1996

CHEMISTRY

UNIT 1

TRIAL EXAM

CHEMISTRY ASSOCIATES
P.O. BOX 2227
KEW, VIC., 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 UNIT 1 (YEAR 11) MATERIALS

SECTION A. MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME _____

Instructions

Complete **ALL** the questions.

Marks will **NOT** be deducted for incorrect answers.

NO mark will be given if more than **ONE** answer is completed for any question.

USE HB PENCIL ONLY.

All answers must be completed like this.

A	B	C	D

One answer per line ***One answer per line***

1	A	B	C	D	**10**	A	B	C	D
2	A	B	C	D	**11**	A	B	C	D
3	A	B	C	D	**12**	A	B	C	D
4	A	B	C	D	**13**	A	B	C	D
5	A	B	C	D	**14**	A	B	C	D
6	A	B	C	D	**15**	A	B	C	D
7	A	B	C	D	**16**	A	B	C	D
8	A	B	C	D	**17**	A	B	C	D
9	A	B	C	D	**18**	A	B	C	D

Please DO NOT fold, bend or staple this form

DETACH THIS ANSWER SHEET AT THE START OF THE EXAMINATION

CHEMISTRY UNIT 1 (YEAR 11)
MATERIALS
1996 TRIAL EXAMINATION

(not to be used before Friday May 31, 1996)

Reading time: 15 minutes

Total writing time: 1 hour 30 minutes

STUDENT NAME _____

Structure of examination paper: Number of booklets = 1
Number of Sections = 2

Directions to students

Materials

Question and answer booklet of 12 pages.
Multiple choice answer sheet.
An approved calculator may be used.

The task

Answer all items from Section A.
Section A items should be answered on the multiple-choice answer sheet provided.
Answer all questions from Section B.
Section B questions should be answered in this booklet in the spaces provided following each question.
All written responses should be in English.

At the end of the task

Please ensure that you write your **name** in the space provided on this booklet and your **name** in the space provided on the multiple-choice answer sheet.
Place the multiple-choice answer sheet inside the back cover of this booklet and hand them in.

SPECIFIC INSTRUCTIONS FOR SECTION A

(1) Section A, Question 1, consists of 18 multiple choice items and is worth 18 marks and therefore about 25% of the total marks available for this examination. You should therefore spend about 23 minutes on Section A.

(2) Choose the response you consider is correct or best, and mark your choice on the Multiple Choice Answer Sheet according to the instructions on that sheet.

(3) A correctly answered item scores 1, an incorrect item scores 0. No credit will be given for an item if two or more letters are marked for that item. Marks will NOT be deducted for incorrect answers and you are urged to attempt every item.

Section A Question 1

For each of the following , put a line through the correct response on the answer sheet provided.

Item 1

Of the following, the softest material would be

A. graphite.

B. quartz (silicon dioxide).

C. silicon carbide.

D. diamond.

Item 2

Which one of the following is most likely to be a good conductor of electricity?

A. solid magnesium oxide

B. sodium metal

C. pure water

D. wood

Item 3

The fundamental particles outside the nucleus of the atom are

A. electrons only.

B. neutrons only.

C. protons only.

D. protons and neutrons.

Item 4

In the negatively charged ion, $^{19}_{9}\mathbf{F}^-$, the numbers of protons, neutrons and electrons are respectively

A. 9, 9, 10.

B. 9, 19, 1.

C. 9, 10, 10.

D. 9, 9, 8.

Section A Question 1

Item 5
Magnesium metal (Mg) and fluorine gas (F_2) have very different chemical properties because the atoms of these elements have

A. different numbers of neutrons.

B. different numbers of outershell electrons.

C. atoms that are different in size.

D. different numbers of electrons.

Item 6
The forces holding water molecules together in ice are best described as

A. electrostatic

B. nuclear

C. gravitational.

D. magnetic.

Item 7
According to the Particle Model of Materials, the motion of the molecules in the solid, liquid and gas phases, is

A. most rapid in liquids and slowest in solids.

B. most rapid in gases and slowest in solids.

C. most rapid in solids and slowest in gases.

D. most rapid in solids and slowest in liquids.

Item 8
Covalent bonding is best described as a

A. an attraction between oppositely charged ions.

B. a repulsion between oppositely charged ions.

C. a sharing of one or more electron pairs.

D. an attraction between polar molecules.

Section A Question 1

Item 9
Of the following materials, the one most likely to show both covalent bonding and hydrogen bonding is

