SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

									Letter
Figures									
Words									

Victorian Certificate of Education
1997

CHEMISTRY

Common Assessment Task 3: Written examination

Tuesday 11 November 1997: 9.00 am to 10.45 am
Reading time: 9.00 am to 9.15 am
Writing time: 9.15 am to 10.45 am
Total writing time: 1 hour 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

Number of questions	*Number of questions to be answered*
8	8

Directions to students

Materials
Question and answer book of 13 pages with a detachable Data sheet in the centrefold.
Working space is provided throughout this book.
An approved calculator may be used.

The task
Detach the Data sheet from the centre of this book during reading time.
Please ensure that you write your **student number** in the space provided on this page.
Answer **all** questions. Questions should be answered in the spaces provided in this book. The suggested times and marks allotted to each question are indicated at the end of the question. There is a total of 67 marks available.
All written responses should be in English.

At the end of the task
Hand in this question and answer book.

Instructions for students

There are 8 questions. Answer all questions.

To obtain full credit for your responses, you should

- give simplified answers with an appropriate number of significant figures to all numerical questions; unsimplified answers will not be given full credit
- show all working in your answers to numerical questions. No credit can be given for an incorrect answer unless it is accompanied by details of the working
- make sure chemical equations are balanced and that the formulas for individual substances include indications of state, for example

$$H_2(g);\ NaCl(s).$$

Question 1

A diet-food manufacturer plans to synthetically produce a no-fat, high-protein food substitute. The food is quite cheap because the protein component is to be produced from just two amino acids – glycine and aspartic acid.

a. Glycine dissolves readily in water. In an aqueous solution of pH 7, glycine is in the form:

$$^{+}NH_3CH_2CO_2^{-}$$

i. In a solution of high pH, glycine has the form:

ii. In a solution of low pH, glycine has the form:

2 marks

b. The side chain of the α-amino acid, aspartic acid, is $-CH_2COOH$. Give the structure of aspartic acid.

1 mark

c. Give the structure of a possible product (other than water) of the condensation reaction between a molecule of glycine and a molecule of aspartic acid.

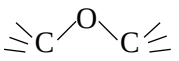
1 mark

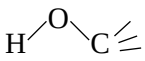
d. The only other components of the synthetic food are complex carbohydrates and water.

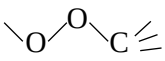
i. What chemical elements are present in pure complex carbohydrates?

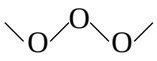
ii. Name **two** different complex carbohydrates commonly found in foodstuffs.

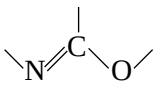
iii. Which of the following gives the chemical structure of the link that forms between the monomer units in the formation of complex carbohydrates. Give your answer by circling the appropriate representation.











4 marks

e. Explain, giving at least **two** reasons, why replacing a normal diet with the synthetic food would eventually be harmful to health.

2 marks

Total 10 marks

(*suggested time: 13 minutes*)

TURN OVER

Question 2

The body of a metal pencil sharpener is made almost entirely of magnesium metal and it has a steel (iron) blade. When the sharpener is left for some days in distilled water, no change is seen in the appearance of the sharpener.

When sodium chloride is dissolved in the water, a white material forms on the surface of the magnesium and small bubbles of gas are evolved from the surface of the steel.

a. **i.** What is the gas that is evolved?

ii. What is the name and formula of the white substance?

iii. Write equations for the **two** half reactions that are occurring.

iv. Write an equation for the net, or overall, reaction occurring.

