1996

CHEMISTRY
2 UNIT

NEW SOUTH WALES
HSC TRIAL EXAMINATION
AND SOLUTIONS

CHEMISTRY ASSOCIATES
PO BOX 2227
KEW
VICTORIA 3101
AUSTRALIA
TEL: (03) 9817 5374 FAX: (03) 9817 4334

email: chemas@vicnet.net.au
Internet: http://www.vicnet.net.au/~chemas/education.htm

CHEMISTRY ASSOCIATES
PO BOX 2227
KEW VIC 3101 **FAX: (03) 9817 4334**

HIGHER SCHOOL CERTIFICATE EXAMINATION

1996
CHEMISTRY
2 UNIT
Section I - Core

(not to be used before Monday August 5, 1996)

Time allowed - Three hours
(Plus 5 minutes reading time)

DIRECTIONS TO CANDIDATES

Section I - Core

- Attempt ALL questions.
- **Part A** 15 multiple-choice questions, each worth 1 mark.
  Mark your answers in pencil on the Answer Sheet provided.
- **Part B** 10 questions, each worth 3 marks.
  Answer this part in the Part B Answer Book.
- **Part C** 6 questions, each worth 5 marks.
  Answer this part in the Part C Answer Book.
- Write your Student Number and Centre Number on each Answer Book.
- You may keep this Question Book. Anything written in the Question Book will NOT be marked.

Section II- Electives

- Attempt ONE question.
- Each question is worth 25 marks.
- Answer the question is a *separate* Elective Answer Booklet.
- Write your Student Number and Centre Number on the cover of each Elective Answer Book.
- Write the Course, Elective Name, and Question Number on the cover of each Elective Answer Book.
- You may ask for extra Elective Answer Books if you need them.

A Periodic Table and Data Sheet are provided with this paper.

SECTION I - CORE

PART A

Attempt ALL questions.
Each question is worth 1 mark.
Select the alternative A, B, C or D that best answers the question.
Mark your answers in pencil on the Answer Sheet provided.

1. Select the group in which exactly **two** substances have ionic bonds.

(A) Water, sodium chloride, carbon dioxide, magnesium oxide.

(B) Water, butane, paraffin wax, hydrogen chloride

(C) Diamond, sodium chloride, paraffin wax, ethanol.

(D) Ethanol, oxygen, calcium oxide, steam.

2. One of the compounds formed when chlorine reacts with propane is 1,1-dichloropropane. This type of reaction is called

(A) addition.

(B) oxidation.

(C) hydrolysis.

(D) substitution.

3. Which one of the following solutions has the highest pH?

(A) 0.2 M sodium carbonate.

(B) 0.1 M sodium hydroxide.

(C) 0.1 M sodium chloride.

(D) 0.2 M hydrochloric acid.

4. 1-butene and cyclobutane are **isomers** because they have

(A) the same molecular formula and the same structural formula.

(B) the same structural formula but different molecular formulae.

(C) the same molecular formula but different structural formulae.

(D) different molecular formulae and different structural formulae.

5. Which one of the following chemical substances has hydrogen bonding in the solid state?

(A) graphite.

(B) water.

(C) sodium.

(D) hydrogen.

6. A chemical equation has the equilibrium constant expression $K = \frac{[W]^2[X]}{[Y]^3[Z]^2}$.

The chemical equation is

(A) $W + X \rightleftharpoons Y + Z$

(B) $3W + 2X \rightleftharpoons 2Y + Z$

(C) $3Y + 2Z \rightleftharpoons 2W + X$

(D) $2W + X \rightleftharpoons 3Y + 2Z$

7. Which group has atoms and ions with the same electronic configuration?

(A) O, Ne, Al^{3+}

(B) O^{2-}, He, Al

(C) O, He, Al^{3+}

(D) O^{2-}, Ne, Al^{3+}

8. A scientist measures the melting temperature and the electrical conductivity of each of the following solids: iodine, copper, diamond and sodium chloride.

The solid with the greatest electrical conductivity and the solid with the highest melting temperature **in that order** are

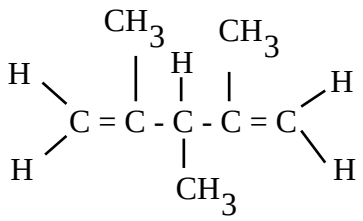
(A) copper and diamond.

(B) sodium chloride and iodine.

(C) diamond and sodium chloride.

(D) iodine and copper.

9.



The IUPAC systematic name for the compound with the structural formula shown above is

(A) 2,3,4-trimethyl-1,4-pentadiene.

(B) 2,4-dimethyl-1,4-pentadiene.

(C) 2,3,4-trimethyl-1,5-pentadiene.

(D) 2,4-dimethyl-1,5-pentadiene.

10. The volume of 0.1 M sodium hydroxide required to react exactly with 20.0 mL of 0.2 M of a **diprotic** acid is

(A) 20 mL.

(B) 40 mL.

(C) 60 mL.

(D) 80 mL.

11. Which one of the following statements about chemical equilibrium is correct?

Chemical equilibrium is reached when

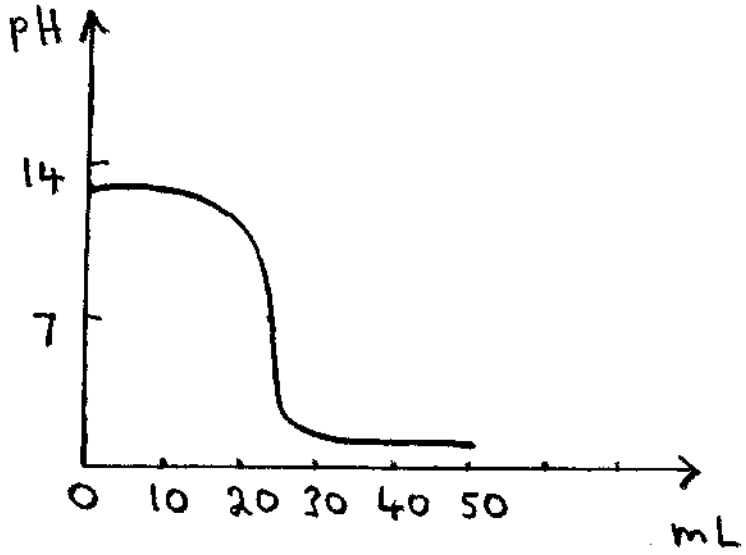
(A) the rate of the forward reaction is equal to the rate of the reverse reaction.

(B) the rate of the forward reaction is less than the rate of the reverse reaction.

(C) the rate of the forward reaction is greater than the rate of the reverse reaction.

(D) the concentration of the products is equal to the concentration of the reactants.

12.



Which one of the following titrations **could** be described by the graph shown above.

(A) 0.2 M HCl is added to 25 mL of 0.4 M NaOH.

(B) 0.2 M HCl is added to 25 mL of 0.2 M NaOH.

(C) 0.2 M HCl is added to 25 mL of 0.1 M NaOH.

(D) 0.2 M HCl is added to 25 mL of 0.05 M NaOH.

13. The electronic configuration of the nitride ion, N^{3-}, is

(A) $1s^2\ 2s^2$

(B) $1s^2\ 2s^2\ 2p^6$

(C) $1s^2\ 2s^2\ 2p^6 3s^2 3p^1$

(D) $1s^2\ 2s^2\ 2p^6 3s^2\ 3p^6$

14. One mole of a diprotic acid is dissolved in ten litres of solution and complete dissociation occurs. The pH of this solution is closest to

(A) 0.1

(B) 0.5

(C) 0.7

(D) 1

15. The equilibrium between NO(g), O_2(g) and NO_2(g) is described by the equation:

$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$; exothermic reaction

When chemical equilibrium has been reached in this system

(A) all chemical reactions have stopped.

(B) only the forward chemical reaction continues.

