



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

0620/32

Paper 3 (Extended)

October/November 2012

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 **13** printed pages and **3** blank pages.



1 This question is concerned with the elements in Period 5, Rb to Xe.

(a) The electron distributions of some of these elements are given in the following list.

element A $2 + 8 + 18 + 8 + 2$

element B $2 + 8 + 18 + 18 + 8$

element C $2 + 8 + 18 + 18 + 5$

element D $2 + 8 + 18 + 18 + 6$

element E $2 + 8 + 18 + 18 + 4$

element F $2 + 8 + 18 + 18 + 7$

(i) Identify element C. [1]

(ii) Which element in the list does not form any compounds?

..... [1]

(iii) Which element in the list forms a chloride of the type $XC l_2$?

..... [1]

(iv) Which **two** elements would react together to form a compound of the type XY_4 ?

..... [1]

(v) Which element in the list would react with cold water to form an alkaline solution and hydrogen?

..... [1]

(b) Predict **two** differences in physical properties and **two** differences in chemical properties between rubidium and the transition metal niobium.

physical

.....

.....

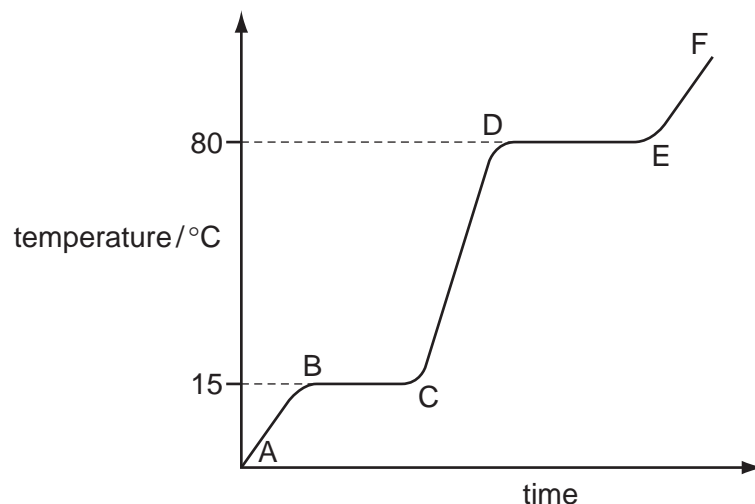
chemical

.....

..... [4]

[Total: 9]

- 2 The diagram shows a heating curve for a sample of compound X.



- (a) Is X a solid, a liquid or a gas at room temperature, 20 °C?

..... [1]

- (b) Write an equation for the equilibrium which exists in region BC.

..... [2]

- (c) Name the change of state which occurs in region DE.

..... [1]

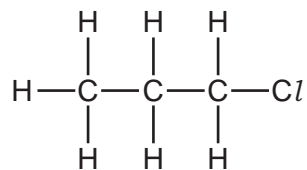
- (d) Explain how the curve shows that a pure sample of compound X was used.

.....
 [2]

[Total: 6]

3 Many organic compounds which contain a halogen have chloro, bromo or iodo in their name.

(a) The following diagram shows the structure of 1-chloropropane.



(i) Draw the structure of an isomer of this compound.

[1]

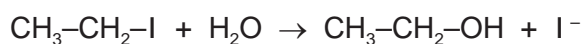
(ii) Describe how 1-chloropropane could be made from propane.

.....
 [2]

(iii) Suggest an explanation why the method you have described in (ii) does not produce a pure sample of 1-chloropropane.

.....
 [2]

(b) Organic halides react with water to form an alcohol and a halide ion.



(i) Describe how you could show that the reaction mixture contained an iodide ion.

.....
 [2]

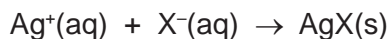
(ii) Name the alcohol formed when 1-chloropropane reacts with water.

..... [1]

- (c) The speed (rate) of reaction between an organic halide and water can be measured by the following method.

A mixture of 10 cm³ of aqueous silver nitrate and 10 cm³ of ethanol is warmed to 60 °C. Drops of the organic halide are added and the time taken for a precipitate to form is measured.

Silver ions react with the halide ions to form a precipitate of the silver halide.



Typical results for four experiments, **A**, **B**, **C** and **D**, are given in the table.

experiment	organic halide	number of drops	time / min
A	bromobutane	4	6
B	bromobutane	8	3
C	chlorobutane	4	80
D	iodobutane	4	0.1

- (i) Explain why it takes longer to produce a precipitate in experiment **A** than in **B**.

.....
 [2]

- (ii) How does the order of reactivity of the organic halides compare with the order of reactivity of the halogens?

.....
 [2]

- (iii) Explain why the time taken to produce a precipitate would increase if the experiments were repeated at 50 °C.

