



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CHEMISTRY

0620/32

Paper 3 (Extended)

October/November 2010

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 **14** printed pages and **2** blank pages.



1 The following table gives information about six substances.

substance	melting point /°C	boiling point /°C	electrical conductivity as a solid	electrical conductivity as a liquid
A	839	1484	good	good
B	-210	-196	poor	poor
C	776	1497	poor	good
D	-117	78	poor	poor
E	1607	2227	poor	poor
F	-5	102	poor	good

(a) Which substance could have a macromolecular structure, similar to that of silicon(IV) oxide?

..... [1]

(b) Which substances are solids at room temperature?

..... [1]

(c) Which substance could be a metal?

..... [1]

(d) Which substance could be aqueous sodium chloride?

..... [1]

(e) Which substance is an ionic compound?

..... [1]

(f) Which substances are liquids at room temperature?

..... [1]

[Total: 6]

2 An ore of the important metal zinc is zinc blende, ZnS. This is changed into zinc oxide which is reduced to the impure metal by carbon reduction.

(a) (i) How is zinc oxide obtained from zinc sulfide?

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

(ii) Write a balanced equation for the reduction of zinc oxide by carbon.

..... [1]

(iii) The major impurity in the zinc is cadmium. The boiling point of zinc is 907 °C and that of cadmium is 767 °C.

Name a technique which could be used to separate these two metals.

..... [2]

(b) In common with most metals, zinc is a good conductor of electricity. It is used as an electrode in cells.

(i) Give **two** other uses of zinc.

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

(ii) Describe the metallic bonding in zinc and then explain why it is a good conductor of electricity.

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

[Total: 11]

3 The decomposition of hydrogen peroxide is catalysed by manganese(IV) oxide.



To 50 cm³ of aqueous hydrogen peroxide, 0.50 g of manganese(IV) oxide was added. The volume of oxygen formed was measured every 20 seconds. The average reaction rate was calculated for each 20 second interval.

time/s	0	20	40	60	80	100
volume of oxygen/cm ³	0	48	70	82	88	88
average reaction rate in cm ³ /s	2.4	1.1	0.3	0.0	0.0

(a) Explain how the average reaction rate, 2.4 cm³/s, was calculated for the first 20 seconds.

.....
 [2]

(b) Complete the table. [1]

(c) Explain why the average reaction rate decreases with time.

.....
 [2]

(d) The experiment was repeated but 1.0 g of manganese(IV) oxide was added. What effect, if any, would this have on the reaction rate and on the final volume of oxygen? Give a reason for each answer.

effect on rate [1]

reason

..... [2]

effect on final volume of oxygen [1]

reason

..... [2]

[Total: 11]

4 Chromium is a transition element.

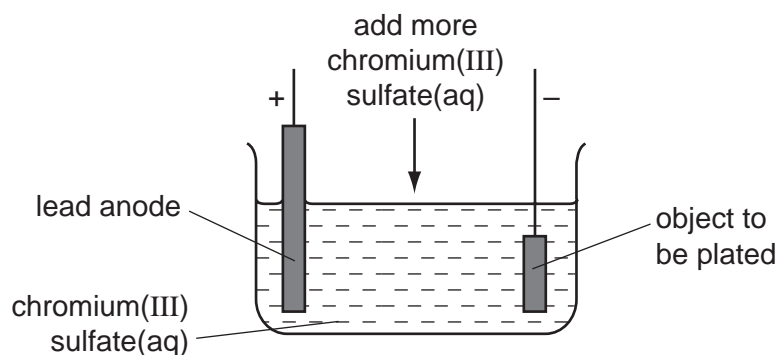
(a) (i) Predict **two** differences in the physical properties of chromium and sodium.

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

(ii) Predict **two** differences in the chemical properties of chromium and sodium.

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

(b) Chromium is used to electroplate steel objects. The diagram shows how this could be done.



(i) Give **two** reasons why steel objects are plated with chromium.

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

(ii) The formula of the chromium(III) ion is Cr^{3+} and of the sulfate ion is SO_4^{2-} . Give the formula of chromium(III) sulfate.

