



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CHEMISTRY

0620/31

Paper 3 (Extended)

October/November 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 on all the work you hand in.

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.

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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

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



1 This question is concerned with the following oxides.

- sulfur dioxide
- carbon monoxide
- lithium oxide
- aluminium oxide
- nitrogen dioxide
- strontium oxide

(a) (i) Which of the above oxides will react with hydrochloric acid but not with aqueous sodium hydroxide?

..... [1]

(ii) Which of the above oxides will react with aqueous sodium hydroxide but not with hydrochloric acid?

..... [1]

(iii) Which of the above oxides will react with both hydrochloric acid and aqueous sodium hydroxide?

..... [1]

(iv) Which of the above oxides will not react with hydrochloric acid or with aqueous sodium hydroxide?

..... [1]

(b) Two of the oxides are responsible for acid rain.
Identify the **two** oxides and explain their presence in the atmosphere.

.....
.....
.....
.....
..... [5]

(c) Lithium oxide is an ionic compound.

(i) Identify another ionic oxide in the list on page 3.

..... [1]

(ii) Draw a diagram which shows the formula of lithium oxide, the charges on the ions and the arrangement of the valency electrons around the negative ion.
Use x to represent an electron from an atom of oxygen.
Use o to represent an electron from an atom of lithium.

[2]

[Total: 12]

2 Two important greenhouse gases are methane and carbon dioxide.

(a) Methane is twenty times more effective as a greenhouse gas than carbon dioxide. The methane in the atmosphere comes from both natural and industrial sources.

(i) Describe **two** natural sources of methane.

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

(ii) Although methane can persist in the atmosphere for up to 15 years, it is eventually removed by oxidation. What are the products of this oxidation?

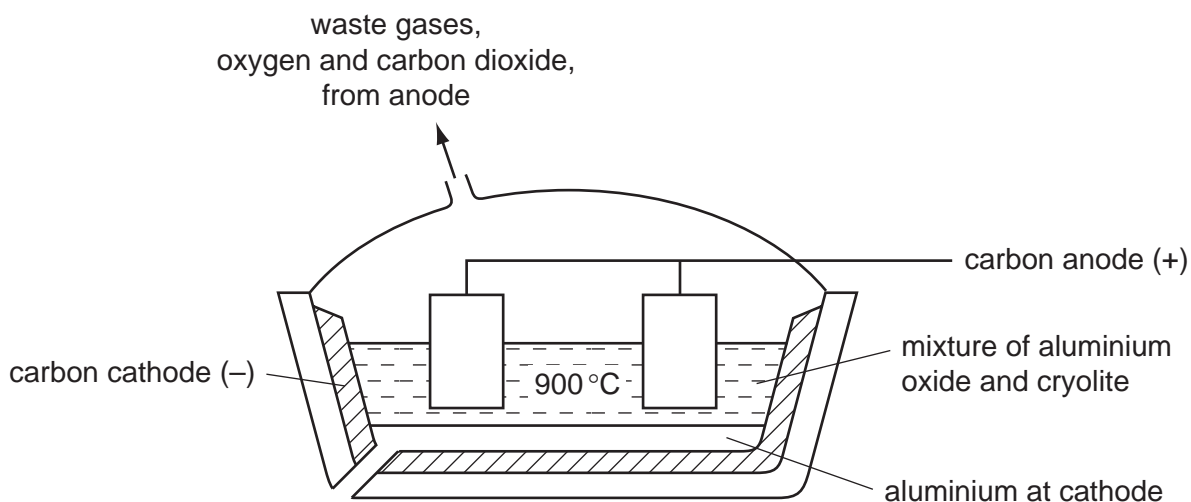
..... [2]

(b) How do the processes of respiration, combustion and photosynthesis determine the percentage of carbon dioxide in the atmosphere?

.....
.....
.....
..... [4]

[Total: 8]

- 3 Aluminium is extracted by the electrolysis of a molten mixture of alumina, which is aluminium oxide, and cryolite.



