SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

									Letter
Figures									
Words									

Victorian Certificate of Education
1997
CHEMISTRY
Common Assessment Task 1: Written examination

Monday 16 June 1997: 11.45 am to 1.30 pm
Reading time: 11.45 am to 12 noon
Writing time: 12 noon to 1.30 pm
Total writing time: 1 hour 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*
A	17	17
B	5	5

Directions to students

Materials
Question and answer book of 15 pages, with a detachable data sheet in the centrefold.
Answer sheet for multiple-choice questions. You should have at least one pencil and an eraser.
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 and your **name** and **student number** in the space provided on the answer sheet for multiple-choice questions.
This paper consists of two sections, Section A and Section B.
Answer **all** questions from Section A. Section A is worth 17 marks.
Section A questions should be answered on the answer sheet provided for multiple-choice questions.
Answer **all** questions from Section B. Section B is worth 49 marks.
Section B questions should be answered in the spaces provided in this book.
There is a total of 66 marks available.
Working space is provided throughout this book.
All written responses should be in English.

At the end of the task
Place the answer sheet for multiple-choice questions inside the front cover of this book and hand them in.

SECTION A

Specific instructions for Section A

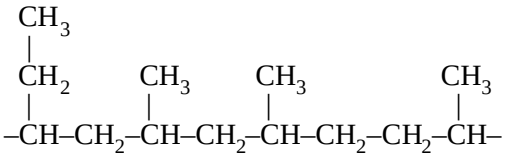
Section A consists of 17 multiple-choice questions. Section A is worth approximately 26 per cent of the marks available. You should spend approximately 23 minutes on this section.

Choose the response that is **correct** or **best answers** the question, and indicate your choice on the multiple-choice answer sheet according to the instructions on that sheet.

A correct answer is worth 1 mark, an incorrect answer is worth no marks. No mark will be given if more than one answer is completed for any question. Marks will **not** be deducted for incorrect answers. You should attempt every question.

Question 1

The following segment of a polymer chain has been built up from monomers



This segment could have been made from

A. $CH_3CH_2CH = CH_2$ and $CH_3CH = CH_2$

B. $CH_3CH = CH_2$ and $CH_2 = CH_2$

C. $CH_3CH_2CH = CH_2$ only

D. $CH_3CH = CH_2$ only

Question 2

An isomer of a compound is another compound that has the same

A. number of protons but a different number of neutrons.

B. molecular formula but a different molar mass.

C. molar mass but a different molecular formula.

D. molecular formula but different properties.

Question 3

The following equilibrium system is established

$$Fe^{3+}(aq) + SCN^{-}(aq) \rightleftharpoons FeSCN^{2+}(aq)$$

A small amount of solid KSCN is added. As the KSCN dissolves, the concentration of $SCN^{-}(aq)$ is initially increased. When the equilibrium is re-established, how will the equilibrium concentrations of the various species have changed compared with their concentrations before the addition of KSCN?

	$[Fe^{3+}(aq)]$	**$[SCN^{-}(aq)]$**	**$[FeSCN^{2+}(aq)]$**
A.	unchanged	increased	unchanged
B.	decreased	decreased	increased
C.	decreased	increased	increased
D.	increased	unchanged	decreased

The following information is referred to in Questions 4 and 5 below.

Sulfuric acid is prepared commercially by the contact process. A flow chart indicating the main stages of this process is given below.

$$S \rightarrow SO_2 \rightarrow SO_3 \rightarrow H_2S_2O_7 \rightarrow H_2SO_4$$

Question 4

The oxidation number of the sulfur in each of the species listed in the flow chart is

	S	**SO_2**	**SO_3**	**$H_2S_2O_7$**	**H_2SO_4**
A.	0	+4	+6	+6	+6
B.	0	+4	+6	+7	+6
C.	0	+2	+3	+5	+6
D.	0	+4	+6	+7	+8

Question 5

$V_2O_5(s)$ is involved in the conversion $SO_2 \rightarrow SO_3$. The main purpose of the V_2O_5 is to

A. provide an extra source of oxygen in order to increase the yield of product.

B. remove impurities from the reaction vessel.

C. increase the rate of the reaction at the operating temperature.

D. absorb the heat evolved during the reaction.

Question 6

Give the name and molecular formula of a compound that has six carbon atoms and belongs to the same homologous series as C_3H_8.