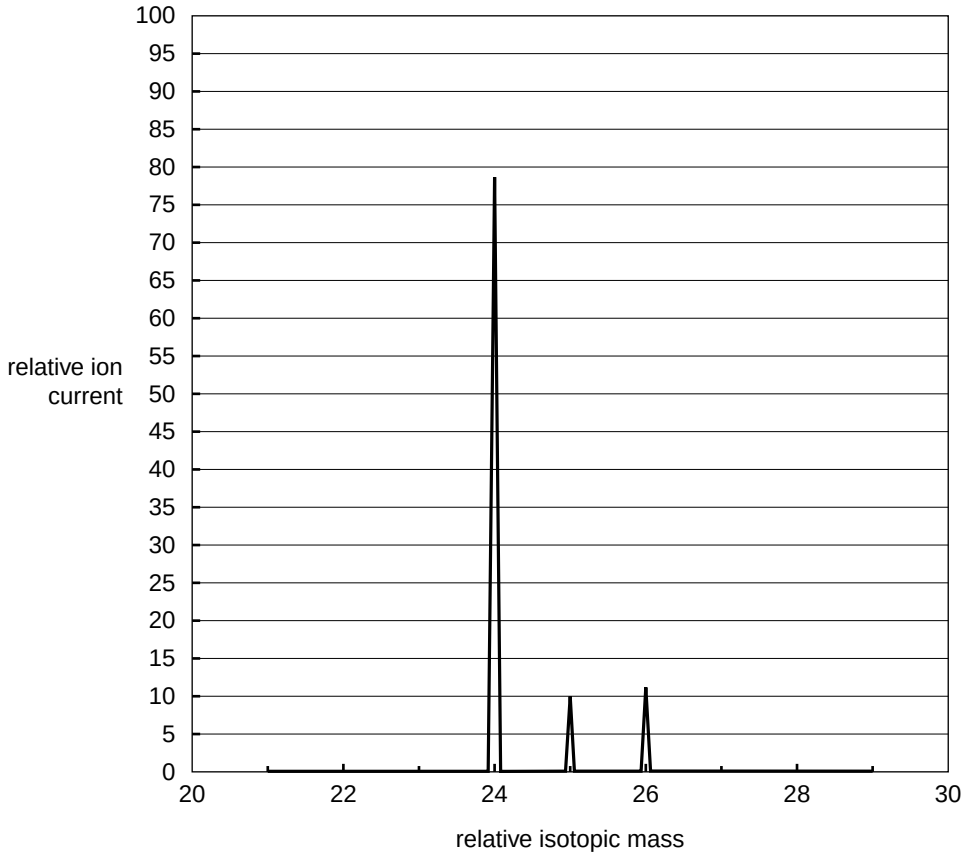
v. Why does reaction occur only when an electrolyte is added to the water?

7 marks

b. Give the electronic structure of the magnesium atom, Mg.

1 mark

c. The diagram below represents the mass spectrum of a sample of magnesium.



Use the data from the graph to calculate the relative atomic mass of magnesium.

3 marks

Total 11 marks

(*suggested time: 15 minutes*)

TURN OVER

Question 3

a. Three solids, labelled **A**, **B** and **C**, are known to be magnesium oxide, aluminium oxide and copper oxide, but not necessarily in that order. Two samples of each solid are prepared. In each case one is treated with a concentrated solution of hydrochloric acid and the other with a concentrated solution of sodium hydroxide. The results are shown below.

	addition of HCl(aq)	**addition of NaOH(aq)**
A	a blue solution forms	solid does not dissolve
B	a colourless solution forms	a colourless solution forms
C	a colourless solution forms	solid does not dissolve

Identify **A**, **B** and **C** from the information above, explaining the reasons for your choice. In each case, give a balanced chemical equation for any reaction (or reactions) occurring.

A

B

C

7 marks

b. When the copper (II) ion is in solution it exists as the complex ion $Cu(H_2O)_6^{2+}(aq)$. Sketch this ion, showing the orientation of water molecules around the copper ion.

2 marks

c. Briefly describe the nature of the bonding in the $Cu(H_2O)_6^{2+}(aq)$ ion

i. between the atoms in the water molecule.

ii. between the water molecules and the copper (II) ion.

3 marks

Total 12 marks

(*suggested time: 16 minutes*)

TURN OVER

Question 4

a. Silver metal is deposited during the electrolysis of an aqueous solution of silver nitrate. Give **two** factors that will affect the mass of silver deposited.

