with oxygen in the air.

$$\text{copper} + \text{oxygen} \rightarrow \text{copper(II) oxide}$$

As the experiment proceeds, suggest what happens to

(i) the total volume of air in the gas syringes,

..... [1]

(ii) the mass of the wire in the tube.

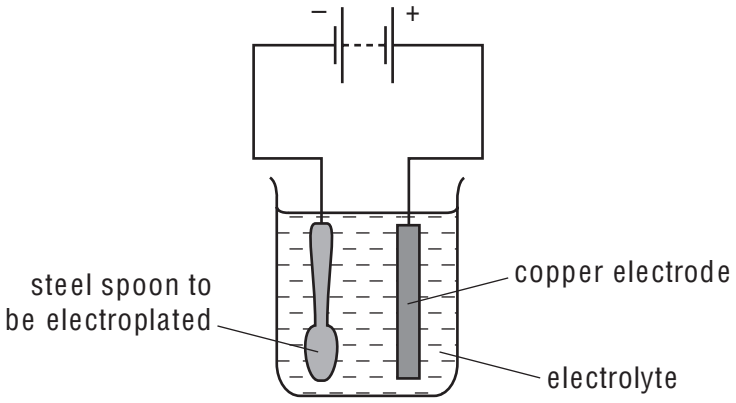
..... [1]

(c) State **one** use of copper.

..... [1]

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(d) A steel spoon can be electroplated using the apparatus shown.



Give a description of this electroplating.
In your answer, refer to:

- a suitable electrolyte that can be used;
- the anode and the cathode;
- changes to the spoon.

.....

.....

.....

.....

.....

..... [3]

[Total: 9]

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4 Ethanol can be produced by fermentation or by the catalytic addition of steam to ethene.

(a) (i) Complete the word equation for fermentation.

glucose → ..... + ethanol

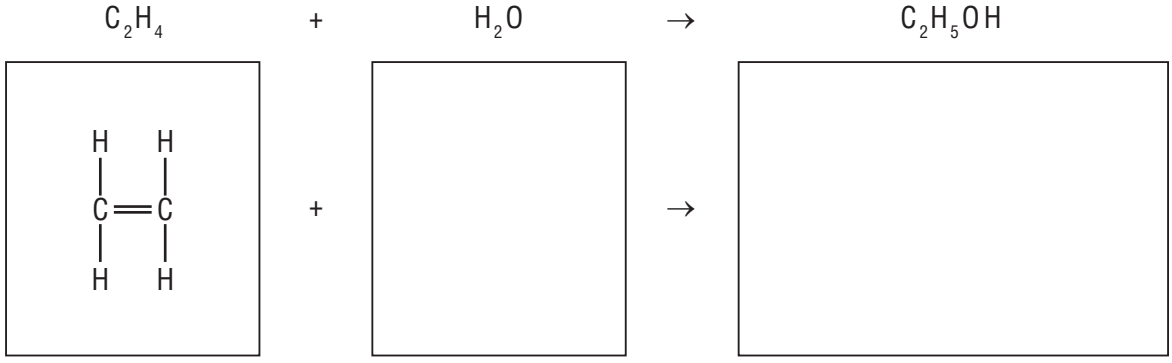
[1]

(ii) State the conditions needed for fermentation.

.....

..... [2]

(b) (i) Complete the equation for the catalytic addition of steam to ethene by drawing the structures of water and ethanol in the boxes.



[2]

(ii) Ethene is an unsaturated hydrocarbon.
Describe a test for an unsaturated hydrocarbon.

test .....

result ..... [2]

(c) Ethanol can be used as a fuel.
State the names of the products formed when ethanol undergoes complete combustion.

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

(d) Complete these sentences using words from the list.

different functional homologous similar unreactive unsaturated

Ethanol is a member of the alcohol ..... series.

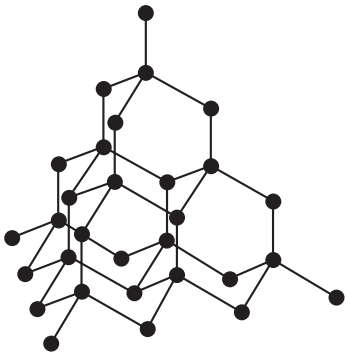
All alcohols have ..... chemical properties because they contain the same

..... group. [3]

[Total: 12]

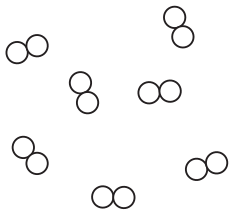
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5 The structures of diamond and chlorine are shown below.



diamond

● = carbon atom



chlorine

○ = chlorine atom

(a) Describe the structure of these two substances.
Use the list of words to help you.

covalent **diatomic** **giant** **macromolecule** **molecule** **structure**

diamond .....

.....

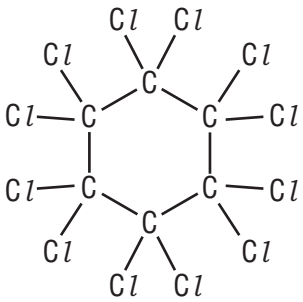
.....

chlorine .....

.....

..... [4]

(b) The structure of a compound containing carbon and chlorine is shown below.



What is the molecular formula of this compound?

..... [1]

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(c) Chlorine is a halogen.

(i) State the colour of chlorine.

