

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	
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TOTAL	

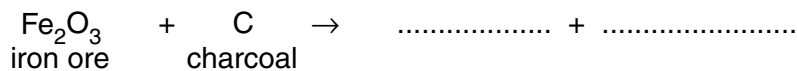
This document consists of **12** printed pages.



2

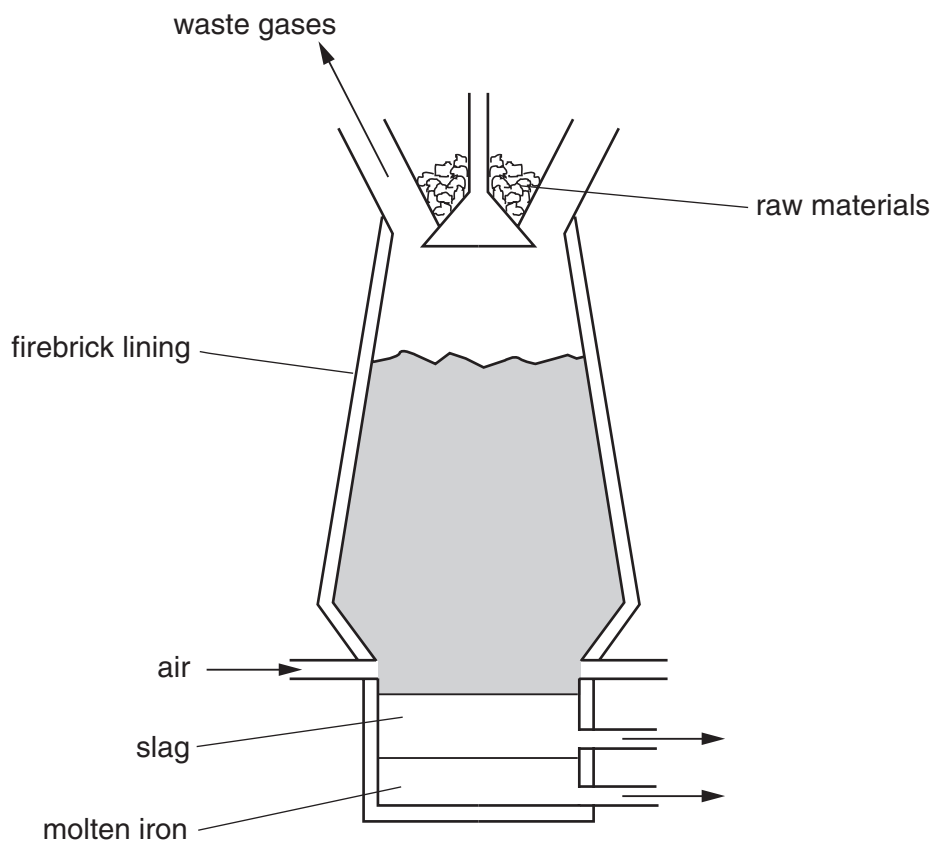
- 1 No one knows where iron was first isolated. It appeared in China, the Middle East and in Africa. It was obtained by reducing iron ore with charcoal.

(a) Complete the following equation.



[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

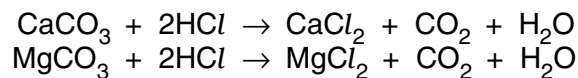
addition of aqueous sodium hydroxide

.....

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.



(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 =

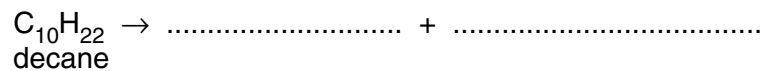
[2]

6

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.



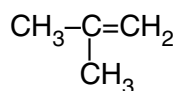
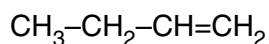
(ii) Propene can be made by the thermal decomposition of chloropropane. Describe how chloropropane can be made from propane.

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

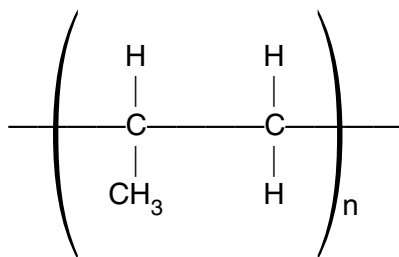
hydrogen

bromine

[3]

(d) Alkenes can polymerise.

