

Centre Number	Candidate Number	Name
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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.

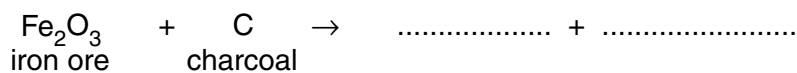
If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

For Examiner's Use	
1	
2	
3	
4	
5	
TOTAL	

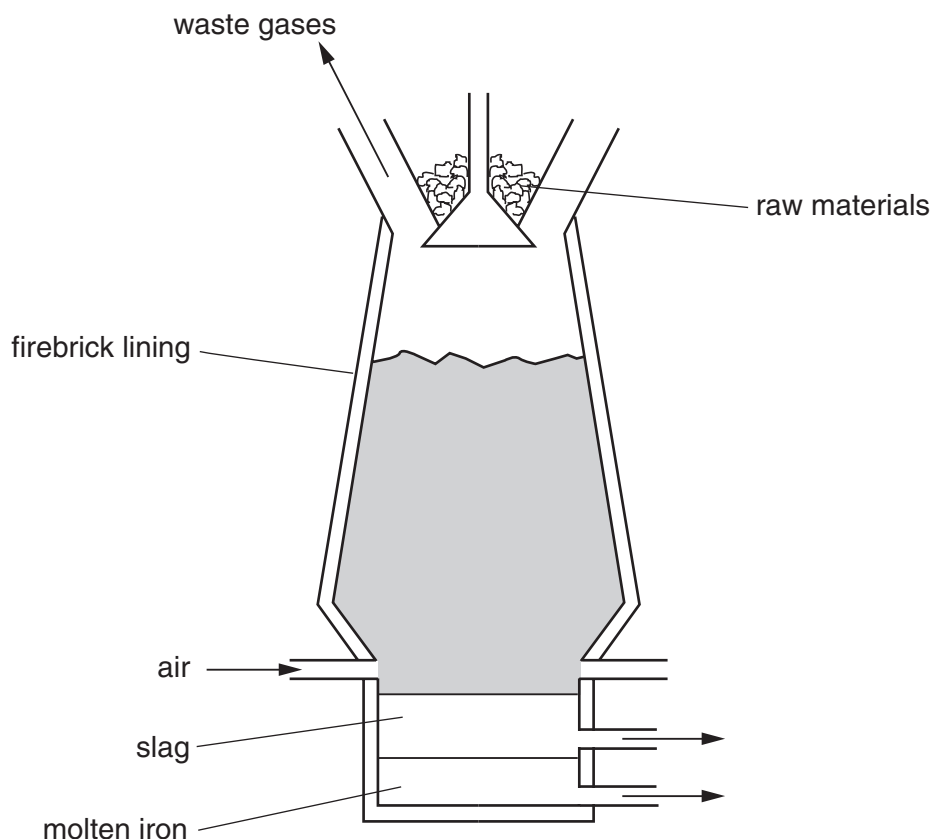
- 1 No one knows where iron was first isolated. It appeared in China, the East and in Africa. It was obtained by reducing iron ore with charcoal.

(a) Complete the following equation.



[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.

.....

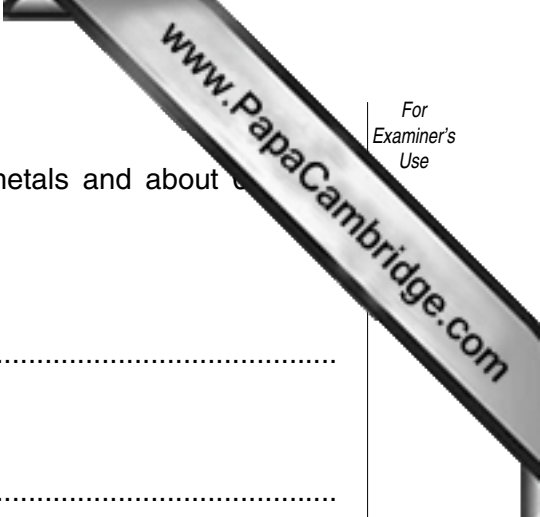
- (ii) In the furnace, the ore is reduced by carbon monoxide. Explain how this is formed.

.....

.....[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 0.02% 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 used 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.

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

(i) zinc ions

addition of aqueous sodium hydroxide

.....

excess sodium hydroxide

.....

(ii) copper(II) ions

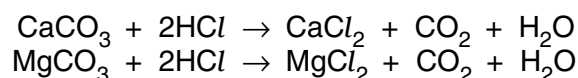
addition of aqueous sodium hydroxide

.....

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.



(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 =

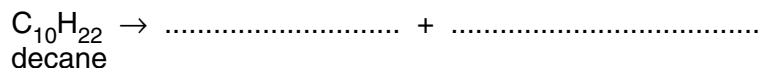
volume of hydrochloric acid, 1.0 mol/dm^3 , needed to react with one tablet =

[2]

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.