- (a) (i) Alumina is obtained from the main ore of aluminium.
Name this ore.

..... [1]

- (ii) Explain why it is necessary to use a mixture, alumina and cryolite, rather than just alumina.

.....

..... [2]

- (iii) Copper can be extracted by the electrolysis of an aqueous solution.
Suggest why the electrolysis of an aqueous solution cannot be used to extract aluminium.

.....

.....

..... [2]

- (b) The ions which are involved in the electrolysis are Al^{3+} and O^{2-} . The products of this electrolysis are given on the diagram.
Explain how they are formed. Use equations where appropriate.

.....

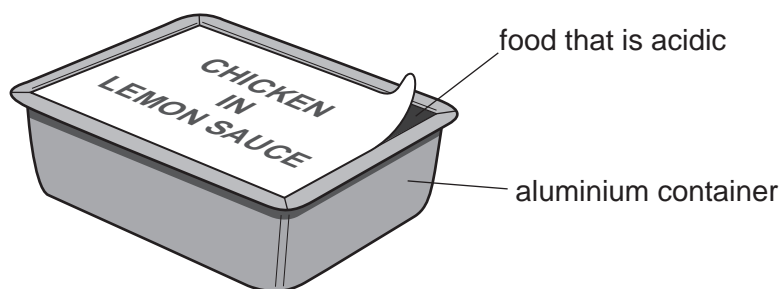
.....

.....

..... [4]

(c) The uses of a metal are determined by its properties.

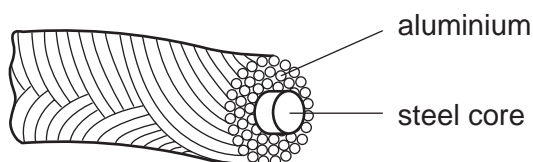
(i) Foods which are acidic can be supplied in aluminium containers.



Explain why the acid in the food does not react with the aluminium.

.....
 [1]

(ii) Explain why overhead electrical power cables are made from aluminium with a steel core.

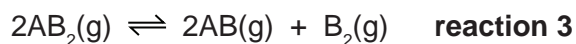


.....

 [3]

[Total: 13]

- 4 Reversible reactions can come to equilibrium. The following are three examples of types of gaseous equilibria.



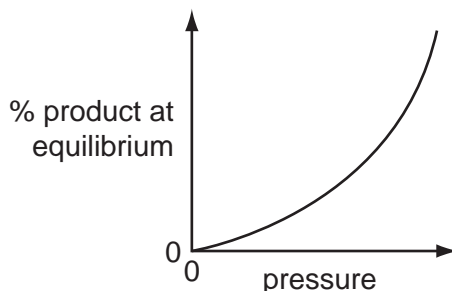
- (a) Explain the term *equilibrium*.

.....
 [2]

- (b) The following graphs show how the percentage of products of a reversible reaction at equilibrium could vary with pressure.

For each graph, decide whether the percentage of products decreases, increases or stays the same when the pressure is **increased**, then match each graph to one of the above reactions and give a reason for your choice.

(i)



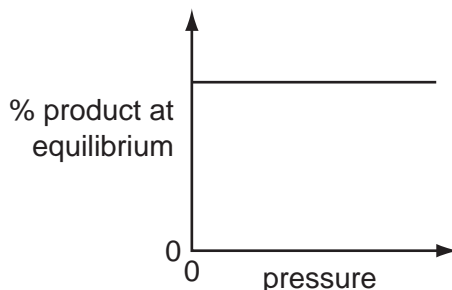
effect on percentage of products

reaction

reason

..... [3]

(ii)



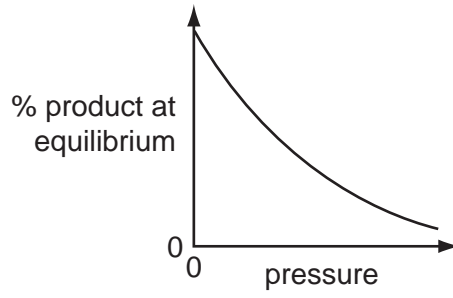
effect on percentage of products

reaction

reason

..... [3]