A. sodium fluoride.

B. methane.

C. hydrogen.

D. water.

Item 10
A solution of aluminium nitrate, $Al(NO_3)_3$ (aq), contains

A. an equal number of nitrate and aluminium ions.

B. three times as many nitrate ions as aluminium ions.

C. six times as many nitrate ions as aluminium ions.

D. nine times as many nitrate ions as aluminium ions.

Item 11
A sample of water passing through steel pipes is found to have a concentration of iron(II) ions, Fe^{2+}(aq), of 11 ppb. The mass of iron present in 1000 g of this water is

A. $1000 \times \frac{10^9}{11}$ g.

B. $1000 \times \frac{11}{10^6}$ g.

C. $1000 \times \frac{11}{10^9}$ g.

D. $1000 \times \frac{10^6}{11}$ g.

Item 12
Which one of the following is **NOT** a physical property of pure water? Pure water

A. has a high surface tension.

B. is a poor conductor of electricity.

C. boils at 100^oC at high altitude.

D. readily dissolves both polar molecules and ionic solids.

Section A Question 1

Item 13
The hydrogen bonding in water is an example of

A. intermolecular bonding.

B. intramolecular bonding.

C. ion-dipole bonding.

D. covalent bonding.

Item 14
Potassium nitrate dissolves in water because the attractions between the potassium ions and the water molecules and between the nitrate ions and the water molecules are

A. greater than the attractions between the potassium ions and the nitrate ions.

B. equal to the attractions between the potassium ions and the nitrate ions.

C. greater than the attractions between the potassium ions and their electrons.

D. equal to the attractions between the nitrate ions and their electrons.

Item 15
Gases show varying solubility in water. Which one of the gases listed below is **most** soluble in water?

A. $N_2(g)$

B. $H_2(g)$

C. $CO_2(g)$

D. $O_2(g)$

Item 16
A sample of water is cloudy due to the presence of small suspended particles in the water.
The best method of obtaining clear water from this sample would be to

A. filter the sample and then add sodium hydroxide.

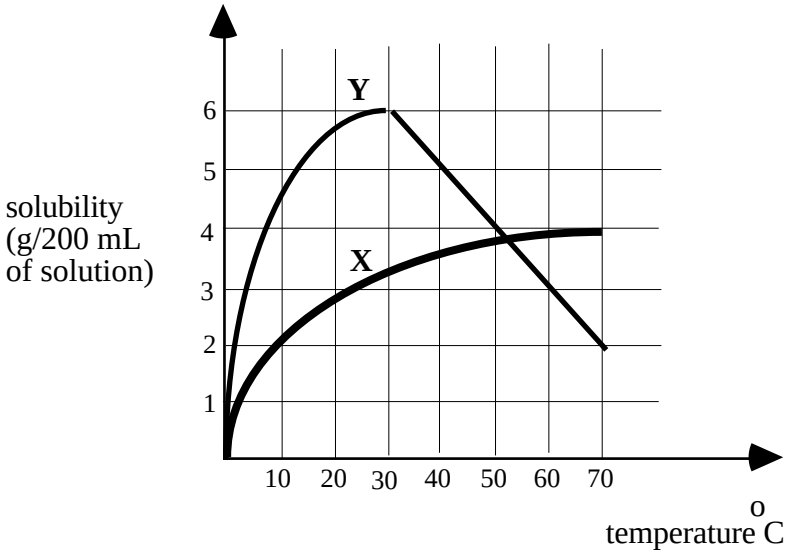
B. filter the sample and then add aluminium sulfate.

C. add sodium hydroxide and then filter the sample.

D. add aluminium sulfate and then filter the sample.

Items 17 and 18 refer to the following information.

The solubility in water of two solutes, **X** and **Y**, varies with temperature according to the graphs shown below.



Item 17

The number of grams of solute **X** that will dissolve in 2.0 L of solution at 70^{o}C is

A. 0.4 g

B. 4 g

C. 40 g

D. 80 g

Item 18

A solution of solute **Y** in water contains 40 g L^{-1} at 50^{o}C. The volume of the solution is 1.5 L.

The solution is then heated to 70^{o}C and a saturated solution is produced.
The mass of solute **Y** that will precipitate from the solution will be

A. 7.5 g

B. 15 g

C. 22.5

D. 45 g

END OF SECTION A

Section B

SPECIFIC INSTRUCTIONS FOR SECTION B

(1) Section B consists of 6 questions (numbered 2 to 7) and is worth 54 marks and therefore 75% of the total marks available for the examination.