(C) only the reverse chemical reaction continues.

(D) both forward and reverse chemical reactions continue.

END PART A

PART B

Attempt **ALL** questions.

Each question is worth 3 marks.

Answer all questions in the Answer Book provided.

In questions involving calculations, you are advised to show working, as marks may be awarded for relevant working.

Question 16

(a) Write the electronic configuration of

(i) the aluminium atom, Al

(ii) the aluminium cation, Al^{3+}

in terms of shells and subshells.

(b) Explain why aluminium does not easily form the ion Al^{4+}.

Question 17

Some of the properties of ethane and ethanol are listed in the table below.

Substance	Relative mass	State at 25°C	Solubility in water
ethane (C_2H_6)	**30**	**gas**	**insoluble**
ethanol (C_2H_5OH)	**46**	**liquid**	**completely soluble**

(a) Draw a structural formula for ethanol

(b) Explain in terms of bonding, the state and solubility properties of ethane and ethanol listed in the table above.

Question 18

(a) How much water must be added to 100 mL of 0.20 mol L^{-1} sodium hydroxide to obtain a solution of concentration 0.05 mol L^{-1}?

(b) 20.0 mL of 0.15 mol L^{-1} hydrochloric acid is titrated with 0.05 mol L^{-l} sodium hydroxide.

What volume of sodium hydroxide is required for neutralisation?

(c) What is the pH of the resulting solution?

Question 19

(a) Write a chemical equation that shows how ammonium chloride forms an acidic solution in water.

(b) Write a chemical equation that shows how sodium bicarbonate forms an alkaline solution in water.

(c) Write the formula of the conjugate base of the ion NH_4^+.

Question 20

Write chemical equations for each of the following:

(a) Bromine gas reacts with butane.

(b) Bromine gas reacts with 1-butene.

(c) Potassium permanganate reacts with 1-butanol

Question 21

Write down the names and structural formulae, where required, for the missing products, labelled **X , Y** in each of the following reactions.

C_3H_8 + H_2O (H_2SO_4 catalyst) → **X** propene	**X** + strong oxidant → **Y** (e.g. acidified $K_2Cr_2O_7$) (assume complete oxidation)

(a) What is the name of compound **X**?

(b) What is the name of compound **Y**?

(c) Write the structural formula of **Y**?

Question 22

(a) Write a balanced chemical equation for the production of ethanol from glucose ($C_6H_{12}O_6$) as the starting material.

(b) What name is given to the reaction in (a)

(c) Write a balanced chemical equation for the reaction of ethanol with oxygen in an internal combustion engine.

Question 23

(a) Carbon tetrachloride is a liquid at room temperature and has been used as a fire extinguisher. Draw the structure of carbon tetrachloride.

(b) Explain why carbon tetrachloride is a liquid while the structurally similar methane is a gas under the same conditions of temperature and pressure.

Question 24.

(a) A major constituent of petrol is heptane, C_7H_{16}. When a car engine is not running efficiently, incomplete combustion with oxygen takes place and carbon monoxide is produced. Write a balanced chemical equation for the production of carbon monoxide and water from the incomplete combustion of heptane.

(b) An alkane can be represented by the general formula C_nH_{2n+2}. Write a balanced chemical equation for the complete combustion of this general alkane with oxygen gas.

Question 25

The equation describing the formation of ammonia is:

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$; exothermic reaction

(a) Write the expression for the equilibrium constant for this equation.

(b) What is the effect on the yield of ammonia gas at equilibrium if the temperature of this equilibrium system is increased. Explain your answer.

(c) If the volume of the vessel is increased at a constant temperature of 350^oC, what would be the effect on the number of mole of NH_3 present when equilibrium is re-established? Explain your answer.

END PART B

PART C

Attempt **ALL** questions.

Each question is worth 5 marks.

Answer all questions in the Answer Book provided.

In questions involving calculations, you are advised to show working, as marks may be awarded for relevant working.

Question 26

The following table shows some of the properties of the oxides of the Period 3 elements.

	sodium	magnesium	aluminium	silicon	phosphorus	sulfur	chlorine
formula	Na_2O	MgO	Al_2O_3	SiO_2	----------	SO_3	Cl_2O_7
appearance at 20^oC	white solid	white solid	white solid	colourless solid	white solid	colourless liquid	colourless liquid
melting temperature (^oC)	920	3802	2027	1710	422	17	-92

(a) Give the chemical formula for the oxide of phosphorus that contains phosphorus in the +5 oxidation state.

(b) What type of bonding would be found in Na_2O and MgO?

(c) What type of bonding would be found in SiO_2 , SO_3 and Cl_2O_7?

(d) Describe the trend in acid-base behaviour of these oxides going across the Period.

Question 27

Hydrogen, $H_2(g)$, bromine $Br_2(g)$ and hydrogen bromide HBr(g) exist in equilibrium according to the equation: $H_2(g) + Br_2(g) \rightleftharpoons 2HBr(g)$.

An equilibrium mixture contains 1.5 mol of Br_2, 0.25 mol of H_2 and 0.50 mol of HBr at a fixed temperature.

(a) Calculate the equilibrium constant for this reaction.

(b) Explain why changing the volume of the reaction vessel, at constant temperature, will not affect the position of equilibrium

(c) In another experiment conducted at the same temperature, some HBr was admitted to an evacuated 2 L vessel and, when equilibrium was obtained, decomposition of the HBr had yielded 3.16 mol of Br_2 as one product.

(i) What was the concentration of each species at equilibrium?

(ii) How many mole of HBr was originally let into the vessel?

Question 28

50 mL of 0.10 M HNO_3 is mixed with 70 mL of 0.10 M $Ca(OH)_2$

(a) Write a balanced chemical equation for the reaction between HNO_3 and $Ca(OH)_2$.

(b) How many mole of hydroxide ions is present in the mixture **before** the reaction?

(c) How many mole of hydroxide ions is present in the mixture **after** the reaction?

(d) What volume of 0.05 M H_2SO_4 is required to neutralise the mixture?

Question 29

(a) Draw the structural formula for the ester, ethyl acetate.

(b) Write a balanced chemical equation for the production of this ester.

(c) Describe the laboratory method by which this ester could be produced.

(d) A student suggests that ethyl acetate could just as easily be produced by heating the reactants together in an open beaker. Explain why this would **not** be an appropriate method.

Question 30

(a) Draw the structural formula for ethene.

(b) Give **two** differences between the structure of ethane and the structure of ethene.

(c) Write a balanced chemical equation showing how ethane could be produced from ethene.

(d) Write a balanced chemical equation for the reaction between ethene and bromine.

Question 31

Sodium carbonate can exist in both an anhydrous state (without water) and a hydrated state (with water).

A sample of sodium carbonate contains an unknown quantity of water and is represented by the formula $Na_2CO_3.xH_2O(s)$. Dilute hydrochloric acid can be used to determine the amount of water in this hydrated sodium carbonate.

In a laboratory experiment ,a student finds that 0.400 g of a **hydrated** form of sodium carbonate reacts exactly with 45 mL of 0.100 M HCl

(a) Write a balanced chemical equation for the reaction between solid hydrated sodium carbonate and dilute hydrochloric acid.

(b) Calculate the number of mole of hydrochloric acid used and, hence, calculate the number of mole of hydrated sodium carbonate used in this experiment.

(c) Calculate the value of *x* in the formula $Na_2CO_3.xH_2O$.

END PART C

SECTION II - ELECTIVES

(25 Marks)

Attempt **ONE** question.
Answer the question in a separate Elective Answer Book.
In questions involving calculations, show all necessary working.
Marks may be awarded for relevant working.

Question 32 Chemical Energy **Marks**

(a) Helium gas behaves approximately like an ideal gas.