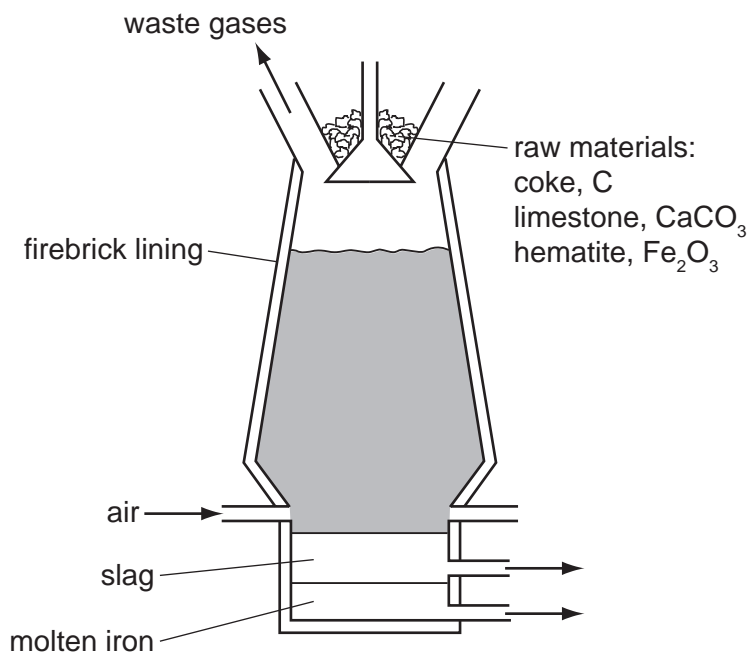
.....

 [3]

[Total: 15]

4 Iron is extracted from its ore, hematite, in the blast furnace.

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(a) The temperature inside the blast furnace can rise to 2000 °C.
Write an equation for the exothermic reaction which causes this high temperature.

..... [1]

(b) Carbon monoxide is formed in the blast furnace. This reduces the ore hematite, Fe₂O₃, to iron.

(i) Explain how carbon monoxide is formed in the blast furnace.

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

(ii) Write an equation for the reduction of hematite by carbon monoxide.

..... [2]

(c) Explain why it is necessary to add limestone, calcium carbonate, to the blast furnace.
Include an equation in your explanation.

.....
.....
..... [3]

(d) Most of the iron from the blast furnace is converted into mild steel. A method of preventing the steel from rusting is coating it with zinc.

(i) What is the name of this method of rust prevention?

..... [1]

(ii) Explain, using the idea of electron transfer, why zinc-coated steel does not rust even when the coating is scratched and the steel is in contact with oxygen and water.

.....

.....

.....

..... [3]

[Total: 12]

5 The food additive E220 is sulfur dioxide. It is a preservative for a variety of foods and drinks.

(a) State **two** other uses of sulfur dioxide.

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

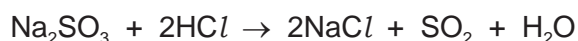
(b) How is sulfur dioxide manufactured?

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

(c) Sulfur dioxide is a reductant (reducing agent). Describe what you would see when aqueous sulfur dioxide is added to acidified potassium manganate(VII).

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

(d) Sulfur dioxide can also be made by the reaction between a sulfite and an acid.



Excess hydrochloric acid was added to 3.15 g of sodium sulfite. Calculate the maximum volume, measured at r.t.p., of sulfur dioxide which could be formed.

The mass of one mole of Na_2SO_3 is 126 g.

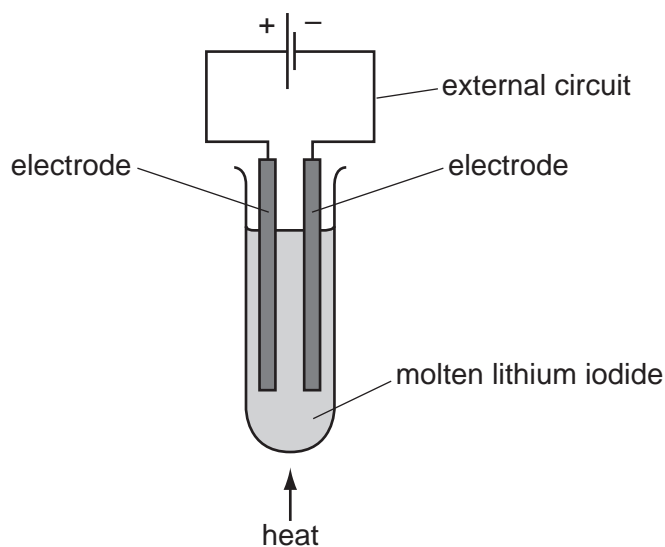
.....
.....
..... [3]

[Total: 9]

- 6 During electrolysis, ions move in the electrolyte and electrons move in the external circuit. Reactions occur at the electrodes.

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- (a) The diagram shows the electrolysis of molten lithium iodide.



- (i) Draw an arrow on the diagram to show the direction of the electron flow in the external circuit. [1]

- (ii) Electrons are supplied to the external circuit. How and where is this done?

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

- (iii) Explain why solid lithium iodide does not conduct electricity but when molten it is a good conductor.

