Centre Number	Candidate Number	Name

CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CHEMISTRY **9701/02**

Paper 2 Structured Questions AS Core

October/November 2003

1 hour

Candidates answer on the Question Paper.
Additional Materials:
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your name, Centre number and candidate number in the spaces provided at the top of this page.
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.

Answer **all** questions.
The number of marks is given in brackets [ ] at the end of each question or part question.
You may lose marks if you do not show your working or if you do not use apropriate units.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

For Examiner's Use	
1	
2	
3	
4	
5	
TOTAL	

This document consists of **11** printed pages and **1** blank page.

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate
[Turn over

1 **(a)** Salt, sodium chloride, forms transparent colourless crystals. Describe the bonding in sodium chloride crystals, give the formula of each particle and sketch part of the crystal structure.

[3]

(b) Explain why crystals of sodium chloride do not conduct electricity, but molten sodium chloride does.

.....

.....

.....[2]

(c) **(i)** With the aid of a diagram of the cell, outline the manufacture of chlorine from brine (aqueous sodium chloride).

(ii) Write the electrode equations, including state symbols.

anode .....

cathode .....

(iii) Name the two by-products of this electrolysis, and give **one** commercial use of each.

by-product I .....

use .....

by-product II .....

use .....

(iv) Explain, with the aid of an equation, why the chlorine generated from the cell has to be kept away from the liquid in the cathode compartment.

.....

.....

.....[9]

[Total : 14]

[Turn over

2 A car can be considered to run on octane, C_8H_{18}.

(a) Write an equation for the complete combustion of octane.

.....[1]

The composition of the exhaust gases (fumes) from a petrol (gasoline) engine is given below.

Gas	Percentage by volume
carbon dioxide	9
water vapour	8
oxygen	4
hydrogen	2
carbon monoxide	3–6
hydrocarbons	0.2
nitrogen oxides	0.4–0.05

(b) (i) What gas, omitted from the table, makes up most of the remainder of the exhaust fumes?

.....

(ii) Explain why there is always water vapour in the exhaust fumes.

.....
[2]

(c) (i) State two gases in the exhaust fumes which are poisonous to humans. Also state briefly for each the particular effect on humans.

gas I .....

effect .....

gas II .....

effect .....

(ii) The two gases you have given in **(c)(i)** can be removed by reaction in a platinised catalytic converter. The products of the reaction in the converter are not hazardous. For each of your gases in **(c)(i)** give an equation which shows how it is removed to form less harmful substances.

I .....

II .....

(iii) Suggest **one** reason why the exhaust fumes from a car fitted with a catalytic converter are still hazardous to human health to some degree.

.....

.....

.....[5]

[Total : 8]

3 (a) (i) What is meant by the *standard enthalpy change of formation*, $\Delta H^{\ominus}_{f}$, of a compound? Explain what is meant by the term *standard*.

.....

.....

.....

(ii) Write an equation, with state symbols, for the $\Delta H^{\ominus}_{f}$ of water.

.....

(iii) Explain why the $\Delta H^{\ominus}_{f}$ for water is identical to the standard enthalpy change of combustion of hydrogen.

.....

.....[4]

(b) When calcium is placed in water, aqueous calcium hydroxide is formed and hydrogen is given off.

(i) Write the equation for the reaction of calcium with water.

.....

(ii) When 1.00 g of calcium is placed in 200 g of water, the temperature increases by 12.2 °C when the reaction is completed. The specific heat capacity of water, *c*, is $4.2\,J\,g^{-1}\,K^{-1}$.

Calculate the heat released in the experiment.

(iii) Calculate the standard enthalpy change of reaction in $kJ\,mol^{-1}$ for your equation in **(b)(i)**.

[4]

(c) (i) State *Hess' Law*.

.....

.....

.....

(ii) Use Hess' Law and your result in **(b)(iii)** to calculate the $\Delta H^{\ominus}_f$ of $Ca(OH)_2$ (aq). You also need the $\Delta H^{\ominus}_f$ of water which is $-286\,kJ\,mol^{-1}$.