You should therefore spend about 67 minutes on Section B. A suggested time allocation is given for each question and the marks allotted to each question are also indicated.

(2) Answers must be written in the spaces following each question in this booklet.

(3) When chemical symbols are used in equations they must be accompanied by correct symbols of state, for example $H_2(g)$ for hydrogen gas.

Question 2 (12 minutes, 9 marks)

Give the chemical name or chemical formula for each of the following.

FORMULA	NAME	FORMULA	NAME
$MgCl_2(s)$			potassium solid
$Na_2O(s)$			graphite solid
$Cu(s)$			hydrogen gas
$C_2H_4(g)$			polyethene solid
$C_2H_6(g)$			dilute hydrochloric acid
$(NH_4)_2SO_4(aq)$			sodium hydroxide dissolved in water
$C_{12}H_{22}O_{11}(s)$			limestone
$(CH_2O)_6(s)$			nitrogen gas
$CH_3CH_2OH(l)$			chalk

Section B

Question 3 (11 minutes, 9 marks)

Complete the following table.
Write the electronic configuration or give the name of the element for each of the following.
Give the Group of the element in the periodic Table.

Element	Atomic number of atom	Electron configuration	Group in Periodic Table
Magnesium	12		
	19	2.8.8.1	
Silicon	14		
	16	2.8.6	
Beryllium	4		
	18	2.8.8	
Nitrogen	7		
	15	2.8.5	
Bromine	35		

Section B

Question 4 (11 minutes, 3 + 3 + 3 = 9 marks)
Chemical bonding is often classified as either **weak** or **strong**.

a. Use a diagram to illustrate the weak bonding that occurs between hydrogen molecules.

b. Use diagrams to illustrate the strong and weak bonding that occurs in HCl(g).

Section B

Question 5 (11 minutes, 5 + 4 = 9 marks)

a. Ethanol is made up of molecules that are larger than water molecules. Even so, ethanol is a liquid at room temperature and pressure with a **lower** boiling temperature than water. Explain why this is so and draw a diagram to illustrate your answer.

_____

_____

_____

_____

_____

b. Water will not mix with oil but will mix with ethanol in any proportion. Using the idea of **polarity**, explain with the aid of a diagram why this is so.

_____

_____

_____

_____

_____

Section B

Question 6 (11 minutes, 1 + 1 + 1 + 2 + 2 + 2 = 9 marks)

Write a balanced chemical equation for each of the following precipitation reactions.

a. silver nitrate solution is added to dilute hydrochloric acid to produce silver chloride solid and hydrogen nitrate solution.

_____

b. aluminium ions aqueous react with hydroxide ions aqueous to produce aluminium hydroxide solid.

_____

c. a student burns a sample of pure hydrogen in air.

_____

d. a student blows though a straw into an aqueous solution of calcium hydroxide

_____

e. lead (II) nitrate aqueous reacts with aqueous sodium sulfide.

_____

f. rust forms on the steel structure of a car.

_____

WORKING SPACE

Section B

Question 7 (11 minutes, 2 + 2 + 2 + 1 + 2 = 9 marks)

a. What is a **condensation polymer**? Give an example.

b. What is a **co-polymer**? Give an example.

c. What is an **addition polymer**? Give an example.

WORKING SPACE

Question 7 (continued)

d. Write a balanced chemical equation showing the formation of polypropylene from propene. Propene has the formula C_3H_6. Propene has one double covalent bond.

_____

e. The amino acids, NH_2CH_2COOH and $NH_2CH(CH_2)COOH$ react with each other to form a molecule called a **dipeptide** and also a water molecule. Write a balanced chemical equation for this reaction.

_____

END OF QUESTION AND ANSWER BOOKLET

1996 CHEMISTRY TRIAL EXAM UNIT 1

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

SUGGESTED SOLUTIONS **Section A**

Question 1

Item 1 ANS A
The material least resistant to scratching is the softest material. Of those listed, graphite is by far the softest.

Item 2 ANS B
A material will be a good conductor of electricity if there are free electrons or ions available in the structure. In sodium metal, the outershell electron is shared throughout the metallic lattice. A 'sea' of electrons exists which can move when an electric potential is applied. In pure water and wood no ions or free electrons are present to carry the electric charge. In solid magnesium oxide the ions are held in fixed positions in the three dimensional lattice and the electrons are held firmly within the ions.