A. hexene C_6H_{14}

B. hexene C_6H_{12}

C. hexane C_6H_{14}

D. hexane C_6H_{12}

Question 7

In the following reaction

$$Mg(s) + H_2SO_4(aq) \rightarrow H_2(g) + MgSO_4(aq)$$

H_2SO_4 is acting as

A. an oxidant.

B. a reductant.

C. an acid.

D. a dehydrating agent.

Question 8

Which one of the following statements is most likely to be correct?

Sulfur and sulfur-containing compounds are removed from crude oil before it is distilled. This is done to

A. increase the rate of the fractional distillation process.

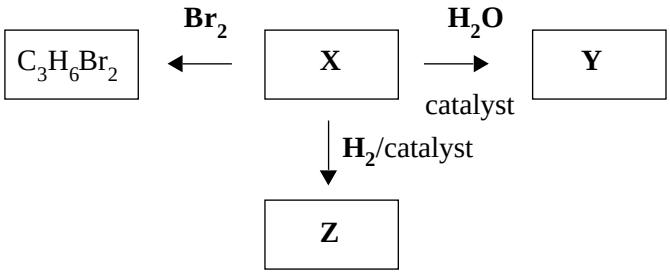
B. produce higher density by-products.

C. make the distillation process safer.

D. minimise the production of sulfur dioxide when the oil is eventually burnt.

Question 9

In the following diagram



substances **X, Y** and **Z** are probably

	X	**Y**	**Z**
A.	C_3H_8	C_3H_7OH	C_3H_8
B.	C_3H_8	C_3H_6OH	C_3H_6
C.	C_3H_6	C_3H_6OH	C_3H_8
D.	C_3H_6	C_3H_7OH	C_3H_8

Question 10

A 100 mL solution of HCl has a pH of 1.5

If the solution is diluted to 1.0 L, the pH of the new solution will be

A. 0.5

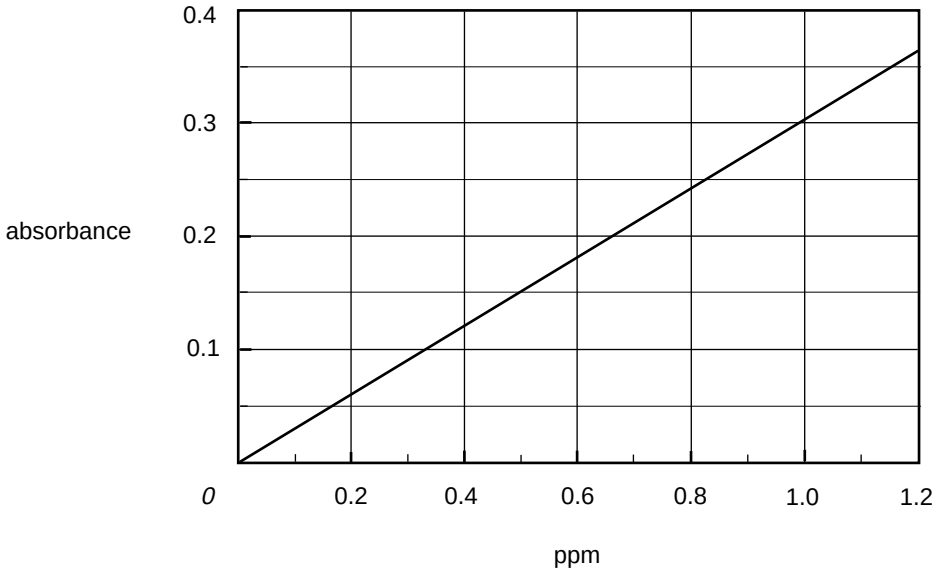
B. 1.5

C. 2.5

D. 3.5

Question 11

The graph below shows the relationship between absorbance and copper content of a liquid sample as measured using atomic absorption spectroscopy (AAS).



