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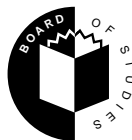
STUDENT NUMBER

Letter

Figures

Words

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**Victorian Certificate of Education
1999**

CHEMISTRY

Common Assessment Task 3: Written examination

Wednesday 10 November 1999: 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

<i>Number of questions</i>	<i>Number of questions to be answered</i>
11	11

Directions to students

Materials

Question and answer book of 14 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 book.

Answer **all** questions. Questions should be answered in the spaces provided in this book. The marks allotted to each question are indicated at the end of the question. There is a total of 77 marks available.

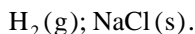
All written responses should be in English.

Instructions for students

There are 11 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 will 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



Question 1

This question tests your recall of some of the factual material studied in Unit 4.

- a. Some amino acids are classified as 'essential' whereas others as 'nonessential'. What is meant by essential and nonessential amino acids?

Essential amino acids _____

Nonessential amino acids _____

2 marks

- b. Give the formulas of **two** ions which can be a direct source of nitrogen for plants.

2 marks

- c. Give the formula of an oxide which dissolves in water to produce an acidic solution.

1 mark

- d. Why is a salt bridge used in a galvanic cell?

2 marks

- e. Give the formula of a suitable compound which can be used in solution in a salt bridge.

1 mark

Total 8 marks

Question 2

For each of the following statements, state whether it is true or false and give a reason for your choice.

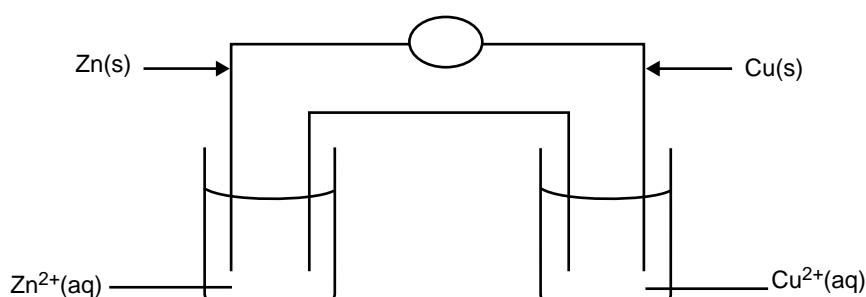
- a. When an aqueous solution of potassium iodide is electrolysed, potassium is deposited at the cathode.

True or False? _____

Reason _____

2 marks

- b. In the following galvanic cell, the mass of copper deposited at the cathode must equal the mass of zinc lost as zinc ions at the anode.



True or False? _____

Reason _____

2 marks

- c. The electronic configuration for potassium has one electron in a 4th shell even though the 3rd shell is not full.

True or False? _____

Reason _____

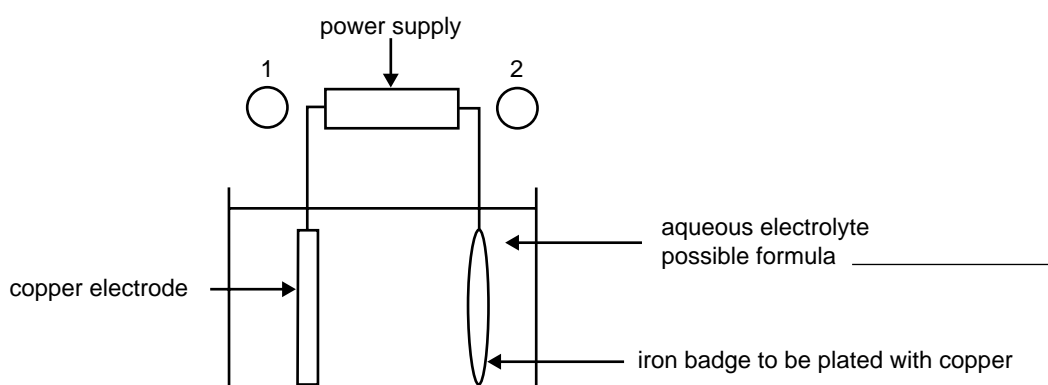
2 marks

Total 6 marks

TURN OVER

Question 3

Electrolysis is used to coat an iron badge with copper metal. A sketch of the experimental setup is given below.



a. On the diagram above

- label the polarity of the electrodes at points 1 and 2
- write the formula of a possible electrolyte in the space provided.