(iii)



effect on percentage of products

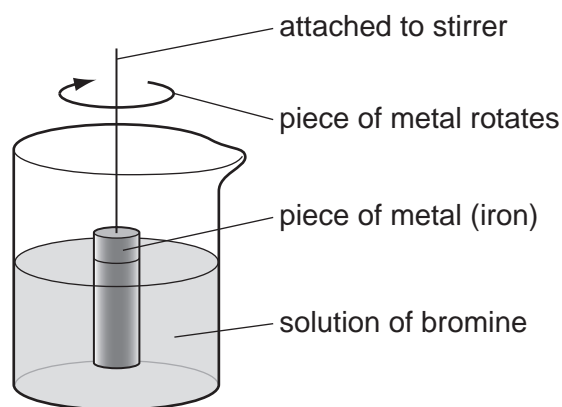
reaction

reason

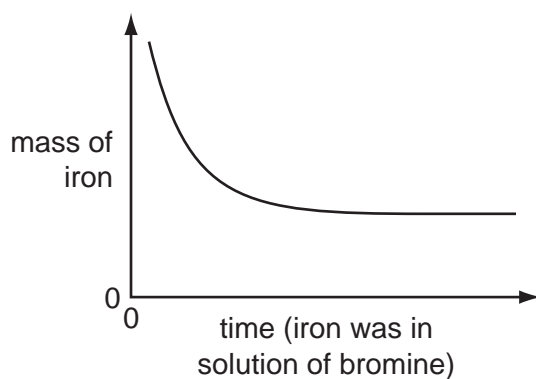
..... [3]

[Total: 11]

- 5 The rate of the reaction between iron and aqueous bromine can be investigated using the apparatus shown below.



- (a) A piece of iron was weighed and placed in the apparatus. It was removed at regular intervals and the clock was paused. The piece of iron was washed, dried, weighed and replaced. The clock was restarted. This was continued until the solution was colourless. The mass of iron was plotted against time. The graph shows the results obtained.



- (i) Suggest an explanation for the shape of the graph.

.....

 [3]

- (ii) Predict the shape of the graph if a similar piece of iron with a much rougher surface had been used. Explain your answer.

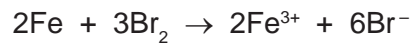
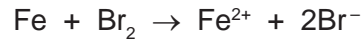
.....
 [2]

- (iii) Describe how you could find out if the rate of this reaction depended on the speed of stirring.

.....

 [2]

- (b) Iron has two oxidation states +2 and +3. There are two possible equations for the redox reaction between iron and bromine.



- (i) Indicate, on the first equation, the change which is oxidation. Give a reason for your choice.

.....
 [2]

- (ii) Which substance in the first equation is the reductant (reducing agent)?

..... [1]

- (c) Describe how you could test the solution to find out which ion, Fe^{2+} or Fe^{3+} , is present.

.....

 [3]

[Total: 13]

6 Structural formulae are an essential part of Organic Chemistry.

(a) Draw the structural formula of each of the following. Show all the bonds in the structure.

(i) ethanoic acid

[1]

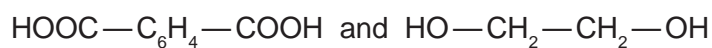
(ii) ethanol

[1]

(b) (i) Ethanoic acid and ethanol react to form an ester.
What is the name of this ester?

..... [1]

(ii) The same linkage is found in polyesters. Draw the structure of the polyester which can be formed from the monomers shown below.