The amount of copper in baby food was determined using atomic absorption spectroscopy. A 5.0 mL sample was diluted to 250 mL with water and the absorbance observed in an AAS experiment was 0.30. The concentration of copper, in ppm, in the undiluted baby food was

A. 0.3

B. 0.8

C. 40

D. 50

Question 12

During 1997 you may have studied a number of instrumental analytical techniques, including high performance liquid chromatography, ultraviolet and visible spectroscopy, and atomic absorption spectroscopy. Which one of the following statements is correct **only** for atomic absorption spectroscopy?

A. A sample is passed over a stationary phase.

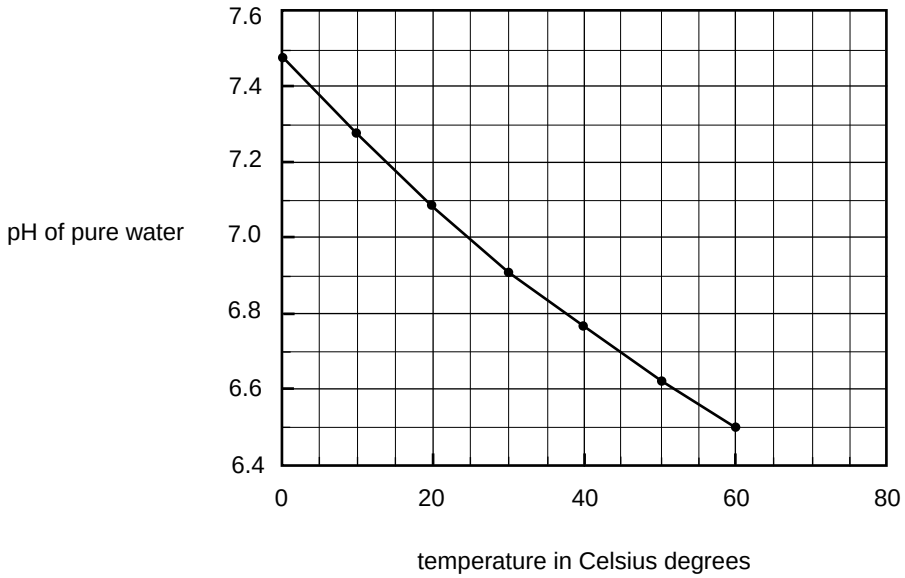
B. A detector is used to measure light.

C. A monochromator is used to select a desired wavelength.

D. A sample is sprayed into a flame.

The following graph is referred to in Questions 13, 14 and 15.

This graph shows the variation of the pH of pure water as a function of temperature.