(i) Explain briefly what is meant by an ideal gas. 2

(ii) Calculate the mass of helium gas occupying a volume of 50 L at a temperature of 0^oC and a pressure of 9.0×10^5 Pa. 2

(b) The gas methane is an excellent fuel. It reacts with oxygen according to the equation: $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ $\Delta H = -889$ kJ mol^{-1}

(i) How much energy is evolved when 50 g of methane is burnt completely? 2

(ii) How much energy is evolved when 50 L of methane at a temperature of 298K and a pressure of 101.3 kPa is burnt completely? 2

(iii) How many mole of methane must be burnt completely to produce 50 kJ of heat energy? 2

(c) A packet of salted peanuts contains the following nutritional information on a 50 g net packet.

energy	**1194 kJ**
protein	**12.2 g**
carbohydrate	**4.3 g**
fat	**24.5 g**
fibre	**4.1 g**

To determine the energy content of the peanuts, they are burnt in oxygen inside a container.

It takes 25 kJ to raise the temperature of this container by 1 ^oC.

All of the peanuts in the packet are crushed to a fine powder and reacted completely with oxygen gas in the container.

(i) Why are the peanuts crushed before combustion? 1

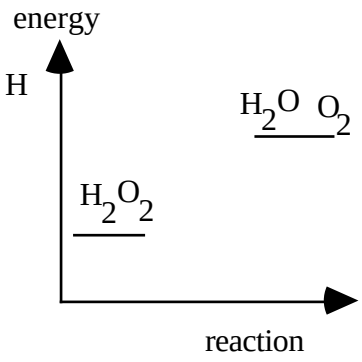
(ii) The temperature in the calorimeter rises by 46 ^oC.
Calculate the energy content of the packet of peanuts. 1

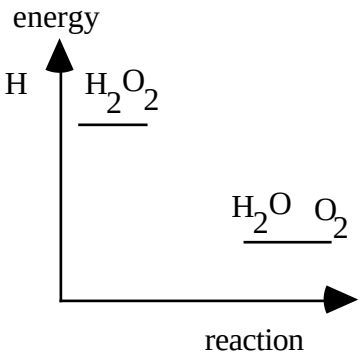
(iii) Give one possible reason why the experimentally determined energy is different from the energy given on the packet. 1

(iv) Calculate the percentage of the energy given on the packet that comes from the fat in the peanuts, given that the heat of combustion of fat is 39 kJ g^{-1}. 2

Question 32 (continued) **Marks**

(d) When a solution of hydrogen peroxide is allowed to stand for a time, decomposition occurs slowly according to the equation
$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$. This is an exothermic reaction.





(i) Which **one** of the diagrams above best describes this exothermic reaction? 1

(ii) Give a reason for your choice. 2

(e) The enthalpies of formation of three gases are shown in the table below.

GAS	FORMULA	ENTHALPY OF FORMATION
water	$H_2O(g)$	-242 kJ mol^{-1}
carbon dioxide	$CO_2(g)$	-393 kJ mol^{-1}
acetylene	$C_2H_2(g)$	+227 kJ mol^{-1}

(i) Determine whether hydrogen or acetylene would provide a welder with a greater amount of heat energy on a mass basis. 5

(ii) Calculate the factor by which the chosen gas provides more energy. 2

Question 33 Oxidation and Reduction **Marks**

(a) Use the chemical equation $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ to explain each of the following.

(i) oxidation

(ii) oxidant

(iii) reductant 3

(b) You are provided with the following chemicals and materials:
$Zn(s)$, $Cu(s)$, $Zn(NO_3)_2(aq)$, $Cu(NO_3)_2(aq)$, filter paper, $NaCl(aq)$, connecting wires.

(i) Draw a fully-labelled diagram showing how these chemicals and materials could be used to construct an electrochemical cell. 3

(ii) Write the half-equation for the oxidation reaction. 1

(iii) Write the half-equation for the reduction reaction. 1

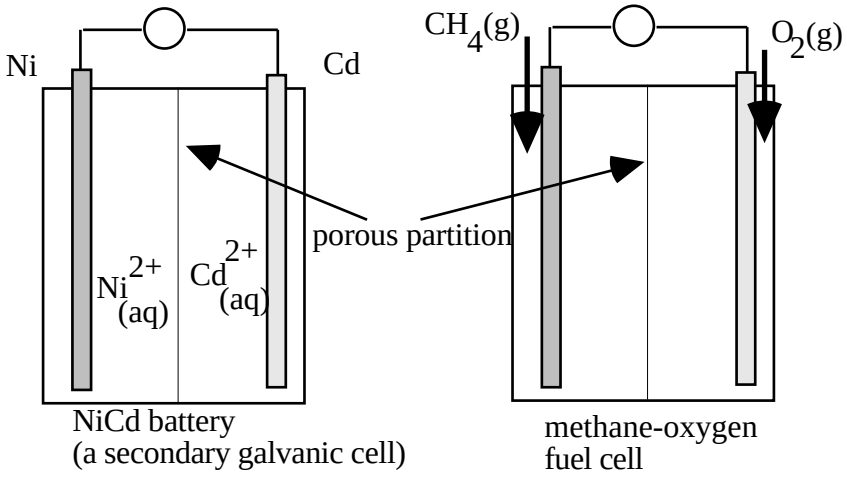
(iv) Write the overall equation for the reaction. 1

(v) Calculate the standard potential for this electrochemical cell 1

Question 33 (continued) **Marks**

(c) Two sources of energy that are undergoing continuous improvement for our energy-hungry world are the secondary galvanic cell and the fuel cell.

Examples of each of these are shown in **simplified diagrams** below.



(i) Write a balanced chemical equation for the overall reaction occurring in the nickel-cadmium (NiCd) battery during use. 1

(ii) What is the maximum potential that could be expected from this battery? 1

(iii) Write a balanced chemical equation for the overall reaction occurring in the methane-oxygen fuel cell. 1

(c) One of the advantages of the NiCd cell is that it can be recharged.

(iv) Write the half-cell equation for the reaction occurring at the nickel electrode during recharging. 1

(v) Comment on the polarity and the potential that should be used during the recharging process. 2

(vi) Eventually, the NiCd cell loses its ability to be recharged. Give one reason for this. 1

Question 33 (continued) **Marks**

(d) Some standard electrode potentials for metals are given in the table below.

Solution and Metal	Standard Electrode Potential
$Ag^{+}(aq)$, Ag(s)	+0.80 V
$Fe^{2+}(aq)$, Fe(s)	-0.44 V
$Cu^{2+}(aq)$, Cu(s)	+0.34 V
$Zn^{2+}(aq)$, Zn(s)	-0.76 V
$Pb^{2+}(aq)$, Pb(s)	-0.14 V
$Mg^{2+}(aq)$, Mg(s)	-2.34 V

(i) Which species is the weakest reductant? 1

(ii) Which species is the strongest oxidant? 1

(iii) In which solution(s), if any, would Zn rods be coated with another metal? Explain your answer. 2

(iv) Which of the metals - Ag(s), Zn(s) or Mg(s) would be coated with Pb when immersed in $Pb(NO_3)_2(aq)$
Explain your answer. 2

(v) Which metals from this list could be used to prevent the corrosion of Fe? Explain your answer. 2

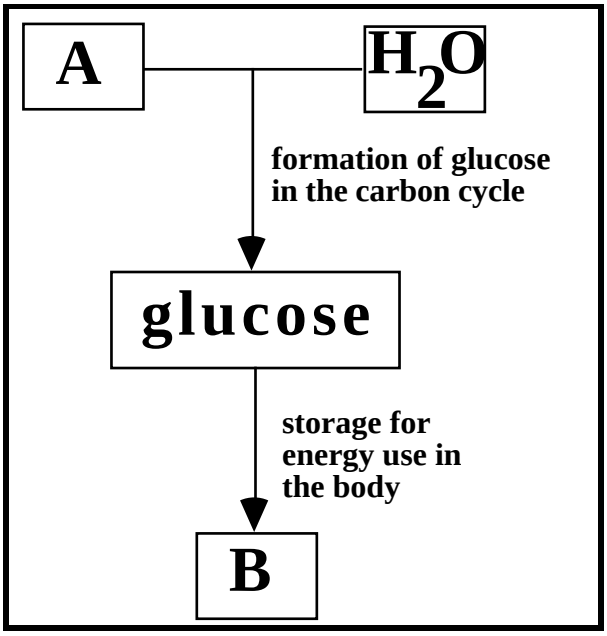
Question 34 Biological Chemistry **Marks**