..... [1]

(iii) Write the equation for the reaction at the negative electrode (cathode).

..... [2]

(iv) A colourless gas, which relights a glowing splint, is formed at the positive electrode (anode). Name this gas.

..... [1]

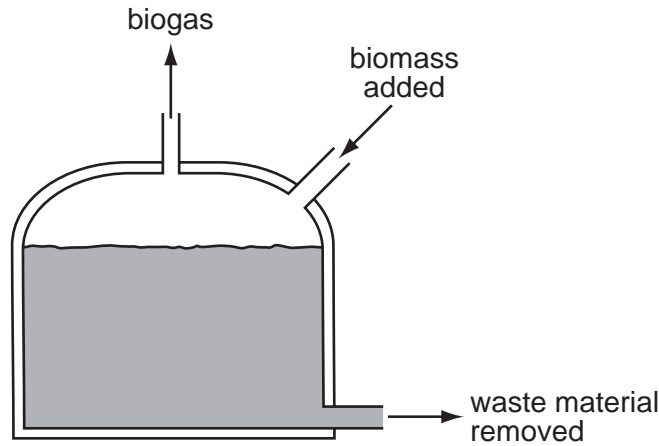
- (v) During electrolysis, it is necessary to add more chromium(III) sulfate but during copper-plating using a copper anode, it is not necessary to add more copper(II) sulfate. Explain.

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

[Total: 12]

- 5 In the absence of oxygen, certain bacteria decompose carbohydrates to biogas. This is a mixture of gases mainly methane and carbon dioxide. Biogas is becoming an increasingly important fuel around the world.

A diagram of a simple biogas generator is given below. Typically, it contains biomass - animal manure, plant material etc.



- (a) (i) What is meant by the term *carbohydrate*?

.....
 [2]

- (ii) The reaction in the generator is an example of anaerobic respiration. Anaerobic means in the absence of oxygen. What does *respiration* mean?

.....
 [2]

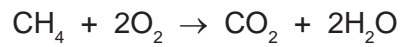
- (iii) The generator must produce some carbon dioxide. Why is it impossible for it to produce only a hydrocarbon such as methane?

..... [1]

- (iv) Suggest a use for the nitrogen-rich solid removed from the generator.

..... [1]

- (b) (i) In an experiment, a 60 cm³ sample of biogas required 80 cm³ of oxygen for the complete combustion of the methane in the sample.
Calculate the percentage of methane in the sample of biogas. Assume that biogas contains only methane and carbon dioxide.



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

- (ii) Carbon dioxide is acidic and methane is neutral.
Suggest another way of measuring the volume of methane in the sample.

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

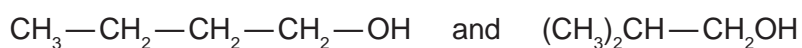
[Total: 10]

6 The alcohols form an homologous series.

(a) Give **three** characteristics of an homologous series.

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

(b) The following two alcohols are members of the series and they are isomers.



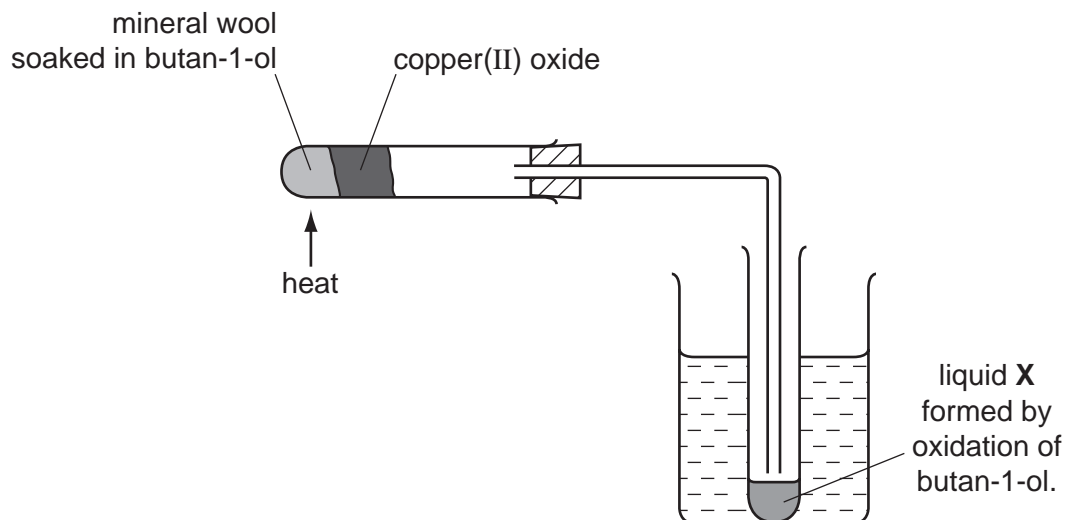
(i) Explain why they are isomers.

