Centre Number	Candidate Number	Name

CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY 0620/03

Paper 3

May/June 2003

1 hour 15 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your name, Centre number and candidate number in the spaces provided at the top of this page.
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 question.
A copy of the Periodic Table is provided 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	
1	
2	
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TOTAL	

This document consists of **12** printed pages.

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Local Examinations Syndicate

[Turn over

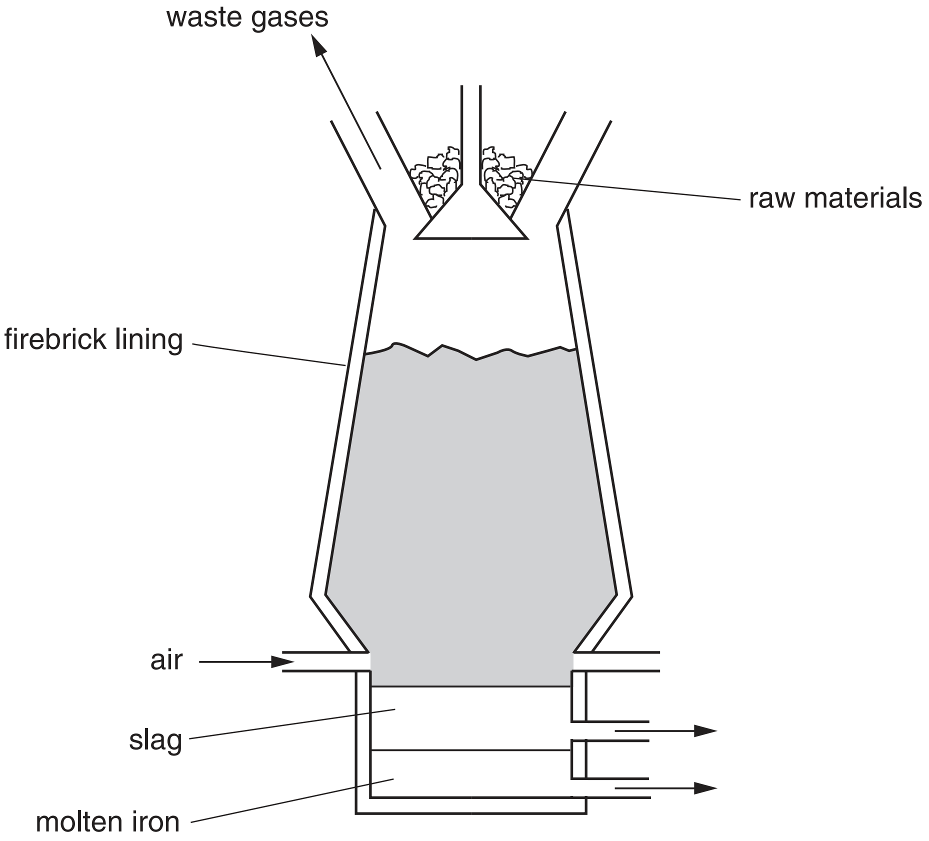
1 No one knows where iron was first isolated. It appeared in China, the Middle East and in Africa. It was obtained by reducing iron ore with charcoal.

(a) Complete the following equation.

$$\underset{\text{iron ore}}{Fe_2O_3} + \underset{\text{charcoal}}{C} \rightarrow \text{..................} + \text{.......................}$$

[2]

(b) In 1705 Abraham Darby showed that iron ore could be reduced using coke in a blast furnace.



(i) The temperature in the furnace rises to 2000 °C. Write an equation for the exothermic reaction that causes this high temperature.

....

(ii) In the furnace, the ore is reduced by carbon monoxide. Explain how this is formed.

....

....[3]

(c) The formation of slag removes an impurity in the ore. Write a word equation for the formation of the slag.

....[2]

(d) Stainless steel is an alloy of iron. It contains iron, other metals and about 0.5% of carbon.

(i) State a use of stainless steel.

....

(ii) Name a metal, other than iron, in stainless steel.

....

(iii) The iron from the blast furnace is impure. It contains about 5% of carbon and other impurities, such as silicon and phosphorus. Describe how the percentage of carbon is reduced and the other impurities are removed.

....

....

....[6]

(e) One of the methods used to prevent iron or steel from rusting is to electroplate it with another metal, such as tin. Complete the following.