(a) (i) Give the name and chemical formula of a complex carbohydrate that can be digested in the human body. 2

(ii) Give the name and chemical formula of a complex carbohydrate that **cannot** be digested in the human body. 2

(iii) Give a reason why the complex carbohydrate in (ii) cannot be digested. 1

(b) The following flowchart shows two of the chemical reactions involving the production and use of glucose



(i) Give the name of compound **A**. 1

(ii) Give the name of process by which glucose is formed. 1

(iii) Give the name of compound **B**. 1

Question 34 (continued) **Marks**

(c) Two amino acids in the vegetarian diet have the formulae

where R and Z are groups of atoms.

(i) Draw the structure of the dipeptide produced when these amino acids combine. 2

(ii) What name is given to this type of reaction? 1

(iii) What other compound is produced in this reaction? 1

(d) Proteins act as important catalysts in biochemical reactions.

(i) What does a biochemical catalyst do? 1

(ii) By referring to the structure of proteins, explain what is meant by the **denaturation** of a protein and its subsequent loss of biochemical activity. 3

(iii) Name one factor that can cause the denaturation of a protein. 1

(e) Complete the following table for a series of laboratory tests on glucose, starch and protein. 6

Chemical Tested	Reagent Used	Expected Results
Glucose		
Starch		
Protein		

(f) Explain how lactic acid can sometimes be produced from the reaction of glucose in living cells. 2

Question 35 Chemistry and the Environment **Marks**

(a) The table below shows the ranges of different chemicals found in metropolitan reservoir water supplies in three Australian State capital cities.
The figures are given in parts per million (ppm).

Chemical	Sydney	Adelaide	Melbourne
Na^+ and K^+	8.3 - 13.8	82 - 106	4.2
Ca^{2+}	1.5 - 9.7	16 - 28	1.6
Mg^{2+}	1.6 - 50	13 - 20	1.1
Fe^{3+}	0.1 - 0.3	0.1 - 0.3	0.15
Cl^-	14.5 - 21.5	141 - 172	7.5
HCO_3^-	3.2 - 44.8	71 - 112	6.0
SO_4^{2-}	2.3 - 8.2	17 - 40	2.2
total hardness (as $CaCO_3$)	11 - 48	102 - 137	10.0
total dissolved solids (TDS)	52 - 99	344 - 409	37.0

(i) Give one reason for the large variation in Na^+ content of these three water supplies. 1

(ii) Name one chemical from the table that would cause a pH greater than 7. 1

(iii) Describe with the aid of a chemical equation a test that could identify the presence of Cl^- in Adelaide water. 2

(iv) Describe with the aid of a chemical equation a test that could identify the presence of SO_4^{2-} in water. 2

(v) How would the total dissolved solids (TDS) figures be obtained for this table? 2

The water in Adelaide is much ‘harder’ than in Sydney.

(vi) What is the effect of hard water in a water supply? 1

(vii) How can hardness in water be controlled? 1

Question 35 (continued) **Marks**

(b) One of the many chemicals found in swimming-pool water is the weak acid, HClO, hypochlorous acid. HClO exists in equilibrium according to the reversible equation

$$HClO(aq) \Leftrightarrow H^+(aq) + ClO^-(aq).$$

This equation has an equilibrium constant of 5.0×10^{-8} at 298 K.

In a 100 mL sample of swimming-pool water at 298 K, the concentration of hypochlorous acid is found to be 5.0×10^{-8} mol L^{-1}.
The pH of the water is measured as 6.7

(i) How many mole of hypochlorous acid is present in the sample? 1

(ii) What is the concentration of hypochlorite ions in the pool water? 1

(iii) What would happen to the concentration of hypochlorite ions if the pH of the pool water were raised to 7.8? 2

(c) The atmosphere is both a source of valuable chemicals and a dumping group for waste materials.

(i) Name two gases that are extracted from the atmosphere for use in our society. Name one use for each gas 2

(ii) Describe a test with the aid of a chemical equation that would identify one of these gases. 2

(iii) Name two waste substances that are discarded into the atmosphere. 2

Question 35 (continued) **Marks**

(d) (i) Which isotope of uranium is present in the larger amount in uranium ore? 1

(ii) Explain what is meant by the enrichment of uranium. 1

(iii) Name one dangerous product from a fission reactor. 1

(iv) How can this product be re-used? 1

(v) How can this product be stored safely? 1

END OF QUESTION BOOKLET

1996 HSC CHEMISTRY TRIAL EXAMINATION

CHEMISTRY ASSOCIATES
P.O. BOX 2227
KEW, VIC., 3101
AUSTRALIA
TEL:(03) 9817 5374 FAX: (03) 9817 4334

CHEMISTRY ASSOCIATES
P.O. BOX 2227
KEW, VIC., 3101
AUSTRALIA
TEL:(03) 9817 5374 FAX: (03) 9817 4334

Higher School Certificate Trial Examination 1996

CENTRE NO.				

DIRECTIONS:

Write your Student Number in the slots provided below as indicated by the large arrow.

Then, in the column of digits below each box, blacken the area which has the same number as you have written in the box. Fill in one area only in each column.

Read each question and its suggested answers. When you have decided which answer is correct, fill in the response area completely with an ordinary pencil. Mark only one area per question. If you change your mind, erase your first mark completely, then make a new mark. Make no stray marks, they may count against you. Do not use a ball-point or ink pen.

SAMPLE: Sydney is A-a country B-a mountain C-an island D-a city

A	B	C	■

CHEMISTRY - 2 UNIT

PART A - ATTEMPT ALL QUESTIONS

STUDENT NUMBER

1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6
7	7	7	7	7	7	7
8	8	8	8	8	8	8
9	9	9	9	9	9	9

PART A

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D

STUDENTS SHOULD NOW CONTINUE WITH PART B

STUDENT NUMBER

CENTRE NUMBER

Higher School Certificate Trial Examination

1996

CHEMISTRY

2 UNIT

PART B ANSWER BOOK

DIRECTIONS TO CANDIDATES

- Write your Student Number and Centre Number at the top right hand corner of this page.
- You should receive this paper with an Answer Sheet for Part A and a Part C Answer Book, and an Elective Answer Book
- Answer Questions 16 to 25 in this Answer Book.
- Questions 16 to 25 are worth 3 marks each.
- Answer the questions in the spaces provided.

EXAMINER'S USE ONLY

PART	Mark	Examiner	Check
B			

EXAMINER'S USE ONLY

PART B

Questions 16 to 25 (3 marks each)
Attempt ALL questions.
Answer questions 16 to 25 in the spaces provided.

16. **(a) (i)** .....

(ii).....

(b) .....

.....

.....

.....

17. **(a)**

(b) .....

.....

.....

.....

EXAMINER'S USE ONLY

18. **(a)** .....

.....

.....

.....

.....

(b) .....

.....

.....

.....

.....

(c) .....

.....

.....

.....

.....

19. **(a)** .....

.....

.....

(b) .....

.....

.....

(c) .....

.....

.....

EXAMINER'S USE ONLY

20. **(a)** .....

.....

(b) .....

.....

(c) .....

.....

---

21. **(a)** .....

(b) .....

(c)

---

22. **(a)** .....

.....

(b) .....

.....

.....

(c) .....

.....

EXAMINER'S USE ONLY

23. **(a)**

(b) .....