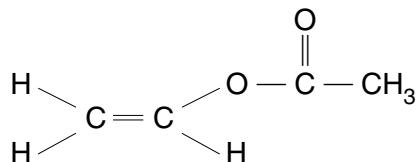
(i) Deduce the name and structural formula of the monomer from the structure of the polymer.



name of monomer

structural formula

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



8

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

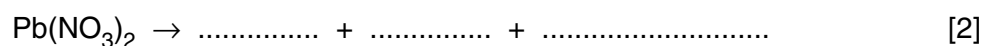
landfill sites
[2]

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.

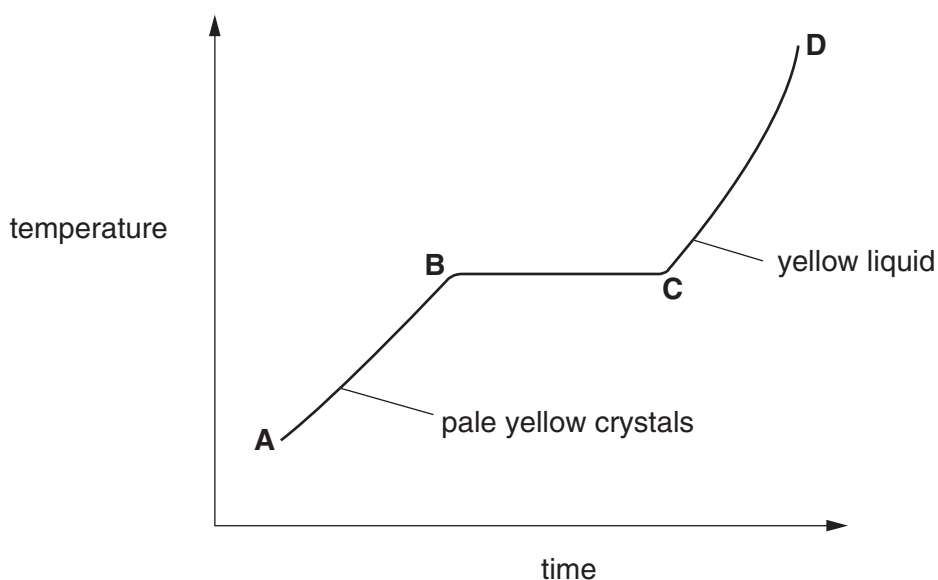
- (i) Write a symbol equation for the decomposition of lead(II) nitrate.



- (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).



(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.



(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.

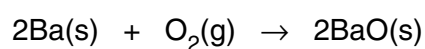
Use o to represent an electron from a chlorine atom.

[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	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulphur 16	17 Cl Chlorine 17	18 Ar Argon 18	19 F Fluorine 9	20 Ne Neon 10	4 He Helium 2																				
23 Na Sodium 11	24 Mg Magnesium 12	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36																				
39 K Potassium 19	40 Ca Calcium 20	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54																		
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	90 Zr Zirconium 40	91 Ni Nickelium 41	92 Hf Hafnium 72	93 Ta Tantalum 73	94 W Tungsten 74	95 Re Rhenium 75	96 Os Osmium 76	97 Ir Iridium 77	98 Pt Platinum 78	99 Au Gold 79	100 Hg Mercury 80	101 Tl Thallium 81	102 Pb Lead 82	103 Bi Bismuth 83	104 Po Polonium 84	105 At Astatine 85	106 Rn Radon 86														
133 Cs Caesium 55	137 Ba Barium 56	138 La Lanthanum 57	139 Ce Cerium 58	140 Pr Praseodymium 59	141 Nd Neodymium 60	142 Pm Promethium 61	143 Sm Samarium 62	144 Eu Europium 63	145 Gd Gadolinium 64	146 Tb Terbium 65	147 Dy Dysprosium 66	148 Ho Holmium 67	149 Er Erbium 68	150 Tm Thulium 69	151 Yb Ytterbium 70	152 Lu Lutetium 71	153 Fr Francium 87	154 Ra Radium 88	155 Ac Actinium 89	156 Th Thorium 90	157 Pa Protactinium 91	158 U Uranium 92	159 Np Neptunium 93	160 Pu Plutonium 94	161 Am Americium 95	162 Cm Curium 96	163 Bk Berkelium 97	164 Cf Californium 98	165 Es Einsteinium 99	166 Fm Fermium 100	167 Md Mendelevium 101	168 No Nobelium 102	169 Lr Lawrencium 103

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

Key

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

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