The anode is made of ....

The cathode is made of ....

The electrolyte is a solution of ....

[3]

2 Calcium and other minerals are essential for healthy teeth and bones. Tablets can be taken to provide these minerals.

Healthy Bones

Each tablet contains

calcium
magnesium
zinc
copper
boron

(a) Boron is a non-metal with a macromolecular structure.

(i) What is the valency of boron?

....

(ii) Predict **two** physical properties of boron.

....

....

(iii) Name another element and a compound that have macromolecular structures.

element …………………..

compound ………………………

(iv) Sketch the structure of one of the above macromolecular substances.

[7]

(b) Describe the reactions, if any, of zinc and copper(II) ions with an excess of aqueous sodium hydroxide.

(i) zinc ions

addition of aqueous sodium hydroxide ....

....

excess sodium hydroxide ....

....

(ii) copper(II) ions

addition of aqueous sodium hydroxide ....

....

excess sodium hydroxide ....

....[4]

(c) Each tablet contains the same number of moles of $CaCO_3$ and $MgCO_3$. One tablet reacted with excess hydrochloric acid to produce 0.24 dm^3 of carbon dioxide at r.t.p.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$
$$MgCO_3 + 2HCl \rightarrow MgCl_2 + CO_2 + H_2O$$

(i) Calculate how many moles of $CaCO_3$ there are in one tablet.

number of moles CO_2 = ...

number of moles of $CaCO_3$ and $MgCO_3$ = ...

number of moles of $CaCO_3$ = ...

[3]

(ii) Calculate the volume of hydrochloric acid, 1.0 mol / dm^3, needed to react with one tablet.

number of moles of $CaCO_3$ and $MgCO_3$ in one tablet = ...
Use your answer to **(c)(i)**.

number of moles of HCl needed to react with one tablet = ...

volume of hydrochloric acid, 1.0 mol / dm^3, needed to react with one tablet = ...

[2]

[Turn over

3 Alkenes are unsaturated hydrocarbons. They undergo addition reactions.

(a) Two of the methods of making alkenes are cracking and the thermal decomposition of chloroalkanes.

(i) Complete an equation for the cracking of the alkane, decane.

$C_{10}H_{22}$ → .... + ...
decane

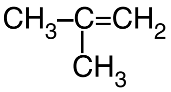
(ii) Propene can be made by the thermal decomposition of chloropropane.
Describe how chloropropane can be made from propane.

reagents propane and ....

conditions .... [4]

(b) The following alkenes are isomers.

$CH_3–CH_2–CH=CH_2$



$CH_3–\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2$

(i) Explain why they are isomers.

....

....

(ii) Give the name and structural formula of another hydrocarbon that is isomeric with the above.

name ....

structural formula

[4]

(c) Give the name of the product when but-1-ene reacts with each of the following.

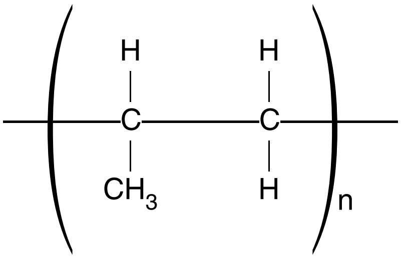
steam ....

hydrogen ....

bromine .... [3]

(d) Alkenes can polymerise.

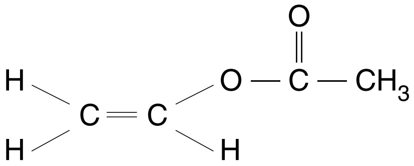
(i) Deduce the name and structural formula of the monomer from the structure of the polymer.



name of monomer ....

structural formula

(ii) Draw the structure of the polymer formed from the following monomer.



[4]

[Turn over

(iii) Describe the pollution problems caused by the disposal of polymers in landfill sites and by burning.

landfill sites ....

....[2]

burning ....

....[1]

4 Nitrogen dioxide, NO_2, is a dark brown gas.

(a) Most metal nitrates decompose when heated to form the metal oxide, nitrogen dioxide and oxygen.