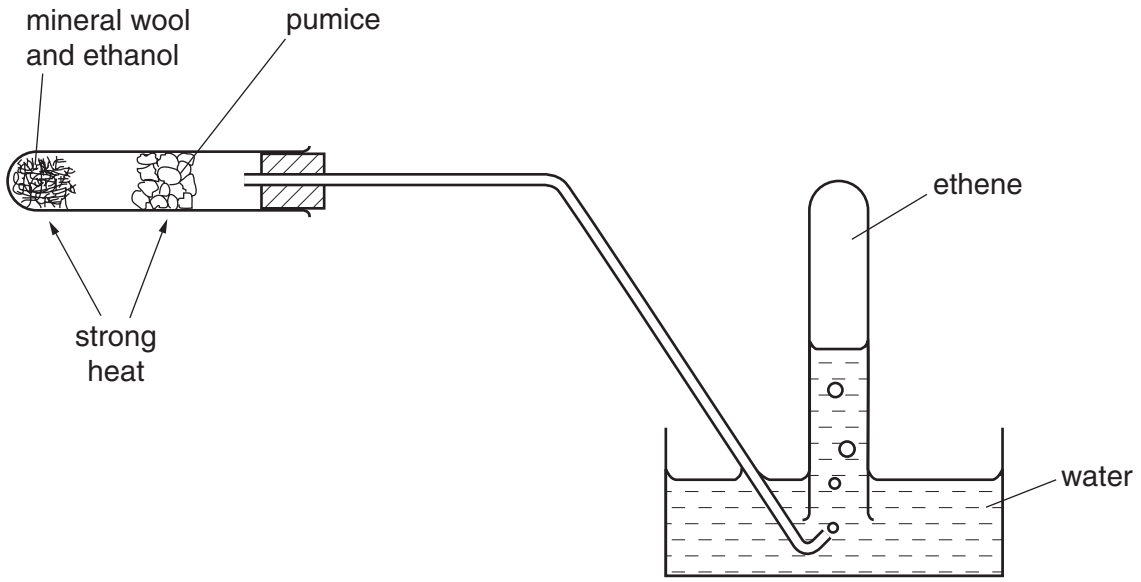
[4]

(d) Calculate the volume of hydrogen, measured at room temperature and pressure, liberated in the experiment described in **(b)(ii)**.

[2]

[Total : 14]

4 The apparatus shown can be used to prepare ethene from ethanol.



(a) **(i)** State what type of reaction takes place on the hot pumice.

.....

(ii) Write an equation for this preparation.

.....

[2]

(b) Describe the colour changes which are observed and write equations for the reaction of ethene with the following two reagents.

(i) bromine

colour change from ..... to .....

equation .....

(ii) cold, dilute, acidified manganate(VII) ions

colour change from ..... to .....

equation .....

[4]

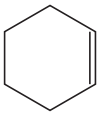
(c) Draw structures for each of the following polymers showing **two** repeat units.

(i) poly(ethene)

(ii) pvc [poly(chloroethene)]

[2]

(d) The formula of the alkene cyclohexene can be written as shown.



(i) State the molecular formula of cyclohexene. .....

(ii) Calculate the percentage of carbon by mass in cyclohexene.

[3]

[Total :11]

[Turn over

5

$CH_3CH_2CH_2CH_2Br$ 1-bromobutane

2-bromo-2-methylpropane

(a) 1-Bromobutane reacts with **aqueous** sodium hydroxide to form butan-1-ol.

(i) Give a balanced equation for this reaction.

.....

(ii) Name the type of reaction. .....

(iii) Describe the mechanism of this reaction.

[5]

(b) 1-Bromobutane and 2-bromo-2-methylpropane both react with an **ethanolic** (**alcoholic**) solution of sodium hydroxide to form alkenes.

(i) Name the type of reaction. .....

(ii) Identify, by means of the structural formula, the alkene formed from

I 1-bromobutane,

II 2-bromo-2-methylpropane.

(iii) Hot, concentrated manganate(VII) ions break the double bond in alkenes. Each of the two alkenes in **(b)(ii)** gives CO_2 and H_2O from the terminal group, but the rest of the molecule remains as an organic oxidation product. Suggest the formula of each of these products.

from I .....

from II .....

[5]

(c) Complete the reaction sequence giving the intermediate, the reagents and the conditions for the synthesis of 2,2-dimethylpropanoic acid.

Step I: reagent .....

conditions .....

Step II: reagent .....

conditions .....

[3]

[Total : 13]

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