[3]

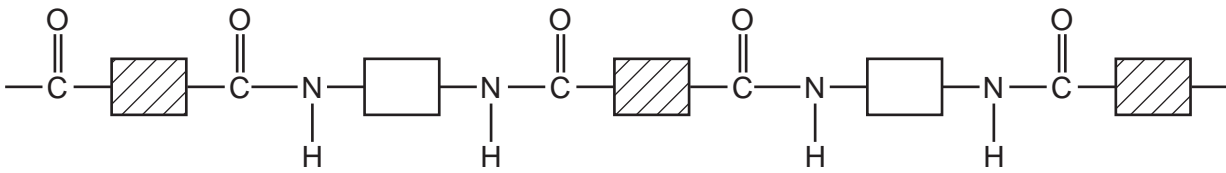
(iii) Describe the pollution problems caused by non-biodegradable polymers.

.....

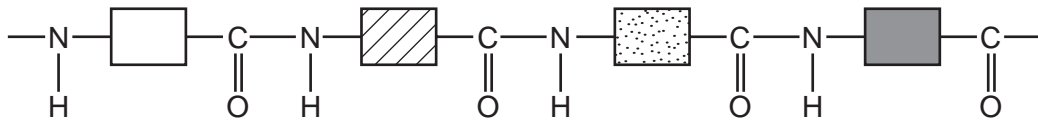
.....

..... [2]

(c) Two macromolecules have the same amide linkage.
Nylon, a synthetic polymer, has the following structure.



Protein, a natural macromolecule, has the following structure.



How are they different?

.....

.....

..... [2]

[Total: 10]

7 Some hydroxides, nitrates and carbonates decompose when heated.

(a) (i) Name a metal hydroxide which does not decompose when heated.

..... [1]

(ii) Write the equation for the thermal decomposition of copper(II) hydroxide.

..... [2]

(iii) Suggest why these two hydroxides behave differently.

..... [1]

(b) (i) Metal nitrates, except those of the Group 1 metals, form three products when heated. Name the products formed when zinc nitrate is heated.

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

(ii) Write the equation for the thermal decomposition of potassium nitrate.

..... [2]

(c) There are three possible equations for the thermal decomposition of sodium hydrogencarbonate.



The following experiment was carried out to determine which one of the above is the correct equation.

A known mass of sodium hydrogencarbonate was heated for ten minutes. It was then allowed to cool and weighed.

Results

Mass of sodium hydrogencarbonate = 3.36 g

Mass of the residue = 2.12 g

Calculation

M_r for NaHCO_3 = 84 g; M_r for Na_2O = 62 g; M_r for NaOH = 40 g

M_r for Na_2CO_3 = 106 g

(i) Number of moles of NaHCO_3 used = [1]

(ii) If residue is Na_2O , number of moles of Na_2O =

If residue is NaOH , number of moles of NaOH =

If residue is Na_2CO_3 , number of moles of Na_2CO_3 = [2]

(iii) Use the number of moles calculated in (i) and (ii) to decide which one of the three equations is correct. Explain your choice.

.....

.....

..... [2]

[Total: 13]

DATA SHEET
The Periodic Table of the Elements

Group		I	II	III	IV	V	VI	VII	0								
		1 H Hydrogen 1							2 He Helium 2								
3	4	7 Li Lithium	9 Be Beryllium		11 B Boron	12 C Carbon	13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon					
11	12	23 Na Sodium	24 Mg Magnesium		27 Fe Iron	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton			
19	20	39 K Potassium	40 Ca Calcium		44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon		
37	38	85 Rb Rubidium	88 Sr Strontium		101 Ru Ruthenium	102 Rh Rhodium	103 Pd Palladium	104 Ag Silver	105 Cd Cadmium	106 In Indium	107 Sn Tin	108 Sb Antimony	109 Te Tellurium	110 I Iodine	111 Xe Xenon		
55	56	133 Cs Caesium	137 Ba Barium		186 Re Rhenium	187 Os Osmium	188 Pt Platinum	189 Au Gold	190 Hg Mercury	191 Tl Thallium	192 Pb Lead	193 Bi Bismuth	194 Po Polonium	195 At Astatine	196 Rn Radon		
87	88	226 Fr Francium	226 Ra Radium		227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	227 Ac Actinium	
		*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 dm³ at room temperature and pressure (r.t.p.).

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