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

(ii) Give the structural formula of another alcohol which is also an isomer of these alcohols.

[1]

(c) Copper(II) oxide can oxidise butan-1-ol to liquid X whose pH is 4.



(i) Name another reagent which can oxidise butan-1-ol.

..... [1]

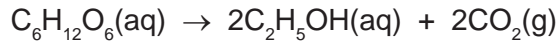
(ii) What type of compound is liquid X and what is its formula?

type of compound [1]

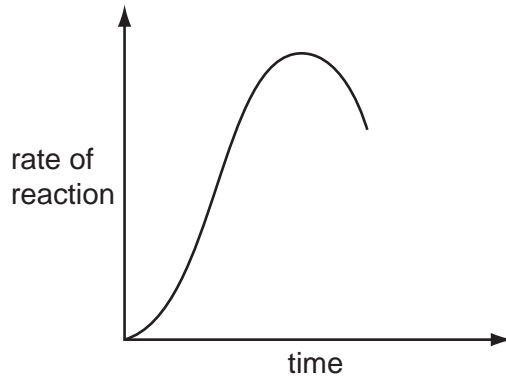
formula of liquid X

[1]

(d) The alcohol ethanol can be made by fermentation. Yeast is added to aqueous glucose.



Carbon dioxide is given off and the mixture becomes warm as the reaction is exothermic. The graph shows how the rate of reaction varies over several days.



(i) Suggest a method of measuring the rate of this reaction.

.....
 [2]

(ii) Why does the rate increase initially?

.....
 [1]

(iii) Suggest **two** reasons why the rate eventually decreases.

.....
 [2]

(iv) Why is fermentation carried out in the absence of air?

.....
 [1]

[Total: 15]

7 The major use of sulfur dioxide is to manufacture sulfuric acid.

(a) (i) Another use of sulfur dioxide is as the food additive E220.
How does it preserve food?

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

(ii) Why is sulfur dioxide used in the manufacture of wood pulp?

..... [1]

(iii) How is sulfur dioxide manufactured?

..... [1]

(b) Complete the following description of the manufacture of sulfuric acid.

Sulfur dioxide reacts with to form sulfur trioxide.

The above reaction is catalysed by

The optimum temperature for this reaction is °C.

Sulfur trioxide needs to react with to form sulfuric acid. [4]

(c) (i) Define the term *acid*.

..... [1]

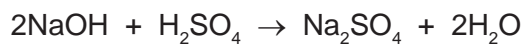
(ii) Sulfuric acid is a strong acid. Ethanedioic acid is a weak acid.

Given solutions of both acids, how could you show that sulfuric acid is a strong acid and ethanedioic acid is a weak acid?

method
..... [1]

result for each acid
..... [1]

- (d) 20.0 cm³ of sulfuric acid, concentration 0.30 mol / dm³, was added to 40 cm³ of sodium hydroxide, concentration 0.20 mol / dm³.