2 marks

b. When 425 C of electricity is passed through a dilute aqueous solution of tin (II) chloride ($SnCl_2$), 0.262 g of tin metal is deposited. How many coulomb of electricity would be needed to deposit the same mass of tin from a dilute solution of tin (IV) chloride ($SnCl_4$)? Show how you arrived at your answer.

2 marks

c. Consider the electrolysis of a dilute aqueous solution of sodium chloride, and a sample of melted (liquid) sodium chloride. Complete the table below to show the half reactions occurring in **each** case.

	reaction at anode (positive electrode)	**reaction at cathode (negative electrode)**
melted NaCl		
dilute aqueous NaCl		

4 marks

d. Explain why different products are obtained in the above **two** cases.

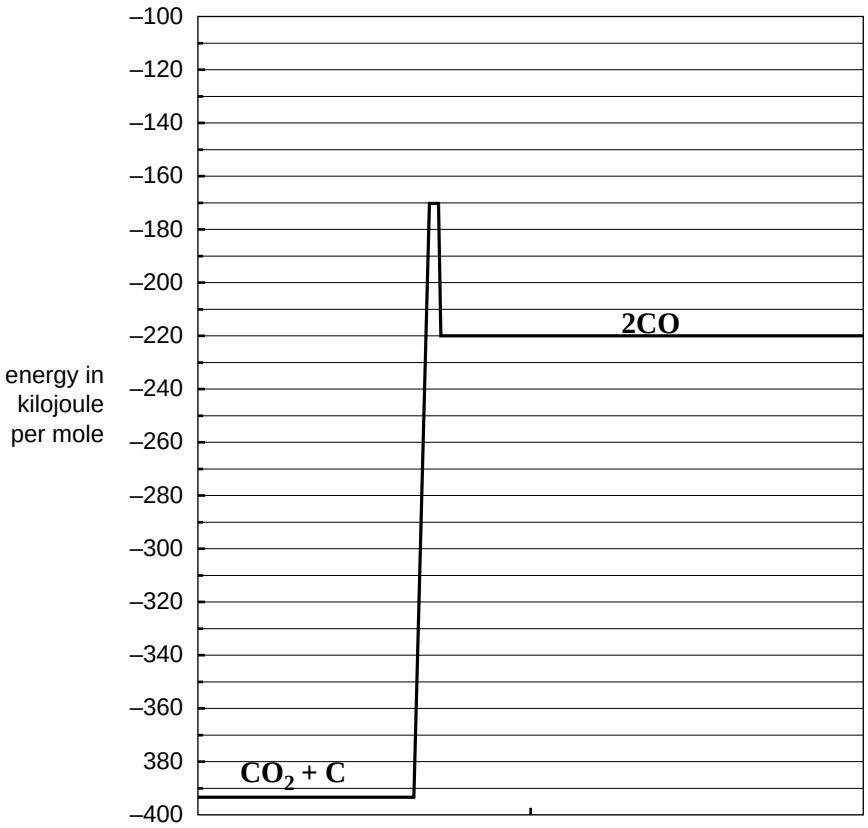
3 marks

Total 11 marks

(*suggested time: 15 minutes*)

Question 5

The following diagram represents an energy profile for the formation of carbon monoxide from CO_2 and carbon.



a. What is the ΔH value for the reaction

$4CO(g) \rightarrow 2C(s) + 2CO_2(g)$?

2 marks

b. What is the activation energy for the reaction

$CO_2(g) + C(s) \rightarrow 2CO(g)$?

1 mark

c. What is the activation energy for the reaction

$CO(g) \rightarrow \frac{1}{2} C(s) + \frac{1}{2} CO_2(g)$?