..... [1]

The table shows some properties of the halogens.

element	boiling point / °C	density in liquid state / g per cm^3	colour
fluorine	–188	1.51	yellow
chlorine	–35	1.56	
bromine	–7		red-brown
iodine	+114	4.93	grey-black

Use the information in the table to answer the following questions.

(ii) Predict the density of liquid bromine.

..... [1]

(iii) Describe the trend in boiling point of the halogens down the group.

..... [1]

(d) **(i)** Complete the word equation for the reaction of bromine with aqueous potassium iodide.

bromine + potassium iodide → ..... + ...

.....

[2]

(ii) Explain why bromine does **not** react with aqueous potassium chloride.

..... [1]

(e) Potassium chloride is an ionic substance but iodine is a molecular substance.
How do most ionic and molecular substances differ in their

solubility in water, ...

.....

electrical conductivity? .....

..... [2]

[Total: 13]

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6 Iron(II) sulfate is a light green salt.

(a) Describe how you can prepare pure dry crystals of iron(II) sulfate from iron powder and dilute sulfuric acid.

.....

.....

.....

.....

..... [3]

(b) The formula for iron(II) sulfate is $FeSO_4.7H_2O$.

(i) What is the meaning of the symbol (II) in this formula?

..... [1]

(ii) Describe a test for iron(II) ions.

test .....

result ..... [3]

(iii) A student warmed a sample of iron(II) sulfate, $FeSO_4.7H_2O$, in a test-tube. Drops of a colourless liquid appeared at the mouth of the test-tube and the iron(II) sulfate turned white.
Explain these observations.

..... [1]

(iv) The reaction in part **(iii)** can be reversed.
Write down the symbol which shows that a reaction is reversible.

[1]

(c) Many centuries ago, sulfuric acid was made from iron(II) sulfate.
Sulfuric acid is a typical acid.

(i) Describe what you would observe when sulfuric acid is added to

blue litmus paper, ...

iron powder. ..... [2]

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(ii) Farmers can add a solution of dilute sulfuric acid to their fields if the soil is too alkaline.
Explain why farmers do **not** want their fields to become too alkaline.

..... [1]

(iii) Which **one** of the following pH values best describes a solution which is slightly alkaline?
Put a ring around the correct answer.

pH 1 **pH 6** **pH 7** **pH 8** **pH 14**

[1]

(iv) Give the name of a compound which farmers add to the soil to make it less acidic.

..... [1]

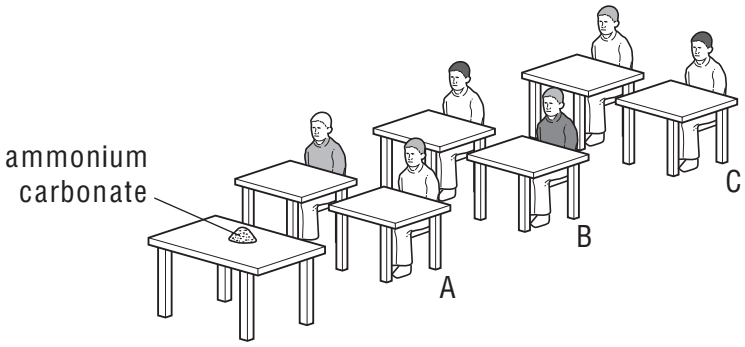
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7 Smelling salts are sometimes used to 'wake up' people who feel faint.
The main chemical in smelling salts is ammonium carbonate. Ammonium carbonate breaks down slowly at room temperature to release ammonia gas.

ammonium carbonate $\rightarrow$ ammonia + carbon dioxide + water

(a) A few crystals of ammonium carbonate were put on a bench at the front of a classroom.



The students in row **A** could smell the ammonia 10 seconds after the smelling salts had been put on the bench. The students in row **C** could smell the ammonia after 40 seconds.

(i) Suggest how long it took the students in row **B** to smell the ammonia.

..... [1]

(ii) Explain these results using ideas about moving particles.

.....

.....

..... [3]

(b) Ammonium carbonate has the formula $(NH_4)_2CO_3$.
Calculate the relative formula mass of ammonium carbonate.

[1]

(c) Ammonia is used to make fertilisers such as ammonium sulfate.

(i) State the names of the **three** chemical elements, essential for plant growth, that are present in fertilisers.

..... [3]

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(ii) Which one of the following statements about ammonium sulfate is correct? Tick **one** box.

When ammonium sulfate is heated with sodium hydroxide, carbon dioxide is given off. ☐

When ammonium sulfate is added to a solution of barium chloride, a blue precipitate is formed. ☐

Ammonium sulfate can be made by adding sulfuric acid to ammonia. ☐

Farmers add ammonium sulfate to the soil to make it alkaline. ☐

[1]

(d) Ammonium carbonate is made by heating ammonium sulfate with excess calcium carbonate.

ammonium sulfate + calcium carbonate $\rightarrow$ ammonium carbonate + calcium sulfate

When 132 g of ammonium sulfate is reacted with calcium carbonate, 96 g of ammonium carbonate is formed.
Calculate the mass of ammonium sulfate needed to make 240 g of ammonium carbonate.

[1]

[Total: 10]

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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
3	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
11	23 Na Sodium	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
19	39 K Potassium	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
37	85 Rb Rubidium	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
55	133 Cs Caesium	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
87	Fr Francium	226 Ra Radium 88	227 Ac Actinium 89 †															

*58-71 Lanthanoid 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
†90-103 Actinoid series	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

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.).

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