Question 13

The $[OH^-]$ in pure water at 0 °C will be approximately

A. $10^{-6.5}$

B. $10^{-7.0}$

C. $10^{-7.5}$

D. 10^{-14}

Question 14

At 60 °C, the pH of a neutral aqueous solution would be

A. 0

B. 6.5

C. 7.0

D. 7.5

Question 15

At 60 °C, K_w for water will be

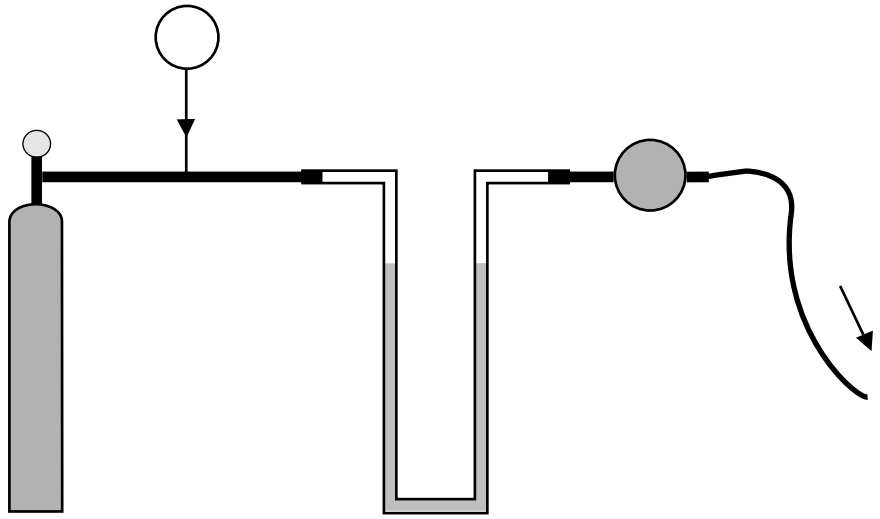
A. $10^{-6.5}$

B. $10^{-7.0}$

C. 10^{-13}

D. 10^{-14}

Question 16



The above diagram probably represents an experimental arrangement for

A. infrared spectroscopy.

B. UV-visible spectroscopy.

C. atomic absorption spectroscopy.

D. gas chromatography.

Question 17

A mixture of two substances is separated using paper chromatography. The substance with the greater R_f value

A. moves further and is more strongly absorbed on the paper.

B. moves further and is less strongly absorbed on the paper.

C. moves less and is more strongly absorbed on the paper.

D. moves less and is less strongly absorbed on the paper.

END OF SECTION A
TURN OVER

SECTION B

Specific instructions for Section B

Section B consists of five short-answer questions. You should answer all of these questions. This section is worth approximately 74 per cent of the total. You should spend approximately 67 minutes on this section.

The marks allotted are shown at the end of each part of each question.

Questions should be answered in the spaces provided in this book.

To obtain full marks for your responses you should

- give simplified answers with an appropriate number of significant figures for all numerical questions; unsimplified answers will not be given full marks.
- 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 all chemical equations are balanced and that the formulas for individual substances include an indication of state {for example, $H_2(g)$; NaCl(s)}.

Question 1

Hydrogen, which is used for the synthesis of ammonia, is sometimes made from the reaction

$$CH_4(g) + H_2O(g) \underset{1030\ K}{\overset{\text{Ni catalyst}}{\rightleftharpoons}} CO(g) + 3H_2(g);\ \Delta H = 206\ kJ\ mol^{-1}$$

In a research laboratory, some methane and water are added to a 1000 cm^3 reaction vessel and equilibrium is established.

a. More CO(g) at 1030 K is added. As a result, the temperature in the reaction vessel should

rise **fall** **remain constant**

Circle the correct response above **and** explain your answer in the space below.

3 marks

b. The total pressure on the reacting system is increased by decreasing the volume of the reaction vessel. As a result the yield of hydrogen would

increase **decrease** **remain constant**

Circle the correct response **and** explain your answer in the space below.

2 marks

c. The total pressure on the reacting system is increased by adding argon (an inert gas) to the reaction vessel without changing its volume. As a result the yield of hydrogen would

increase **decrease** **remain constant**

Circle the correct response **and** explain your answer in the space below.

2 marks

d. Equal number of mole of methane and water are added to an empty reaction vessel at 1030 K in the presence of the nickel catalyst. The system reaches equilibrium. At equilibrium, the concentrations of methane and water are each 0.012 M and the concentration of carbon monoxide is 0.0083 M. What is the concentration of hydrogen?

1 mark

e. Give an expression for the equilibrium constant for the reaction and calculate its value at 1030 K.

2 marks

Total 10 marks

(*suggested time: 14 minutes*)

Question 2

a. A compound is found to contain 52.2% by mass of carbon and 13.0% by mass of hydrogen; the rest is oxygen. Show that the compound has the empirical formula C_2H_6O.