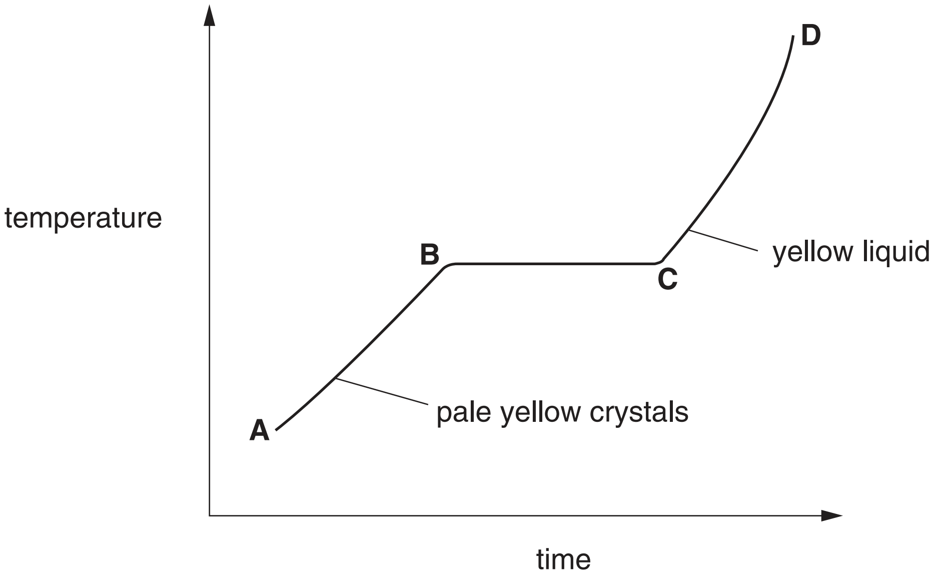
(i) Write a symbol equation for the decomposition of lead(II) nitrate.

$Pb(NO_3)_2 \rightarrow$ .... + ... + ... [2]

(ii) Potassium nitrate does not form nitrogen dioxide on heating. Write the word equation for its decomposition.

....[1]

(b) When nitrogen dioxide is cooled, it forms a yellow liquid and then pale yellow crystals. These crystals are heated and the temperature is measured every minute. The following graph can be drawn.



(i) Describe the arrangement and movement of the molecules in the region **A**–**B**.

....

....

(ii) Name the change that occurs in the region **B**–**C**

....[4]

(c) Nitrogen dioxide and other oxides of nitrogen are formed in car engines.

(i) Explain how these oxides are formed.

....

....

(ii) How are they removed from the exhaust gases?

....

....[4]

(d) Nitrogen dioxide, oxygen and water react to form dilute nitric acid.
Describe how lead(II) nitrate crystals could be prepared from dilute nitric acid and lead(II) oxide.

....

....

....[3]

5 The first three elements in Period 6 of the Periodic Table of the Elements are caesium, barium and lanthanum.

(a) How many **more** protons, electrons and neutrons are there in one atom of lanthanum than in one atom of caesium. Use your copy of the Periodic Table of the Elements to help you.

number of protons ....

number of electrons ....

number of neutrons .... [3]

(b) All three metals can be obtained by the electrolysis of a molten halide. The electrolysis of the aqueous halides does not produce the metal.

(i) Complete the equation for the reduction of lanthanum ions at the negative electrode (cathode).

La^{3+} + ... → ....

(ii) Name the **three** products formed by the electrolysis of aqueous caesium bromide.

....

....[4]

(c) All three metals react with cold water. Complete the word equation for these reactions.

metal + water → .... + ... [2]

(d) Barium chloride is an ionic compound. Draw a diagram that shows the formula of the compound, the charges on the ions and gives the arrangement of the valency electrons around the negative ion.
The electron distribution of a barium atom is 2.8.18.18.8.2

Use x to represent an electron from a barium atom.
Use o to represent an electron from a chlorine atom.

[2]

(e) Describe, by means of a simple diagram, the lattice structure of an ionic compound, such as caesium chloride.

[2]

(f) The reactions of these metals with oxygen are exothermic.

$$2Ba(s) + O_2(g) \rightarrow 2BaO(s)$$

(i) Give an example of bond forming in this reaction.

....

(ii) Explain using the idea of bond breaking and forming why this reaction is exothermic.

....

....[3]

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** Radium 88	227 **Ac** Actinium 89 †															

*58-71 Lanthanoid series
†90-103 Actinoid 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
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 **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.).