2 marks

b. i. Write an equation for the half reaction that occurs on the badge surface.

ii. A current of 2.7 A is passed through the cell for 24 minutes. Calculate the mass of copper that would be deposited on the badge in that time.

4 marks

c. A student is asked to coat another badge. Accidentally, the circuit was connected so that the direction of current flow was reversed. Describe what you expect to happen at the badge surface.

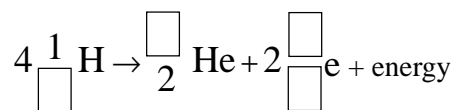
1 mark

Total 7 marks

Question 4

This question refers to energy transformations.

- a. i. Complete the following equation.



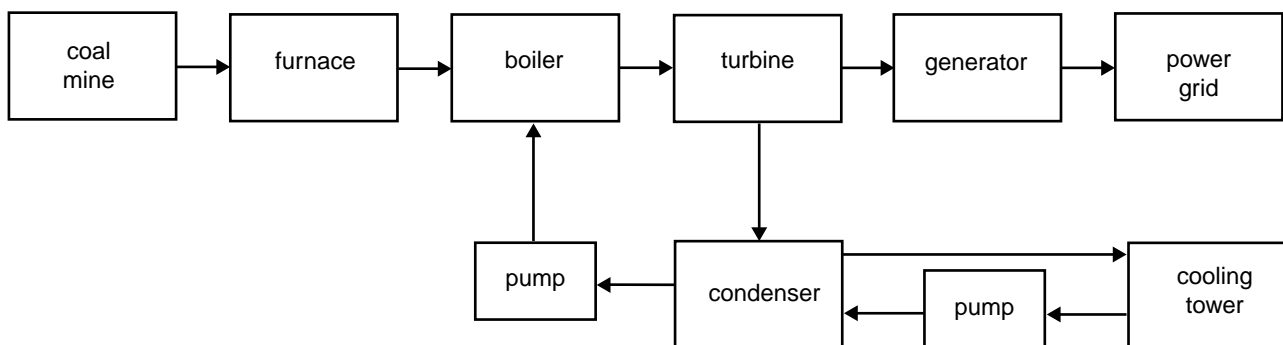
- ii. What type of nuclear reaction is represented by this equation?

- iii. Name one place where this reaction could occur.

- iv. What is the source of the energy released in this reaction?

5 marks

- b. The diagram below represents the process of generating electricity from coal in a power station.



Briefly identify the nature of the energy transformation that occurs in the

- i. furnace _____

- ii. turbine _____

- iii. generator _____

3 marks

- c. List two renewable energy sources.

1 mark

Total 9 marks

TURN OVER

Question 5

Two different fuels, (propane C_3H_8 (g) and ethanol C_2H_5OH (l)) were tested in a car.

- a. Write an equation for the complete combustion of each of these fuels in oxygen.

Propane C_3H_8 (g)

Ethanol C_2H_5OH (l)

3 marks

- b. When one mole of propane undergoes complete combustion, 2 220 kJ of energy are released.

Calculate the energy released from the combustion of 1.00 kg of propane.

2 marks

- c. When 1.00 kg of ethanol undergoes complete combustion, 30 000 kJ of energy are released.

List three factors to consider when choosing between propane and ethanol for use as a fuel for a car.

2 marks

Total 7 marks

Question 6

In answering this question, you will need to refer to the following compounds.

$C_3H_5(OH)_3$		$H_2NCH(CH_3)COOH$
Glycerol	Glucose	Alanine
$HOCOC_{17}H_{35}$	H_2NCH_2COOH	
Stearic acid	Glycine	Fructose

- a. Give the names of **two** of the above compounds which can react together to form a disaccharide.

1 mark

- b. i. Select **two** of the above compounds which can react together to form a dipeptide and give an equation for the reaction.

- ii. Name the type of reaction involved. _____

- iii. Circle the peptide link in the dipeptide.

4 marks

Total 5 marks

TURN OVER

Question 7

On the label of a bottle of vegetable oil is the following information.

The information refers to 100 gram of oil.

Energy (kJ)		3 400
Fats	– polyunsaturated	27%
	– monounsaturated	58%
	– saturated	15%

- a. State the fundamental difference between polyunsaturated, monounsaturated and saturated fats.