.....

.....

24. **(a)** .....

.....

(b) .....

.....

.....

25. **(a)** .....

.....

.....

.....

(b) .....

.....

.....

.....

(c) .....

.....

.....

.....

END OF PART B ANSWER BOOK

CHEMISTRY ASSOCIATES
P.O. BOX 2227
KEW, VIC., 3101
AUSTRALIA
TEL:(03) 9817 5374 FAX: (03) 9817 4334

STUDENT NUMBER

CENTRE NUMBER

Higher School Certificate Trial Examination

1996

CHEMISTRY

2 UNIT

PART C ANSWER BOOK

DIRECTIONS TO CANDIDATES

- Write your Student Number and Centre Number at the top right hand corner of this page.
- You should receive this paper with an Answer Sheet for Part A and a Part B Answer Book, and an Elective Answer Book
- Answer Questions 26 to 31 in this Answer Book.
- Questions 26 to 31 are worth 5 marks each.
- Answer the questions in the spaces provided.

EXAMINER'S USE ONLY

PART	Mark	Examiner	Check
C			

EXAMINER'S USE ONLY

PART C

Questions 26 to 31 (5 marks each)
Attempt **ALL** questions.
Answer questions 26 to 31 in the spaces provided.

26. **(a)** .....

(b) .....

.....

.....

.....

(c) .....

.....

.....

.....

(d) .....

.....

.....

.....

EXAMINER'S USE ONLY

27. **(a)** .....

.....

.....

.....

(b) .....

.....

.....

.....

(c) (i) .....

.....

.....

.....

(ii) .....

.....

.....

.....

EXAMINER'S USE ONLY

28. **(a)** .....

.....

(b) .....

.....

.....

.....

.....

(c) .....

.....

.....

.....

.....

(d) .....

.....

.....

.....

.....

EXAMINER'S USE ONLY

29. (a)

(b) .....

.....

(c) .....

.....

.....

.....

.....

(d) .....

.....

.....

.....

.....

EXAMINER'S USE ONLY

30. (a)

(b) (i) .....

.....

.....

(ii).....

.....

.....

(c) .....

.....

(d) .....

.....

EXAMINER'S USE ONLY

31. **(a)** .....

.....

(b) .....

.....

.....

.....

.....

.....

.....

(c) .....

.....

.....

.....

.....

.....

.....

END OF PART C ANSWER BOOK

CHEMISTRY ASSOCIATES
P.O. Box 2227
Kew, Vic., 3101
Fax: (03) 9817 4334

STUDENT NUMBER

CENTRE NUMBER

ALL SCIENCE SUBJECTS
ALL COURSES

ELECTIVES/MODULES
ANSWER BOOK

COURSE	NAME OF ELECTIVE / MODULE	QUESTION / MODULE NUMBER

DIRECTIONS TO CANDIDATES

- Write your Student Number and Centre Number at the top right hand corner of this page
- In the table above:

  (i) write the name of the course you are doing;

  (ii) write the name of the Elective / Module you are answering.

  (iii) write the Question / Module Number of the Elective / Module you are answering.
- Only ONE Elective / Module should be attempted in this Answer Book.

EXAMINER'S USE ONLY

Question / Module Number	Mark	Examiner	Check

Candidates may ask for an extra Electives / Modules Answer Book if extra space is required for the answer. This practice is not encouraged, as marks are awarded on the *content* of the answer and *not* on the *length* of the answer.

EXAMINER'S USE ONLY

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

EXAMINER'S USE ONLY

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

EXAMINER'S USE ONLY

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

EXAMINER'S USE ONLY

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

EXAMINER'S USE ONLY

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

EXAMINER'S USE ONLY

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

EXAMINER'S USE ONLY

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

END OF ELECTIVE / MODULE ANSWER BOOK

1996 HSC CHEMISTRY 2 UNIT TRIAL EXAMINATION

DATA SHEET

- Values of several numerical constants -

Avogadro's constant, N_A	6.022 x 10^{23} mol^{-1}
Boltzmann's constant, *k*	1.381 x 10-23 J K^{-1}
Elementary charge, *e*	1.602 x 10^{-19} C
Faraday constant, *F*	96 490 C mol^{-1}
Gas constant, *R*	8.314 J K^{-1} mol^{-1}
	0.0821 L atm K^{-1} mol^{-1}
Ionisation constant for water at 298 K (25^{o}C), K_w	1.0 x 10^{-14}
Mass of electron, m_e	9.109 x 10^{-31} kg
Mass of neutron, m_n	1.675 x 10^{-27} kg
Mass of proton, m_p	1.673 x 10^{-27} kg
Volume of 1 mole ideal gas at 101.3 kPa (1.00 atm) and	
at 273 K (0^{o}C)	22.41 L
at 298 K (25^{o}C)	24.47 L

l Some standard potentials

$K^+ + e^-$	$\Leftrightarrow$	$K(s)$	-2.92 V
$Ba^{2+} + 2e^-$	$\Leftrightarrow$	$Ba(s)$	-2.90 V
$Ca^{2+} + 2e^-$	$\Leftrightarrow$	$Ca(s)$	-2.87 V
$Na^+ + e^-$	$\Leftrightarrow$	$Na(s)$	-2.71 V
$Mg^{2+} + 2e^-$	$\Leftrightarrow$	$Mg(s)$	-2.36 V
$Al^{3+} + 3e^-$	$\Leftrightarrow$	$Al(s)$	-1.66 V
$Mn^{2+} + 2e^-$	$\Leftrightarrow$	$Mn(s)$	-1.18V
$H_2O + e^-$	$\Leftrightarrow$	$\frac{1}{2} H_2(g) + OH^-$	-0.83 V
$Zn^{2+} + 2e^-$	$\Leftrightarrow$	$Zn(s)$	-0.76 V
$Fe^{2+} + 2e^-$	$\Leftrightarrow$	$Fe(s)$	-0.41 V
$Cd^{2+} + 2e^-$	$\Leftrightarrow$	$Cd(s)$	-0.40 V
$Ni^{2+} + 2e^-$	$\Leftrightarrow$	$Ni(s)$	-0.23 V
$Sn^{2+} + 2e^-$	$\Leftrightarrow$	$Sn(s)$	-0.14 V
$Pb^{2+} + 2e^-$	$\Leftrightarrow$	$Pb(s)$	-0.13 V
$H^+ + e^-$	$\Leftrightarrow$	$\frac{1}{2} H_2(g)$	0.00 V
$SO_4^{2-} + 4H^+ + 2e^-$	$\Leftrightarrow$	$H_2SO_3 + H_2O$	0.17 V
$Cu^{2+} + 2e^-$	$\Leftrightarrow$	$Cu(s)$	0.35 V
$\frac{1}{2} O_2(g) + H_2O + 2e^-$	$\Leftrightarrow$	$2OH^-$	0.40 V
$Cu^+ + e^-$	$\Leftrightarrow$	$Cu(s)$	0.52 V
$\frac{1}{2} I_2(s) + e^-$	$\Leftrightarrow$	I^-	0.54 V
$\frac{1}{2} I_2(aq) + e^-$	$\Leftrightarrow$	I^-	0.62 V
$Fe^{3+} + e^-$	$\Leftrightarrow$	Fe^{2+}	0.77 V
$Ag^+ + e^-$	$\Leftrightarrow$	$Ag(s)$	0.80 V
$\frac{1}{2} Br_2(l) + e^-$	$\Leftrightarrow$	Br^-	1.07 V
$\frac{1}{2} Br_2(aq) + e^-$	$\Leftrightarrow$	Br^-	1.09 V
$\frac{1}{2} O_2(g) + 2H^+ + 2e^-$	$\Leftrightarrow$	H_2O	1.23 V
$\frac{1}{2} Cl_2(g) + e^-$	$\Leftrightarrow$	Cl^-	1.36 V
$\frac{1}{2} Cl_2(aq) + e^-$	$\Leftrightarrow$	Cl^-	1.40 V
$MnO_4^- + 8H^+ + 5e^-$	$\Leftrightarrow$	$Mn^{2+} + 4H_2O$	1.51 V
$\frac{1}{2} F_2(g) + e^-$	$\Leftrightarrow$	F^-	2.87 V

SECTION I CORE PART A.