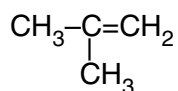
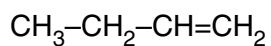
(ii) Propene can be made by the thermal decomposition of chloropropane. Describe how chloropropane can be made from propane.

reagents propane and

conditions

[4]

(b) The following alkenes are isomers.



(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

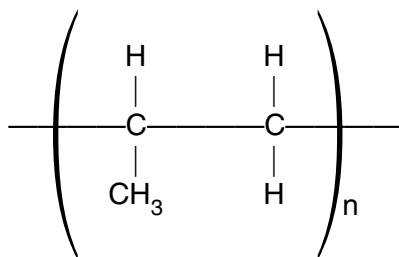
hydrogen

bromine

[3]

(d) Alkenes can polymerise.

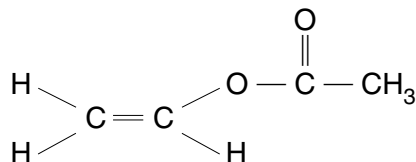
(i) Deduce the name and structural formula of the monomer from the structure of the polymer.



name of monomer

structural formula

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



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

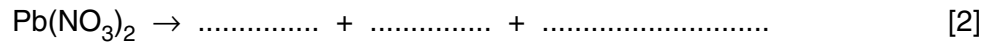
landfill sites
.....[2]

burning
.....[1]

4 Nitrogen dioxide, NO₂, is a dark brown gas.

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

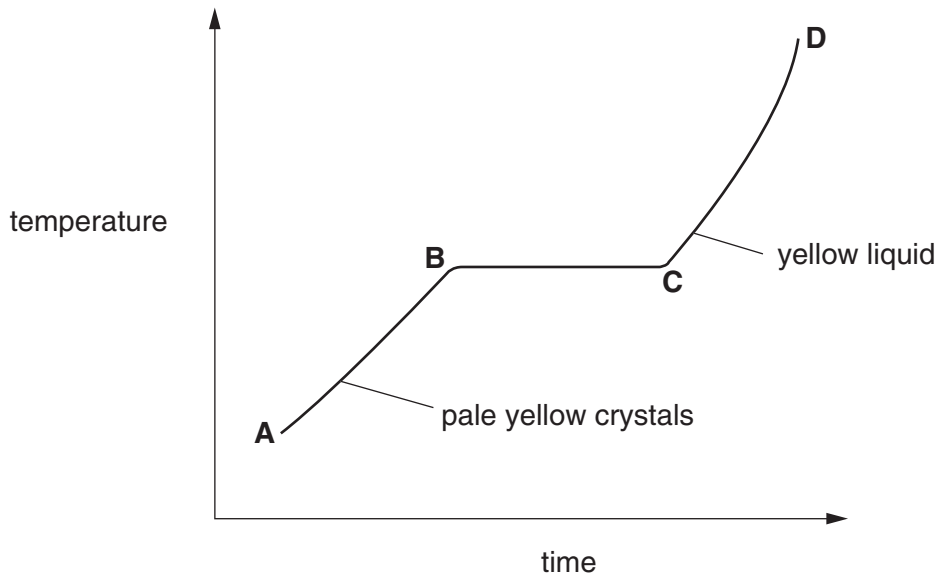
- (i) Write a symbol equation for the decomposition of lead(II) nitrate.



- (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

.....

(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).



(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 \rightarrow + [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.

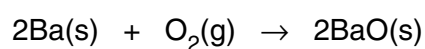
Use o to represent an electron from a chlorine atom.

[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.



- (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	O																											
7 Li Lithium 3	9 Be Beryllium 4	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>1 H Hydrogen 1</td> <td colspan="10"></td> </tr> <tr> <td>4 He Helium 2</td> <td colspan="10"></td> </tr> </table>										1 H Hydrogen 1											4 He Helium 2											20 Ne Neon 10
1 H Hydrogen 1																																		
4 He Helium 2																																		
23 Na Sodium 11	24 Mg Magnesium 12	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	35.5 Cl Chlorine 17	40 Ar Argon 18																										
39 K Potassium 19	40 Ca Calcium 20	27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	33 Se Selenium 34	79 Br Bromine 35	84 Kr Krypton 36																										
85 Rb Rubidium 37	88 Sr Strontium 38	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	76 Se Selenium 34	112 Cd Cadmium 48	127 I Iodine 53	131 Xe Xenon 54																										
133 Cs Caesium 55	137 Ba Barium 56	65 Zn Zinc 30	64 Cu Copper 29	66 Ni Nickel 28	68 Ag Silver 47	201 Hg Mercury 80	209 Pb Lead 82	210 Bi Bismuth 83																										
226 Ra Radium 88	227 Ac Actinium 89	56 Fe Iron 26	59 Co Cobalt 27	58 Ni Nickel 28	60 Cd Cadmium 48	197 Au Gold 79	207 Pb Lead 82	208 Bi Bismuth 83																										

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	175 Lu Lutetium 71
232 Th Thorium 90	238 U Uranium 92	91 Pa Protactinium 91	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102

3-71 Lanthanoid series
0-103 Actinoid series

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).