2 marks

- b. In order to check the energy content of the oil, a bomb calorimeter was first calibrated and its calibration factor determined.

- i. The calibration factor of the calorimeter was found by passing a current of 1.32 A, at a potential difference of 5.91 V, through the calorimeter for 6.50 minutes and recording the temperature rise of the water surrounding the bomb.

On the basis of the experimental results, the calibration factor was calculated to be $1\,135\text{ J }^{\circ}\text{C}^{-1}$.

If the final temperature of the water bath was found to be $22.36\text{ }^{\circ}\text{C}$, what was the initial temperature of the water bath in this experiment?

- ii. The same calorimeter was then used to determine the energy content of the oil. A mass of 0.500 g of the oil was burnt in the bomb in the presence of excess oxygen. The temperature of the water bath was found to increase from 20.02 °C to 34.48 °C .

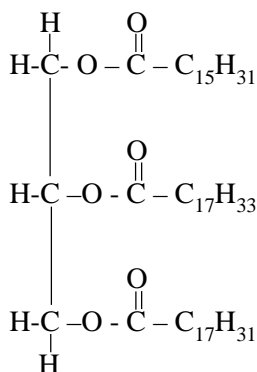
Calculate the energy content of the oil in kJ g^{-1} .

- iii. Compare your answer in ii. to the nutritional information given on the label of the bottle and describe **one** possible reason for the difference between the two values.

7 marks

- c. The following structural formula represents a fat molecule with three different fatty acid chains.

Circle any **unsaturated** fatty acid chains in the molecule.



1 mark

Total 10 marks

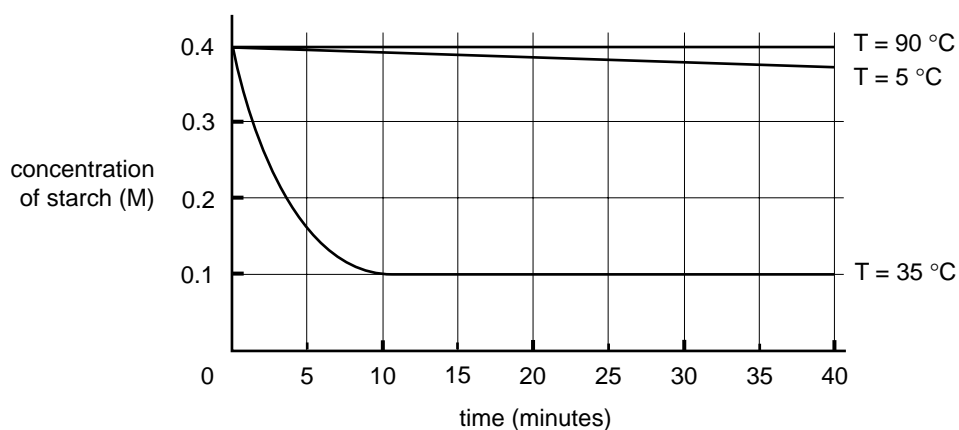
TURN OVER

Question 8

A biscuit is crushed and mixed with water. The biscuit contains starch, a carbohydrate polymer. The biscuit-water mixture is divided into three equal parts. Each part is placed in a separate water bath, maintained at a different temperature (90 °C, 35 °C and 5 °C).

Equal amounts of the enzyme, amylase, found in human saliva, are added to the samples of the mixture and the concentration of starch in each sample is measured over time.

The results are represented as follows.



- a. For the experiment conducted at 35 °C, estimate the time taken for the starch concentration to fall to half its original value.

1 mark

- b. Explain why the rate of decrease of starch was less at 5 °C than at 35 °C.

1 mark

- c. Explain why the reaction is so slow at 90 °C.

1 mark

- d. Give the name for this type of chemical reaction.

1 mark

- e. Name one possible product of this reaction.

1 mark

Total 5 marks

Question 10

Naturally occurring rhenium, an element in the third series of transition metals, consists of a mixture of two isotopes in the following approximate proportions.

^{185}Re (relative isotopic mass 184.95) = 37.50%

^{187}Re (relative isotopic mass 186.96) = 62.50%

a. ^{185}Re is a stable isotope while ^{187}Re is radioactive.