2 marks

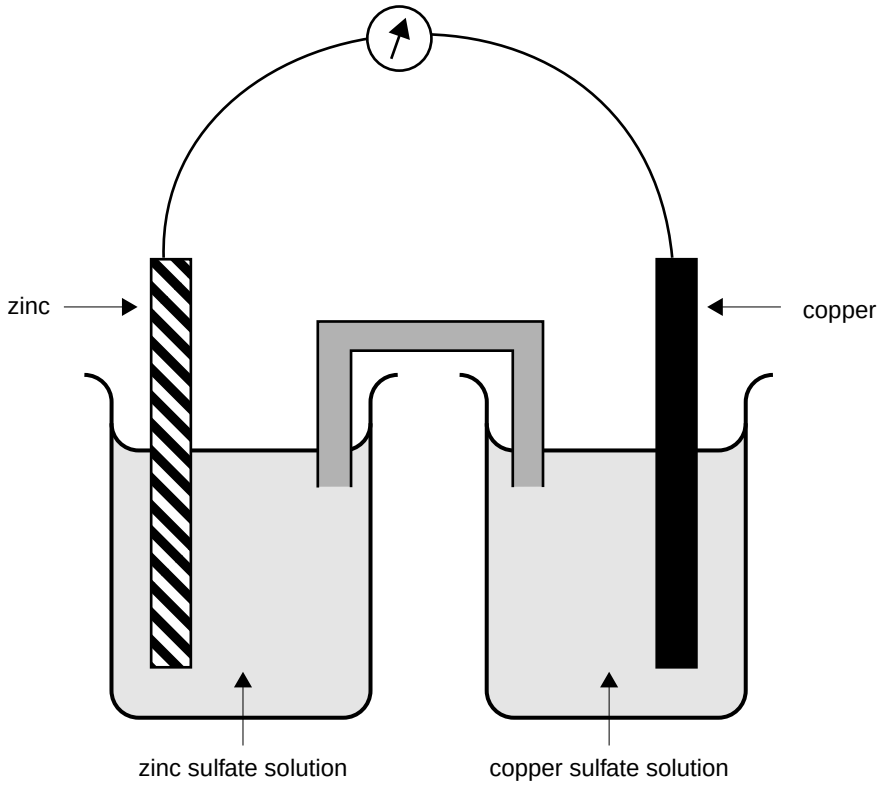
Total 5 marks

(*suggested time: 7 minutes*)

TURN OVER

Question 6

The Daniell cell was one of the first galvanic cells to be used commercially. A form of the Daniell cell is illustrated below.



a. Give **three** changes that might be observed in the above system if a large current flowed for several hours.

3 marks

b. On the diagram, indicate the direction of the flow of positive ions through the salt bridge.

1 mark

c. On the diagram, indicate the direction of the flow of electrons in the external circuit.

1 mark

d. Give a balanced half-equation for the reaction occurring at the anode.

1 mark

Total 6 marks

(*suggested time: 8 minutes*)

Question 7

a. Briefly describe the processes of nuclear fusion and nuclear fission, giving at least one example in each case. Equations may be used but are not essential.

Description of nuclear fusion

Description of nuclear fission

4 marks

b. Each one of the following scientists has contributed to the development of our understanding of atomic structure: Dalton, Bohr, Ramsay, Curie, Seaborg, Soddy, Meitner. Briefly describe the contribution of **one** of these individuals to our understanding of atomic structure.

Name chosen

Brief description of individual's contribution

1 mark

Total 5 marks

(*suggested time: 7 minutes*)

TURN OVER

Question 8

a. When two glucose units condense, the disaccharide maltose is produced. What is the molecular formula of maltose?

_____

_____

1 mark

b. The sugar fructose has the molecular formula $C_6H_{12}O_6$. Fructose can be oxidised in the body to form carbon dioxide and water. Write a molecular equation for this reaction.

_____

_____

1 mark

c. The energy released when fructose is oxidised can be determined using a bomb calorimeter. **Sketch** a bomb calorimeter suitable for studying the oxidation of fructose in oxygen. **Label** the key features of the bomb calorimeter.

3 marks

d. A bomb calorimeter has a calibration factor of 7690 J K^{-1}. When 0.252 g of fructose is burnt in excess oxygen in the calorimeter the temperature is observed to rise from 297.221 K to 297.733 K.

i. Calculate the heat evolved by the 0.252 g of fructose.

ii. Calculate the heat that would be evolved by burning one mole of fructose.

2 marks

Total 7 marks

(*suggested time: 9 minutes*)

Working space

END OF QUESTION AND ANSWER BOOK