



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.

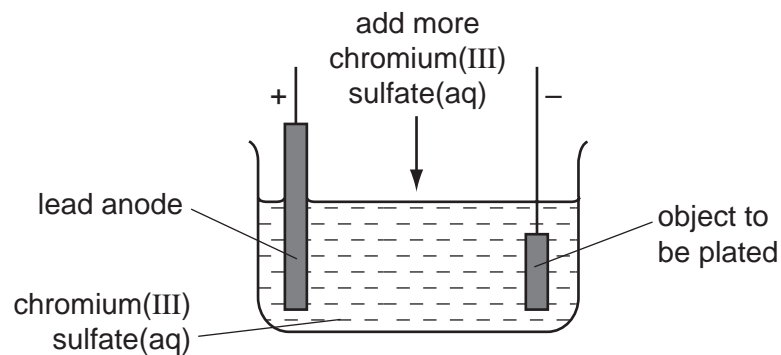
(a) (i) Predict **two** differences in the physical properties of chromium and sodium.

.....
..... [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]

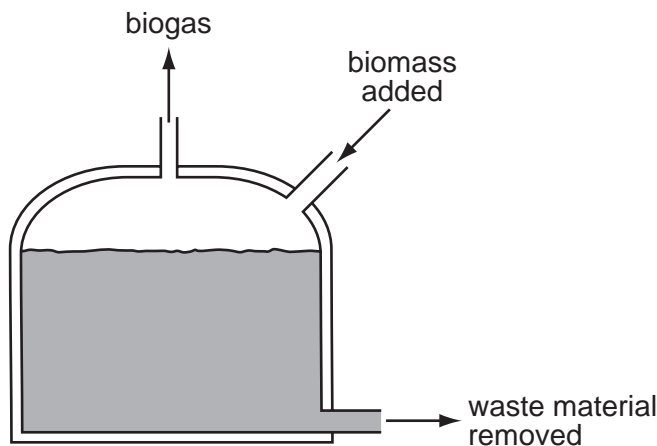
- (v) During electrolysis, it is necessary to add more chromium(III) sulfate but during copper-plating using a copper anode, it is not necessary to add more copper(II) sulfate. Explain.

.....
.....
..... [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]

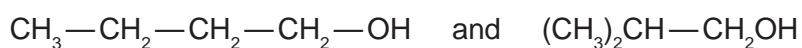
[Total: 10]

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.



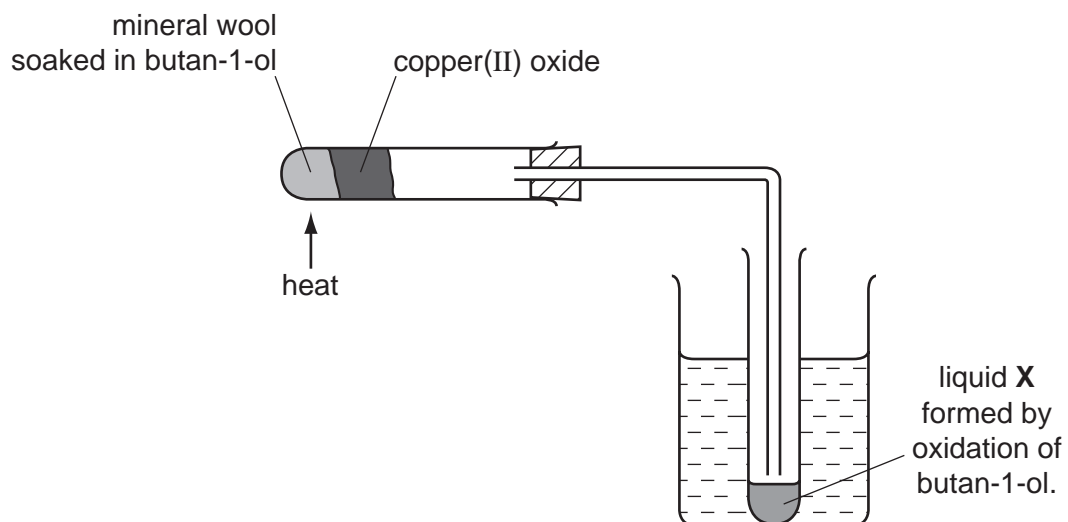
(i) Explain why they are isomers.

.....
.....
..... [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]

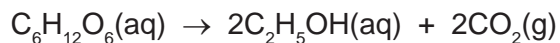
(ii) What type of compound is liquid X and what is its formula?

type of compound [1]

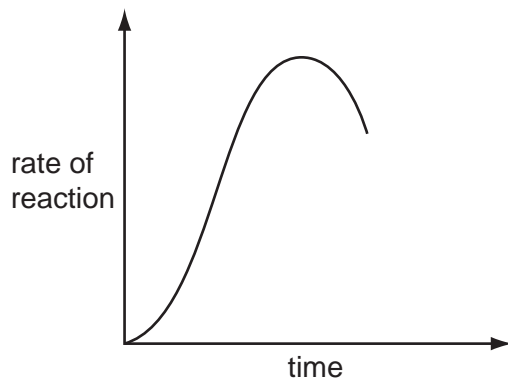
formula of liquid X

[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]

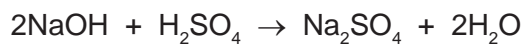
(ii) Sulfuric acid is a strong acid. Ethanedioic acid is a weak acid.

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 | 14 N Nitrogen 7 | 16 O Oxygen 8 | 19 F Fluorine 9 | 20 Ne Neon 10 | 27 Al Aluminium 13 | 28 Si Silicon 14 | 31 P Phosphorus 15 | 32 S Sulfur 16 | 35.5 Cl Chlorine 17 | 40 Ar Argon 18 | 4 He Helium 2 |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 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 | 86 Xe Xenon 54 |
| 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 91 Zr Zirconium 40 | 91 Nb Niobium 41 | 93 Ta Tantalum 73 | 93 Nb Niobium 41 | 101 Ru Ruthenium 44 | 103 Rh Rhodium 45 | 106 Pd Palladium 46 | 108 Ag Silver 47 | 112 Cd Cadmium 48 | 119 In Indium 49 | 122 Sb Antimony 51 | 127 I Iodine 53 | 131 Xe Xenon 54 | 133 Cs Caesium 55 |
| 137 Ba Barium 56 | 139 La Lanthanum 57 | 141 Pr Praseodymium 59 | 144 Nd Neodymium 60 | 148 Sm Samarium 62 | 150 Eu Europium 63 | 152 Gd Gadolinium 64 | 157 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 | 181 Fr Francium 87 | 186 Rn Radon 86 |
| 226 Ra Radium 88 | 227 Ac Actinium 89 | 232 Th Thorium 90 | 238 U Uranium 92 | 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 | 226 Fr Francium 87 | 227 Ac Actinium 89 |

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

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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