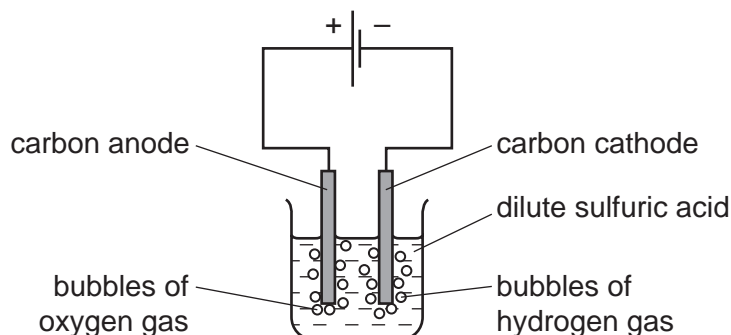
.....
..... [1]

- (b) The results of experiments on electrolysis are shown in the following table. Complete the table. The first line has been done as an example.

electrolyte	electrodes	product at cathode	product at anode	change to electrolyte
molten lithium iodide	carbon	lithium	iodine	used up
aqueous copper(II) sulfate	platinum		oxygen	
concentrated aqueous potassium chloride	carbon		chlorine	

[4]

- (c) The diagram below shows the electrolysis of dilute sulfuric acid. Hydrogen is formed at the negative electrode (cathode) and oxygen at the positive electrode (anode) and the concentration of sulfuric acid increases.

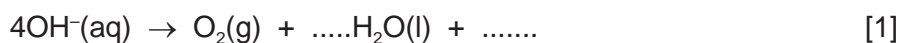


The ions present in the dilute acid are $\text{H}^+(\text{aq})$, $\text{OH}^-(\text{aq})$ and $\text{SO}_4^{2-}(\text{aq})$.

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

..... [2]

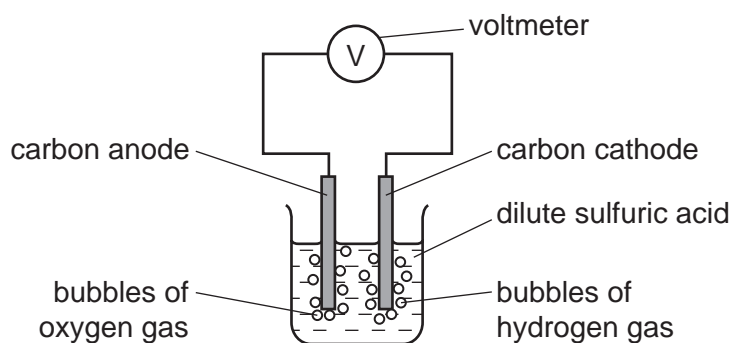
- (ii) Complete the equation for the reaction at the positive electrode (anode).



- (iii) Suggest an explanation of why the concentration of the sulfuric acid increases.

..... [1]

- (d) In the apparatus used in (c), the power supply is removed and immediately replaced by a voltmeter.



A reading on the voltmeter shows that electrical energy is being produced. Suggest an explanation for how this energy is produced.

.....

 [3]

[Total: 15]

7 The alcohols form a homologous series. The first member of this series is methanol, CH₃OH.

(a) (i) Give the general formula of the alcohols.

..... [1]

(ii) The mass of one mole of an alcohol is 116 g. What is its formula?
Show your reasoning.

.....

..... [2]

(iii) Draw a diagram showing the arrangement of the outer (valency) electrons in one molecule of methanol.

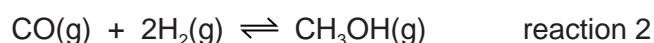
Use x to represent an electron from a carbon atom.

Use o to represent an electron from a hydrogen atom.

Use • to represent an electron from an oxygen atom.

[3]

(b) Methanol is manufactured using the following method.



The conditions for reaction 2 are:

pressure 100 atmospheres

catalyst a mixture of copper, zinc oxide and aluminium oxide

temperature 250 °C

The forward reaction is exothermic.

(i) Why is high pressure used in reaction 2?

.....

..... [2]

12

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- (ii) Explain why using a catalyst at 250 °C is preferred to using a higher temperature of 350 °C and no catalyst.

.....
.....
..... [3]

- (c) Methanol is oxidised by atmospheric oxygen. This reaction is catalysed by platinum.

- (i) The products of this reaction include a carboxylic acid. Give its name and structural formula.

name

structural formula showing all bonds

[2]

- (ii) Deduce the name of the ester formed by the reaction of methanol with the carboxylic acid named in (i).

..... [1]

[Total: 14]

DATA SHEET
The Periodic Table of the Elements

		Group																																																																																																																																
I	II	III	IV	V	VI	VII	0																																																																																																																											
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 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10	18 Ar Argon 18	19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	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	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	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	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	†	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	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	212 Po Polonium 84	210 At Astatine 85	210 Rn Radon 86	226 Fr Francium 87	227 Ra Radium 88	227 Ac Actinium 89	†	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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	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.).

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