



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CHEMISTRY

0620/03

Paper 3 (Extended)

May/June 2007

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials 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 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.
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 **14** printed pages and **2** blank pages.



1 A major source of energy is the combustion of fossil fuels.

(a) (i) Name a solid fossil fuel.

..... [1]

(ii) Name a gaseous fossil fuel.

..... [1]

(b) Petroleum is separated into more useful fractions by fractional distillation.

(i) Name **two** liquid fuels obtained from petroleum.

..... and [2]

(ii) Name **two** other useful products obtained from petroleum that are not used as fuels.

..... and [2]

(iii) Give another mixture of liquids that is separated on an industrial scale by fractional distillation.

..... [1]

[Total: 7]

2 Complete the following table.

type of structure	particles present	electrical conductivity of solid	electrical conductivity of liquid	example
ionic	positive and negative ions	poor
macro molecular	atoms of two different elements in a giant covalent structure	poor	poor
metallic and	good	copper

[Total: 6]

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3 There are three methods of preparing salts.

Method **A** – use a burette and an indicator.

Method **B** – mix two solutions and obtain the salt by precipitation.

Method **C** – add an excess of base or a metal to a dilute acid and remove the excess by filtration.

For each of the following salt preparations, choose one of the methods **A**, **B** or **C**, name any additional reagent needed and then write or complete the equation.

(i) the soluble salt, zinc sulphate, from the insoluble base, zinc oxide

method

reagent

word equation [3]

(ii) the soluble salt, potassium chloride, from the soluble base, potassium hydroxide

method

reagent

equation + → KCl + H₂O [3]

(iii) the insoluble salt, lead(II) iodide, from the soluble salt, lead(II) nitrate

method

reagent

equation Pb²⁺ + → [4]

[Total: 10]

4 Use your copy of the periodic table to help you answer these questions.

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(a) Predict the formula of each of the following compounds.

(i) barium oxide [1]

(ii) boron oxide [1]

(b) Give the formula of the following ions.

(i) sulphide [1]

(ii) gallium [1]

(c) Draw a diagram showing the arrangement of the valency electrons in one molecule of the covalent compound nitrogen trichloride.

Use x to represent an electron from a nitrogen atom.
Use o to represent an electron from a chlorine atom. [3]

(d) Potassium and vanadium are elements in Period IV.

(i) State **two** differences in their physical properties.

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

(ii) Give **two** differences in their chemical properties.

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

(e) Fluorine and astatine are halogens. Use your knowledge of the other halogens to predict the following:

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(i) The physical state of fluorine at r.t.p.

The physical state of astatine at r.t.p. [2]

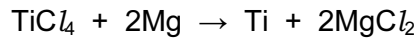
(ii) **Two** similarities in their chemical properties

.....

..... [2]

[Total 15]

- 5 (a) Titanium is produced by the reduction of its chloride. This is heated with magnesium in an inert atmosphere of argon.



- (i) Explain why it is necessary to use argon rather than air.

..... [1]

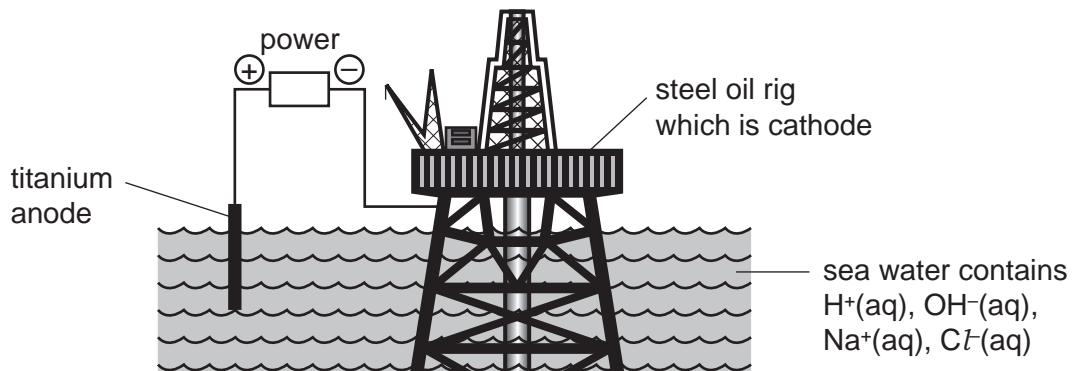
- (ii) Name another metal that would reduce titanium chloride to titanium.

..... [1]

- (iii) Suggest how you could separate the metal, titanium, from the soluble salt magnesium chloride.

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

- (b) Titanium is very resistant to corrosion. One of its uses is as an electrode in the cathodic protection of large steel structures from rusting.



- (i) Define oxidation in terms of electron transfer.

..... [1]

- (ii) The steel oil rig is the cathode. Name the gas formed at this electrode.

..... [1]

- (iii) Name the **two** gases formed at the titanium anode.

..... and [2]

- (iv) Explain why the oil rig does not rust.

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

- (v) Another way of protecting steel from corrosion is sacrificial protection.
Give **two** differences between sacrificial protection and cathodic protection.

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

[Total: 12]

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6 Aluminium is extracted by the electrolysis of a molten mixture that contains alumina, which is aluminium oxide, Al_2O_3 .

