



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

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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

.....

.....

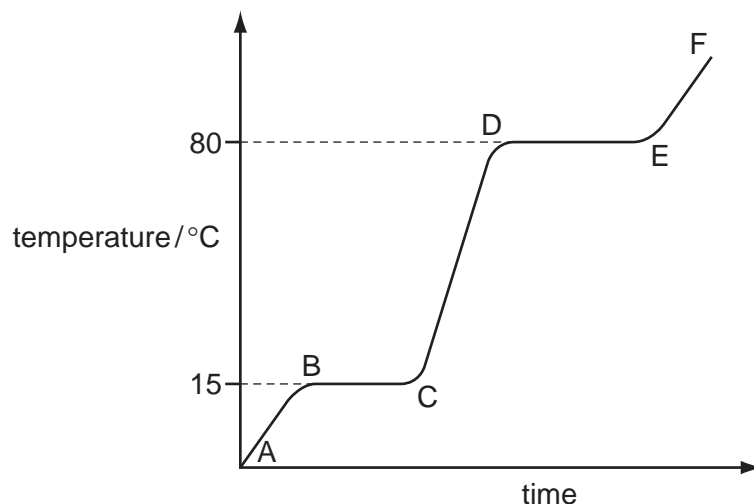
chemical

.....

..... [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]

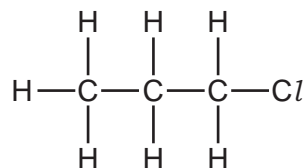
- (d) Explain how the curve shows that a pure sample of compound X was used.

.....
..... [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.

.....

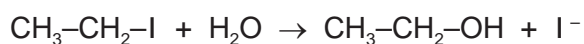
..... [2]

(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]

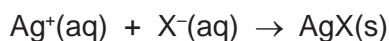
(ii) Name the alcohol formed when 1-chloropropane reacts with water.

..... [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]

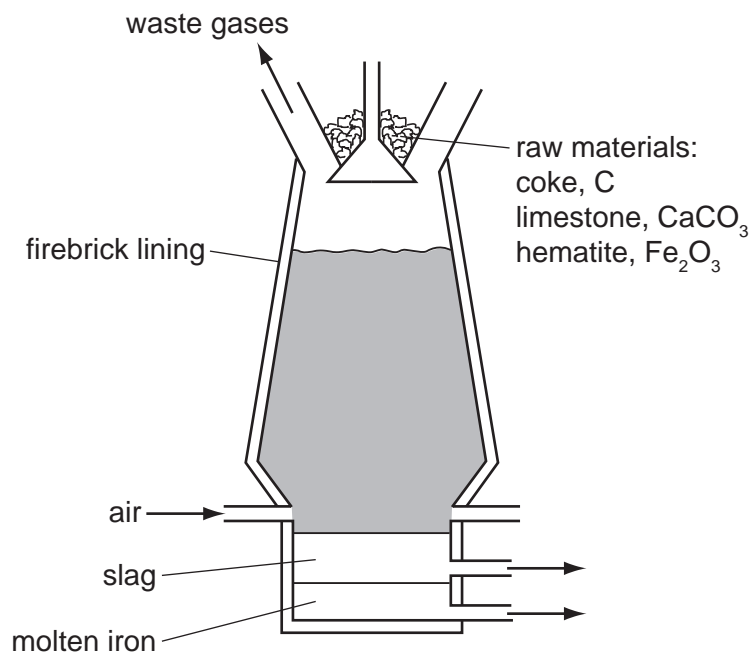
- (iii) Explain why the time taken to produce a precipitate would increase if the experiments were repeated at 50 °C.

.....

 [3]

[Total: 15]

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



- (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, Fe_2O_3 , 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]

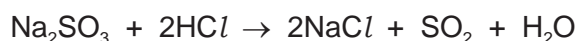
(b) How is sulfur dioxide manufactured?

.....
..... [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.

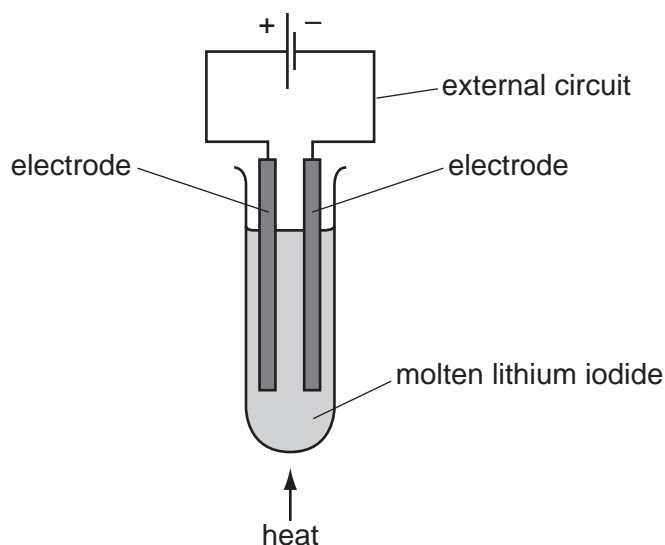
The mass of one mole of Na_2SO_3 is 126 g.

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

[Total: 9]

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

(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.

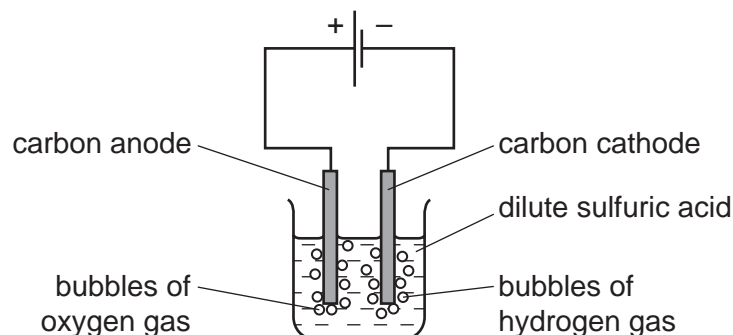
..... [1]

- (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.

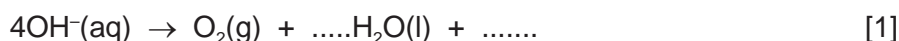


The ions present in the dilute acid are $\text{H}^+(\text{aq})$, $\text{OH}^-(\text{aq})$ and $\text{SO}_4^{2-}(\text{aq})$.

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

..... [2]

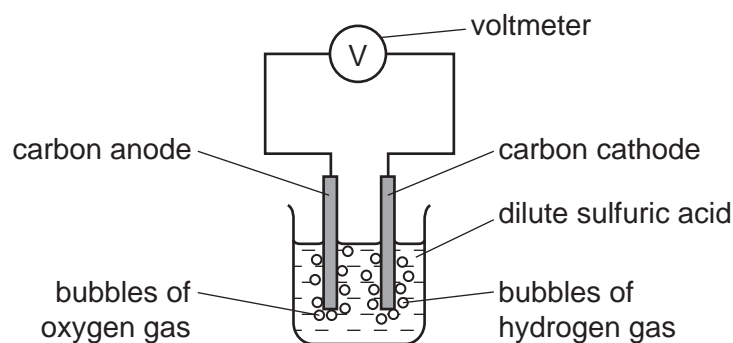
- (ii) Complete the equation for the reaction at the positive electrode (anode).



- (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.

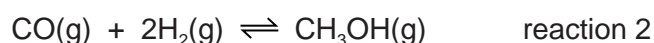
Use x to represent an electron from a carbon atom.

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]

- (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]

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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