3 marks

b. The compound is a liquid at room temperature but is a gas at 120 °C. At 120 °C, a 0.373 g sample of the gaseous compound occupies a volume of 265 mL at a pressure of 750 mmHg. Show that the molar mass of the compound is 46 g mol^{-1}.

3 marks

c. Given that the compound is an alcohol, give the name of the alcohol **and** write an equation showing how it can be prepared from ethene.

2 marks

Total 8 marks

(*suggested time: 11 minutes*)

Question 3

A blast furnace is used to produce iron. Carbon dioxide (CO_2) is produced in three distinctly different ways inside the blast furnace. Write a chemical equation for each of the three different CO_2-producing reactions **and** briefly explain the role or roles the reaction plays in the production of iron.

first equation

_____

_____

explanation _____

_____

_____

_____

second equation

_____

_____

explanation _____

_____

_____

_____

third equation

_____

_____

explanation _____

_____

_____

_____

7 marks

(*suggested time: 10 minutes*)

Question 4

The concentration of hydrochloric acid in a liquid concrete cleaner was determined using the following method.

A 25.00 mL sample was diluted to 250 mL in a volumetric flask. A pipette was used to transfer a 10.00 mL sample of this diluted concrete cleaner to a conical flask. An indicator was added and the sample of diluted concrete cleaner was titrated against a 0.200 M solution of sodium carbonate in a burette. The titre was found to be 23.15 mL.

The equation for the reaction is

$$2HCl(aq) + Na_2CO_3(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

a. What amount, in mole, of Na_2CO_3 has reacted?

2 marks

b. What amount, in mole, of HCl reacted with the Na_2CO_3?

1 mark

c. What was the concentration of HCl in the 250 mL volumetric flask?

1 mark

d. What was the concentration of HCl in the original sample of concrete cleaner?

1 mark

e. Give **two** safety precautions that should be taken when carrying out the above analysis.

2 marks

f. When preparing for the above analysis, it is necessary to carefully wash and rinse all items of volumetric glassware before use.

Show which liquid should be used for the **final** rinse for each of the three items in the table below by placing a tick in the appropriate box.

	distilled water	dilute concrete cleaner solution	standard sodium carbonate solution
pipette			
burette			
conical flask			

3 marks

g. **Justify your choice of final rinsing liquid for the pipette** by explaining how **each** of the two **wrong choices** would have affected the final value of the HCl concentration.

wrong choice 1 _____

Explain the effect wrong choice 1 would have on the final result.

_____

_____

_____

wrong choice 2 _____

Explain the effect wrong choice 2 would have on the final result.

_____

_____

_____

2 marks

Total 12 marks

(*suggested time: 16 minutes*)

Question 5

a. Homogenised milk is an oil-in-water emulsion, while butter is a water-in-oil emulsion. Explain the difference between these two types of emulsion. You may use a labelled diagram to assist your explanation.

2 marks

b. Emulsions normally need to be ‘stabilised’.

i. What happens to an emulsion that is not stabilised?

1 mark

ii. Describe the chemical nature of a good stabiliser.

2 marks

c. Briefly describe **two** tests that would enable you to distinguish between an oil-in-water and a water-in-oil emulsion. Briefly describe the result you would expect from **each** type of emulsion for **each** test in the table provided.

	oil-in-water emulsion	**water-in-oil emulsion**
Test 1 – brief description	**test result**	**test result**
Test 2 – brief description	**test result**	**test result**

4 marks

d. A major fraction of palm oil is palmitic acid which has the chemical formula $CH_3(CH_2)_{14}COOH$. When palmitic acid is reacted with potassium hydroxide, KOH, the major component of a well-known soap is formed.

i. Write a chemical equation for the reaction between palm oil and potassium hydroxide.

1 mark

ii. When palm oil and potassium hydroxide react the product formed is a much better surfactant than palmitic acid itself. Explain why.

2 marks

Total 12 marks

(*suggested time: 16 minutes*)

END OF QUESTION AND ANSWER BOOK