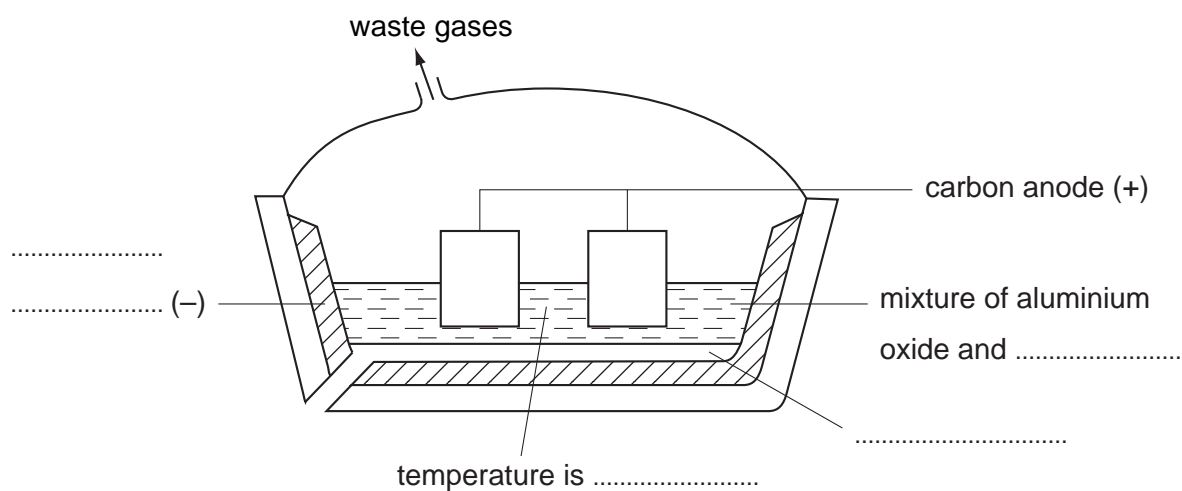
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(a) The ore of aluminium is bauxite. This contains alumina, which is amphoteric, and iron(III) oxide, which is basic. The ore is heated with aqueous sodium hydroxide. Complete the following sentences.

The dissolves to give a solution of

The does not dissolve and can be removed by [4]

(b) Complete the labelling of the diagram.



[4]

(c) The ions that are involved in the electrolysis are Al^{3+} and O^{2-} .

(i) Write an equation for the reaction at the cathode.

..... [2]

(ii) Explain how carbon dioxide is formed at the anode.

..... [2]

.....

(d) Give an explanation for each of the following.

(i) Aluminium is used extensively in the manufacture of aircraft.

..... [1]

(ii) Aluminium is used to make food containers.

..... [2]

(iii) Aluminium electricity cables have a steel core.

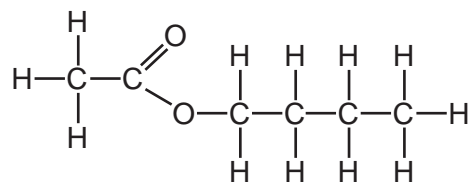
..... [1]

[Total: 16]

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7 Esters, fats and polyesters all contain the ester linkage.

(a) The structural formula of an ester is given below.



Name **two** chemicals that could be used to make this ester and draw their structural formulae. Show all bonds.

names and [2]

structural formulae

[2]

(b) (i) Draw the structural formula of a polyester such as *Terylene*.

[2]

(ii) Suggest a use for this polymer.

..... [1]

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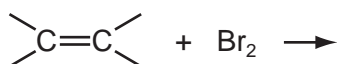
- (c) Cooking products, fats and vegetable oils, are mixtures of saturated and unsaturated esters.

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The degree of unsaturation can be estimated by the following experiment. 4 drops of the oil are dissolved in 5 cm³ of ethanol. Dilute bromine water is added a drop at a time until the brown colour no longer disappears. Enough bromine has been added to the sample to react with all the double bonds.

cooking product	mass of saturated fat in 100 g of product/g	mass of unsaturated fat in 100 g of product/g	number of drops of bromine water
margarine	35	35	5
butter	45	28	4
corn oil	10	84	12
soya oil	15	70	10
lard	38	56

- (i) Complete the one blank space in the table. [1]
- (ii) Complete the equation for bromine reacting with a double bond.



[2]

- (iii) Using saturated fats in the diet is thought to be a major cause of heart disease. Which of the products is the least likely to cause heart disease?

..... [1]

- (d) A better way of measuring the degree of unsaturation is to find the iodine number of the unsaturated compound. This is the mass of iodine that reacts with all the double bonds in 100 g of the fat.

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Use the following information to calculate the number of double bonds in one molecule of the fat.

Mass of one mole of the fat is 884 g.

One mole of I_2 reacts with one mole $\begin{array}{c} \diagup \\ \text{C}=\text{C} \\ \diagdown \end{array}$.

The iodine number of the fat is 86.2 g.

Complete the following calculation.

100 g of fat reacts with 86.2 g of iodine.

884 g of fat reacts with g of iodine.

One mole of fat reacts with moles of iodine molecules.

Number of double bonds in one molecule of fat is [3]

[Total: 14]

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DATA SHEET
The Periodic Table of the Elements

		Group																							
I	II	III	IV	V	VI	VII	0					0													
		1 H Hydrogen 1										4 He Helium 2													
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5													
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					20 Ne Neon 10													
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	101 Ru Ruthenium 44	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	210 Po Polonium 84	210 At Astatine 85	210 Rn Radon 86								
226 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89											227 Fr Francium 87												
												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	173 Yb Ytterbium 70	175 Lu Lutetium 71		
												232 Th Thorium 90	238 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103

*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.).