- (i) How many moles of H₂SO₄ were added? [1]
- (ii) How many moles of NaOH were used? [1]
- (iii) Which reagent is in excess? Give a reason for your choice.
- reagent in excess [1]
- reason [1]
- [1]
- (iv) Is the pH of the final mixture less than 7, equal to 7 or more than 7?
- [1]

[Total: 15]

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	104 Rf Rutherfordium 104	105 Db Dubnium 105	106 Sg Seaborgium 106	107 Bh Bohrium 107	108 Hs Hassium 108	109 Mt Meitnerium 109	110 Ds Darmstadtium 110	111 Rg Roentgenium 111	112 Cn Copernicium 112	113 Nh Nihonium 113	114 Fl Flerovium 114	115 Mc Moscovium 115	116 Lv Livermorium 116	117 Ts Tennessine 117	118 Og Oganesson 118	119 Uu Ununennium 119	120 Uub Unbibium 120	121 Uut Untrium 121	122 Uuq Unquadrium 122	123 Uuq Unquadrium 123	124 Uuq Unquadrium 124	125 Uuq Unquadrium 125	126 Uuq Unquadrium 126	127 Uuq Unquadrium 127	128 Uuq Unquadrium 128	129 Uuq Unquadrium 129	130 Uuq Unquadrium 130	131 Uuq Unquadrium 131	132 Uuq Unquadrium 132	133 Uuq Unquadrium 133	134 Uuq Unquadrium 134	135 Uuq Unquadrium 135	136 Uuq Unquadrium 136	137 Uuq Unquadrium 137	138 Uuq Unquadrium 138	139 Uuq Unquadrium 139	140 Uuq Unquadrium 140	141 Uuq Unquadrium 141	142 Uuq Unquadrium 142	143 Uuq Unquadrium 143	144 Uuq Unquadrium 144	145 Uuq Unquadrium 145	146 Uuq Unquadrium 146	147 Uuq Unquadrium 147	148 Uuq Unquadrium 148	149 Uuq Unquadrium 149	150 Uuq Unquadrium 150	151 Uuq Unquadrium 151	152 Uuq Unquadrium 152	153 Uuq Unquadrium 153	154 Uuq Unquadrium 154	155 Uuq Unquadrium 155	156 Uuq Unquadrium 156	157 Uuq Unquadrium 157	158 Uuq Unquadrium 158	159 Uuq Unquadrium 159	160 Uuq Unquadrium 160	161 Uuq Unquadrium 161	162 Uuq Unquadrium 162	163 Uuq Unquadrium 163	164 Uuq Unquadrium 164	165 Uuq Unquadrium 165	166 Uuq Unquadrium 166	167 Uuq Unquadrium 167	168 Uuq Unquadrium 168	169 Uuq Unquadrium 169	170 Uuq Unquadrium 170	171 Uuq Unquadrium 171	172 Uuq Unquadrium 172	173 Uuq Unquadrium 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260	261 Uuq Unquadrium 261	262 Uuq Unquadrium 262	263 Uuq Unquadrium 263	264 Uuq Unquadrium 264	265 Uuq Unquadrium 265	266 Uuq Unquadrium 266	267 Uuq Unquadrium 267	268 Uuq Unquadrium 268	269 Uuq Unquadrium 269	270 Uuq Unquadrium 270	271 Uuq Unquadrium 271	272 Uuq Unquadrium 272	273 Uuq Unquadrium 273	274 Uuq Unquadrium 274	275 Uuq Unquadrium 275	276 Uuq Unquadrium 276	277 Uuq Unquadrium 277	278 Uuq Unquadrium 278	279 Uuq Unquadrium 279	280 Uuq Unquadrium 280	281 Uuq Unquadrium 281	282 Uuq Unquadrium 282	283 Uuq Unquadrium 283	284 Uuq Unquadrium 284	285 Uuq Unquadrium 285	286 Uuq Unquadrium 286	287 Uuq Unquadrium 287	288 Uuq Unquadrium 288	289 Uuq Unquadrium 289	290 Uuq Unquadrium 290	291 Uuq Unquadrium 291	292 Uuq Unquadrium 292	293 Uuq Unquadrium 293	294 Uuq Unquadrium 294	295 Uuq Unquadrium 295	296 Uuq Unquadrium 296	297 Uuq Unquadrium 297	298 Uuq Unquadrium 298	299 Uuq Unquadrium 299	300 Uuq Unquadrium 300

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

a	X
b	†

Key
 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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