1. **A** Sodium chloride and magnesium oxide have ionic bonding.
Water and carbon dioxide have covalent bonding

2. **D** The chlorine atoms have taken the place of the hydrogen atoms.
It is a substitution reaction

3. **B** Sodium hydroxide is a strong base while sodium carbonate is a weak base. Hence, 0.1 M NaOH will have the highest pH.

4. **C** Isomers have the same molecular formula but different structural formulae.

5. **B** Of these, only water has hydrogen bonding.

6. **C** The products are on the top line of the fraction raised to the power of the equation coefficient. The reactants are on the bottom line of the fraction raised to the power of the equation coefficient.

7. **D** O^{2-}, Ne and Al^{3+} all have 10 electrons the electronic configuration $1s^2\ 2s^2\ 2p^6$.

8. **A** The solid with the best electrical conductivity is the metal copper which has weakly held valence electrons. The solid with the highest melting temperature is the covalent solid diamond which has strong covalent bonds holding the carbon atoms together.

9. **A** The longest carbon chain has 5 carbon atoms and the double bonds start at the first and fourth carbon atoms. Hence, it is 1, 4-pentadiene. The methyl groups are attached to the second, third and fourth carbon atoms.
Hence, the name is 2,3,4 trimethyl-1,4-pentadiene.

10. **D** The concentration of hydrogen ions in the diprotic acid = 0.4 M.
Hence, 4 x 20 mL = 80 mL of 0.1 M sodium hydroxide will be required.

11. **A** Chemical equilibrium is reached when the rate of the forward reaction is equal to the rate of the reverse reaction.

12. **B** From the graph, a pH of 7 is reached when 25 mL of the acid has been added. Hence, the acid must have the same hydrogen ion concentration as the sodium hydroxide has hydroxide concentration (0.2 M).

13. **B** The nitride ion has 10 electrons. Hence, the electronic configuration is $1s^2\ 2s^2\ 2p^6$.

14. **C** The concentration of the acid is 0.1 M. Hence, [H+] = 2 x 0.1 = 0.2 M.
Hence, pH = $-\log_{10}$ (0.2) = 0.7

15. **D** In a chemical equilibrium, both the forward and the reverse reactions continue at the same rate. It is dynamic equilibrium.

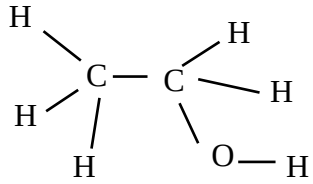
PART B
Question 16

(a) (i) Al(13) $1s^2 2s^2 2p^6 3s^2 3p^1$

(ii) Al^{3+} $1s^2 2s^2 2p^6$

(b) The ion Al^{3+} has a full second electron shell. A lot of extra energy is required to remove the next electron. Hence, Al^{4+} does not form easily.

Question 17
(a)



(b) The bonding between ethane molecules (dispersion forces) is much weaker than the bonding between ethanol molecules (dipole-dipole interaction).

Hence, ethane is a gas while ethanol is a liquid at 25^oC.
Unlike ethane, ethanol can form hydrogen bonds with water molecules.
Hence, ethanol is soluble in water while ethane is insoluble.

Question 18

(a) n(NaOH) = 0.1 x 0.2 = 0.02.
Hence, V(NaOH) = $\frac{0.02}{0.05}$ = 0.4 L.
Hence, V(water added) = 400 - 100 = 300 mL **ANS**

(b) The balanced equation is: $HCl + NaOH = NaCl + H_2O$

Hence, n(NaOH) = n(HCl) = 0.02 x 0.15 = 0.003.
Hence, V(NaOH) = $\frac{0.003}{0.05}$ = 0.06 L = 60 mL **ANS**

(c) The pH of the resulting solution is 7 since this is the neutralisation of a strong acid by a strong base

Question 19

(a) Hydronium ions are produced in solution according to the equations:

$NH_4Cl(s) \rightarrow NH_4^+(aq) + Cl^-(aq)$.

Then, $NH_4^+(aq) + H_2O(l) \rightarrow H_3O^+(aq) + NH_3(aq)$

(b) Hydroxide ions are produced in solution according to the equations:

$NaHCO_3(s) \rightarrow Na^+(aq) + HCO_3^-(aq)$

Then, $HCO_3^-(aq) + H_2O(l) \rightarrow OH^-(aq) + CO_3^{2-}(aq)$

(c) The conjugate base of the ion NH_4^+ is NH_3.

Question 20

(a) $CH_3CH_2CH_2CH_3 + Br_2 \rightarrow CH_3CH_2CH_2CH_2Br + HBr$
(many other substitution reactions are also possible)

(b) $CH_2{=}CHCH_2CH_3 + Br_2 \rightarrow CH_2BrCHBrCH_2CH_3$

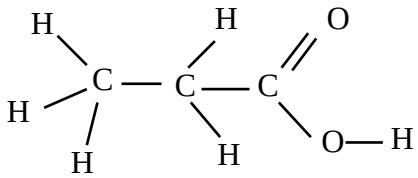
(c) $CH_3CH_2CH_2CH_2OH + (KMnO_4 / H^+) \rightarrow CH_3CH_2CH_2COOH + (Mn^{2+} / H_2O)$
(it is not intended that students write the balanced partial equations)

Question 21

(a) The addition of water to propene produces propanol.

(b) The oxidation of propanol with potassium dichromate produces propanoic acid.

(c) The structural formula of propanoic acid is



Question 22

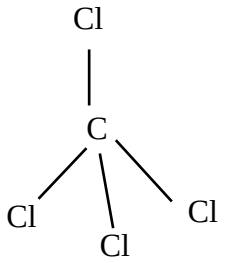
(a) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

(b) This reaction is called fermentation.

(c) $C_2H_5OH(g) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$

Question 23

(a) Carbon tetrachloride is a tetrahedral molecule like methane as shown in the structural formula below.



(b) The intermolecular bonding in carbon tetrachloride is stronger than the intermolecular bonding in methane because chlorine atoms contain more electrons. Hence, carbon tetrachloride is a liquid while methane is a gas under the same conditions of temperature and pressure.

Question 24

(a) The balanced equation for the incomplete combustion of heptane is:

$$C_7H_{16}(l) + \frac{15}{2}O_2(g) \rightarrow 7CO(g) + 8H_2O(g)$$

(b) $$C_nH_{2n+2} + \frac{3n+1}{2}O_2 \rightarrow nCO_2 + (n+1)H_2O$$

Question 25

(a) $$K = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

(b) When the temperature is increased, the equilibrium shifts in favour of the endothermic reaction. That is, the reverse reaction is favoured. Hence, the yield of ammonia decreases. Also, the value of the equilibrium constant decreases.

(c) When the volume is increased at constant temperature, the equilibrium shifts in favour of the reaction producing the larger number of mole of gas. Hence, the reverse reaction is favoured. Hence, the number of mole of NH_3 decreases. It should be noted that the value of the equilibrium constant remains the same since the temperature is unchanged.

PART C

Question 26

(a) The oxide of phosphorus is $P_4O_{10}(s)$.

(b) The oxides of sodium and magnesium have ionic bonding with the ions Na^+, Mg^{2+} and O^{2-}.

(c) SiO_2 is a giant molecule with covalent bonding. SO_3 and Cl_2O_7 have covalent bonding within the molecules and dispersion forces between the molecules.