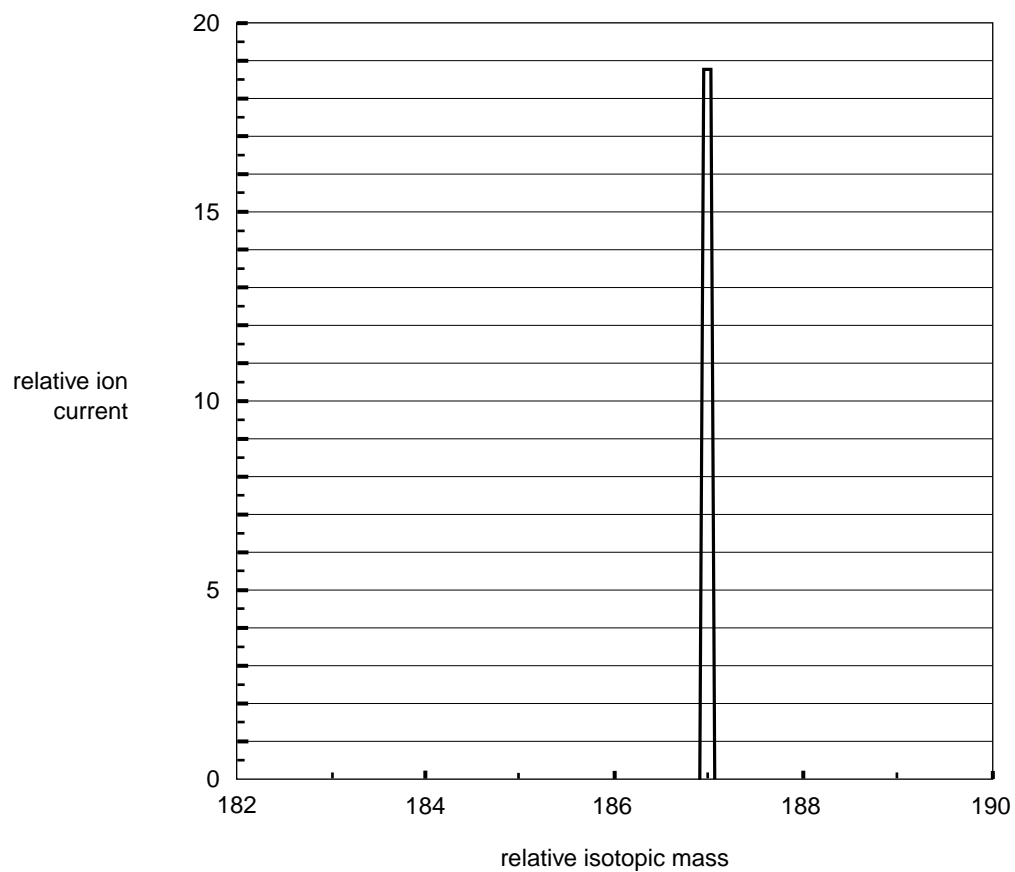
i. Explain the term 'stable' isotope.

ii. Nuclei of ^{187}Re decay by emitting beta particles (electrons). Write the symbol of the element that is produced as a result of this decay process.

iii. Calculate the mass, in gram, of a single ^{185}Re atom.

4 marks

- b. Below is shown a portion of the mass spectrum of a sample of naturally occurring rhenium.



- i. Calculate the height and position of the other peak you would expect to observe in the mass spectrum and sketch it on the above graph.

- ii. Calculate the relative atomic mass of rhenium.

4 marks

Total 8 marks

TURN OVER

Question 11

- a. You are given two different metals. One of them is a group I metal, the other a transition metal.

Suggest a physical property that you could measure to distinguish between the two metals. Explain how the result of this measurement would enable you to make the distinction.

1 mark

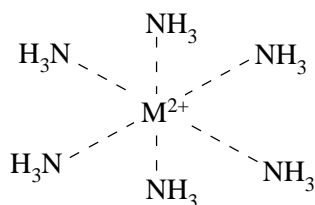
- b. Select a transition metal that shows variable oxidation states and has some compounds that are coloured.

- i. Give formulas of two **compounds** to illustrate the different oxidation states of your chosen element.

- ii. Identify a coloured compound (that is, one that is not white) of the element and write an equation showing how the compound might be formed from the element.

4 marks

- c. The structural formula below represents a complex ion of a transition metal, M, with ammonia.



Describe the bonding between the metal ion and the ammonia molecules.

1 mark

Total 6 marks