(d) The oxides become increasingly acidic moving across the Period. Sodium and magnesium oxides are basic. Aluminium oxide is amphoteric. The other oxides are acidic. Equations showing these properties include:

$Na_2O + H_2O \rightarrow 2NaOH$;

$Al_2O_3 + 6H^+ \rightarrow 2Al^{3+} + 3H_2O$;

$Al_2O_3 + 2OH^- + 3H_2O \rightarrow 2Al(OH)_4^-$

$SO_3 + H_2O \rightarrow H_2SO_4$

Question 27

(a) $K = \dfrac{[HBr]^2}{[H_2]\{Br_2]} = \dfrac{(0.5)^2}{0.25 \text{ x } 1.5} = 0.67$ **ANS**

(b) There is an equal number of mole of gas on both sides of the equation. Hence, the volume cancels out in the calculation.

(c) (i) $[H_2]_e = [Br_2]_e = \dfrac{3.16}{2} = 1.58$ M **ANS**

Since the temperature is the same, the value of the equilibrium constant is the same. Hence, $[HBr]e = \sqrt{0.67 \text{ x } 1.58 \text{ x } 1.58} = 1.29$ M **ANS**

(ii) Number of mole of HBr originally = $n(HBr)_e + 2 \text{ x } n(Br_2)_e$
$= (1.29 \text{ x } 2) + (2 \text{ x } 3.16) = 8.9$ mole **ANS**

Question 28

(a) The balanced equation is: $2HNO_3(aq) + Ca(OH)_2(aq) \rightarrow Ca(NO_3)_2(aq) + 2H_2O(l)$

(b) $n(OH^-)$ present before the reaction = 0.10 x 2 x 0.070 = 0.014 **ANS**

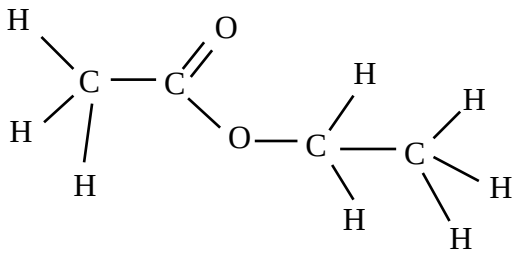
(c) $n(OH^-)$ left after the reaction = $n(OH^-)$ originally present - $n(OH^-)$ used up in the reaction
= $n(OH^-)$ originally present - $n(H^+)$ used up in the reaction

= 0.014 - (0.1 x 0.05) = 0.014 - 0.005 = 0.009 mol **ANS**

(d) Volume of 0.05 M H_2SO_4 required to neutralise = $\frac{0.009}{0.1}$ = 0.09 L = 90 mL **ANS**

Question 29

(a) Ethyl acetate has the structure shown below.



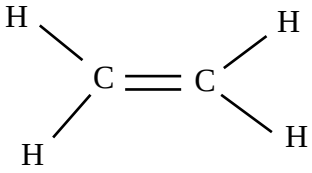
(b) $CH_3COOH(aq) + C_2H_5OH(aq) \rightarrow CH_3COOC_2H_5(aq) + H_2O(l)$

(c) The ethanoic acid and ethanol are heated together in a pear-shaped flask containing boiling chips. A water condenser is attached to the top of the flask so the mixture is heated under reflux.

(d) Heating the mixture in an open beaker would result in the loss of the volatile reactants and products. Hence, this would not be a suitable method.

Question 30

(a) Ethene has the structure shown below.



(b) (i) Ethane contains only single covalent bonds while ethene has one double covalent bond.

(ii) There is a tetrahedral distribution of atoms around each carbon atom in ethane. Ethene, on the other hand, is a planar molecule.

(c) $C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$ . . . . and addition reaction.

(d) $C_2H_4(g) + Br_2(g) \rightarrow C_2H_4Br_2(g)$ . . . . and addition reaction.

Question 31

(a) The balanced equation is:

$$Na_2CO_3.xH_2O(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2CO_3(aq) + xH_2O(l)$$

(b) $n(Na_2CO_3.xH_2O(s)) = \frac{1}{2}$ x $n(HCl) = \frac{1}{2}$ x 0.100 x 0.045 = 0.00225 mol **ANS**

(c) $n(Na_2CO_3) = n(Na_2CO_3.xH_2O(s)) = 0.00225$.
Hence, $m(Na_2CO_3) = 106 \times 0.00225 = 0.2385$ g.
Hence, $m(H_2O) = 0.400 - 0.2385 = 0.161$ g.
Hence, $n(H_2O) = \frac{0.161}{18} = 0.0089$.
Hence, 1 mole of Na_2CO_3 combines with $\frac{0.2385}{0.0089} = 4$ mol of water.
$x = 4$ **ANS**

SECTION II - ELECTIVES

Question 32 Chemical Energy

(a) (i) An ideal gas is a gas in which the molecules(atoms) have zero volume and in which there are no forces acting between the molecules(atoms).

(ii) $m(He) = 4 \times \frac{PV}{RT} = 4 \times \frac{9.0 \times 10^5 \times 50 \times 10^{-3}}{8.314 \times 273} = 79.3$ g **ANS**

(b) (i) $n(\text{methane}) = \frac{50}{16}$. Hence, energy evolved $= 889 \times \frac{50}{16} = 2778$ kJ **ANS**

(ii) $n(\text{methane}) = \frac{50}{24.47}$. Hence, energy evolved $= 889 \times \frac{50}{24.47} = 1817$ kJ **ANS**

(iii) One mole of methane produces 889 kJ.
Hence, the number of mole of methane producing 50 kJ $= \frac{50}{889} = 0.056$ mol **ANS**

(c) (i) The peanuts are crushed so that the surface area will be large and combustion will be complete.

(ii) Energy content of the packet of peanuts $= 25 \times 46 = 1150$ kJ **ANS**

(iii) Since the energy given on the packet is greater, one possible explanation is that combustion has not been complete.

(iv) According to the information on the packet, the energy from the fat $= 39 \times 24.5 = 955.5$ kJ.
Hence, the percentage of energy from the fat $= \frac{955.5}{1194} \times 100 = 80.0\%$ **ANS**

(d) (i) The diagram on the right hand side of the page.

(ii) Since this is an exothermic reaction, the heat content of the products must be less than the heat content of the reactants.

Question 32 Chemical Energy

(e) (i) The relevant equations are:

$H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(g)$; $C(s) + O_2(g) \rightarrow CO_2(g)$;

$2C(s) + H_2(g) \rightarrow C_2H_2(g)$; $C_2H_2(g) + \frac{5}{2} O_2(g) \rightarrow 2CO_2(g) + H_2O(g)$

When 1 mole of hydrogen burns 242 kJ is released. This is $\frac{242}{2}$ = 121 kJ per gram.

When 1 mole of acetylene burns, the energy change = (2 x -393) + (-242) - (+227)
= -1255 kJ. This is $\frac{1255}{26}$ = 48.3 kJ per gram.

Hence, hydrogen provides more energy on a mass basis.

(ii) The factor by which hydrogen gas provides more energy = $\frac{121}{48.3}$ = 2.5 **ANS**

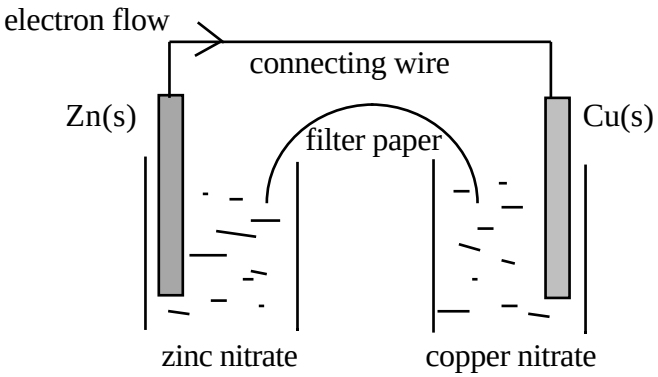
Question 33 Oxidation and Reduction

(a) (i) Oxidation is an increase in oxidation number. Hydrogen is oxidised because it changes from 0 in H_2 to +1 in H_2O.

(ii) The oxidant is the chemical causing the oxidation; in this case, oxygen gas.

(iii) The reductant is the chemical causing the reduction; in this case hydrogen gas.

(b) (i)



(ii) The oxidation reaction is $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$

(iii) The reduction reaction is $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

(iv) The overall reaction is $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

(v) The standard potential for this cell = 0.35 - (-0.76) = 1.11 V **ANS**

(c) (i) Since $Ni^{2+}(aq)$ is the stronger oxidant, the overall spontaneous reaction is:
$Ni^{2+}(aq) + Cd(s) \rightarrow Ni(s) + Cd^{2+}(aq)$

(ii) The maximum potential from this battery = 0.4 - 0.23 = 0.17 V **ANS**

(iii) The overall reaction in the methane-oxygen fuel cell is the reaction that occurs when methane burns in oxygen. $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

(iv) During recharging: $Ni(s) \rightarrow Ni^{2+}(aq) + 2e^-$

(v) During the recharging process, the nickel electrode must be made positive (so that electrons are drawn out of the electrode) and the external potential must be greater than 0.17 V.

(vi) The NiCd cell loses the ability to be recharged because some of the reactants move away from the electrodes and/or the surface of the electrodes become contaminated.

(d) (i) The weakest reductant is Ag(s).

(ii) The strongest oxidant is $Ag^{+(}aq)$.

(iii) Zn rods would be coated with metals with higher (more positive) electrode potentials. These metals would be Fe(s), Pb(s), Cu(s) and Ag(s).

(iv) Both Zn(s) and Mg(s) would be coated with Pb(s) since these metals have lower (more negative) electrode potentials.

(v) Both Zn(s) and Mg(s) corrode more readily than Fe(s). Hence, these metals could be used to prevent the corrosion of Fe(s).

Question 34 Biological Chemistry

(a) (i) One example is glycogen (a polymer of glucose); formula $(C_6H_{10}O_5)_n$

(ii) One example is cellulose (a polymer of glucose); formula $(C_6H_{10}O_5)_n$

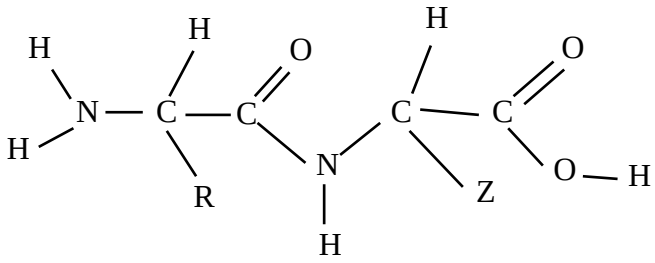
(iii) The human body lacks the enzyme required for the rapid hydrolysis of cellulose.

(b) (i) Compound A is carbon dioxide.

(ii) The process by which glucose is formed is photosynthesis.

(iii) Compound B is glycogen.

(c) (i)



(ii) This is called a condensation reaction.

(iii) The other compound produced in this reaction is water.

(d) (i) A biochemical catalyst specifically increases the rate of a particular chemical reaction in cells. The operating conditions for biological catalysts are very mild relative to inorganic catalysts.

(ii) A protein has a primary structure (the order in which the amino acids are linked), a secondary structure in which coiling and folding occurs sometimes due to hydrogen bonding and a tertiary structure which is the overall three dimensional shape adopted by the protein. Disulfide links are often important in this tertiary structure. Denaturation occurs when this tertiary structure is destroyed. Since it is the shape of the protein that gives it the specific biochemical activity, denaturation results in the loss of this activity.

(iii) Denaturation can be caused by high temperature or a change in pH.

(e)

Chemical Tested	Reagent Used	Expected Results
Glucose	benedict solution	a red-yellow precipitate forms when the solution is warmed.
Starch	iodine solution	the solution turns dark blue
Protein	biuret solution	colour change from blue to violet-pink

(f) Under anaerobic conditions (lack of oxygen) a different chemical pathway occurs and lactic acid is formed from glucose via pyruvic acid.

Question 35 Chemistry and the Environment

(a) (i) The soils through which the water flows vary significantly in Na^+ content.

(ii) A pH greater than 7 is alkaline. HCO_3^- would give this.

(iii) Add a few drops of silver nitrate solution to the water sample. If the concentration of chloride ions is high enough, a white precipitate of silver chloride will be produced according to the equation: $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$.

(iv) Add a few drops of barium hydroxide solution to the water sample. If the concentration of sulfate ions is high enough, a white precipitate of barium sulfate will be produced according to the equation: $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$.

(v) Total dissolved solids can be measured by evaporating a sample of the water (after first filtering to remove undissolved solids) and measuring the mass of the residue.

(vi) Hardness in water is caused by the presence of metal ions such as calcium, magnesium and iron. If water is hard, it is difficult to form a lather with soap and water.

(vii) Permanent hardness in water can be controlled by adding a water softener such as sodium carbonate. This removes the unwanted metal ions from the solution.

(b) (i) $n(HClO) = 5.0 \times 10^{-8} \times 0.1 = 5.0 \times 10^{-7}$ mol ANS

(ii) The concentration of hypochlorite ions = the concentration of hydrogen ions
$= 10^{-6.7}$ M

(iii) If the pH is raised, the hydrogen ion concentration is decreased. Hence, the equilibrium will shift to the right and the concentration of hypochlorite ions will increase. The new value can be calculated from the information given if the temperature is assumed to be the same.

Question 35 Chemistry and the Environment

(c) (i) Oxygen and nitrogen are extracted from the atmosphere for use in our society.
Oxygen is used for medical purposes.
Nitrogen is used as a cooling agent (in liquid form).

(ii) Oxygen gas will cause a glowing splint to burst into flame.

$C(s) + O_2(g) \rightarrow CO_{2(}g)$

(iii) Two waste substances that are discarded into the atmosphere are carbon dioxide and sulfur dioxide.

(d) (i) U-238 is present in the larger amount.

(ii) Uranium is enriched when the proportion of the isotope U-235 is increased in the sample.

(iii) Plutonium is one dangerous product from a fission reactor.

(iv) Plutonium can itself be used to produce energy.

(v) Plutonium can be stored safely only with great difficulty since it remains dangerous for a very long period of time.

END OF SUGGESTED SOLUTIONS

1996 HSC CHEMISTRY TRIAL EXAMINATION

CHEMISTRY ASSOCIATES
P.O. BOX 2227
KEW, VIC., 3101
AUSTRALIA
TEL:(03) 9817 5374 FAX: (03) 9817 4334

PERIODIC TABLE

Key

Atomic Number 79 Au symbol of element

Atomic Mass 197.0 Gold name of element

																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium								1 H 1.008 Hydrogen			5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.06 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.90 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.71 Nickel	29 Cu 63.55 Copper	30 Zn 65.38 Zinc	31 Ga 69.72 Gallium	32 Ge 72.59 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.62 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.94 Molybdenum	43 Tc 98.91 Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Cesium	56 Ba 137.3 Barium	57 La 138.9 Lanthanum	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.9 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po — Polonium	85 At — Astatine	86 Rn — Radon
87 Fr — Francium	88 Ra 226.0 Radium	89 Ac — Actinium	104	105	106												

58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm — Promethium	62 Sm 150.4 Samarium	63 Eu 152.0 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.0 Ytterbium	71 Lu 175.0 Lutetium
90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np 237.0 Neptunium	94 Pu — Plutonium	95 Am — Americium	96 Cm — Curium	97 Bk — Berkelium	98 Cf — Californium	99 Es — Einsteinium	100 Fm — Fermium	101 Md — Mendelevium	102 No — Nobelium	103 Lr — Lawrencium