Item 3 ANS A
Protons **and** neutrons are found in the nucleus of the atom while electrons move outside the nucleus in atomic orbitals.

Item 4 ANS C
In the ion $^{19}_{9}F^-$, the **9** indicates the number of protons in the nucleus and the **19** shows the total number of protons plus neutrons in the nucleus. Hence, there are 10 neutrons in the nucleus. The **-** shows that there is one more negatively charged electron than protons around the nucleus. Hence, there are 10 electrons.

Item 5 ANS B
The chemical properties of an element are determined by the number of outershell electrons (valence electrons) in the atoms of the elements. Magnesium has two outershell electrons which it tends to lose easily. Chlorine has seven outershell electrons and tends to gain one more electron.

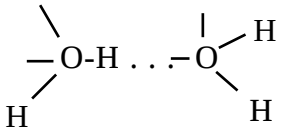
Item 6 ANS A
Like all chemical bonding, the hydrogen bonding between water molecules involves the attraction between positive and negative charges. That is, it is electrostatic.

Item 7 ANS B
According to the Particle Model of Materials, molecules move most quickly in the gas phase and most slowly in the solid phase. The rapidity of movement in the liquid phase is in between these two extremes.

Item 8 ANS C
Covalent bonding is the sharing of one or more electron pairs between nuclei. For example, one shared pair between hydrogen atoms in H_2, two shared pairs between carbon atoms in C_2H_4 and three shared pairs between carbon atoms in C_2H_2.

Question 1

Item 9 ANS D
Sodium fluoride has ionic bonding. Methane, hydrogen and water all have covalent bonding. The formulae are respectively CH_4, H_2, and H_2O. Hydrogen bonding occurs when a H atom is bonded to a very electronegative atom such as F, O or N and there is a non-bonding electron pair on a neighbouring molecule. The only material for which this is true is water. The hydrogen bonding can be represented as . . . as in the diagram below.

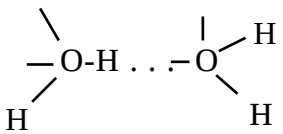


Item 10 ANS B
When aluminium nitrate dissolves in water, one $Al^{3+}(aq)$ ion is produced for every three $NO_3^-(aq)$ ion according to the equation: $Al(NO_3)_3\ (aq) + aq = Al^{3+}(aq) + 3NO_3^-(aq)$

Item 11 ANS C
11 ppb means 11 parts per billion. That is, 11 parts per 10^9.
The mass of iron is 11 g in every 10^9 g of water.
Therefore, in 1000 g of water, the mass of iron = $\frac{6 \times 10^9}{1000}$ g.

Item 12 ANS C
Pure water has a high surface tension, is a poor conductor of electricity and will dissolve polar materials such as ammonia gas and salt. However, at high altitude, the boiling temperature of water is **less than** 100^oC.

Item 13 ANS A
In water, the negative oxygen end of the water molecule is attracted to the positive hydrogen end of a neighbouring water molecule. This is **inter**molecular bonding. Each water molecule is a dipole. (A dipole is separation of positive and negative charges in a molecule). This attraction between dipoles in water is called hydrogen bonding.



Item 14 ANS A
The positive potassium ions are surrounded by the negative oxygen ends of the water molecules while the negative nitrate ions are surrounded by the positive hydrogen ends of the water molecules. These forces of attraction are greater than the forces of attraction between the potassium ions and the nitrate ions.

Item 15 ANS C
Nitrogen and hydrogen are not soluble in water to any extent. Oxygen is slightly soluble in water. Carbon dioxide is by far the most soluble in water of these gases.

SUGGESTED SOLUTIONS **Section A**

Question 1

Item 16 ANS D

The first stage in the treatment of water carrying small suspended particles is to add 'alum', that is, aluminium sulfate. This causes the small particles to come together and fall to the bottom of the container. This process is known as flocculation. Filtration can then be used to remove the solid material.

Item 17 ANS C

At 70^{o}C, solute **X** contains 4 g per 200 mL of solution.

Hence, in 2.0L there will be $4 \times \frac{2000}{200}$ g = 4 x 10 = 40 g. **ANS**

Item 18 ANS D

When the saturated solution of solute **Y** at 50^{o}C is heated to form a saturated solution at 70^{o}C, 2 g **per 200 mL** of solution will be precipitated. Since the volume of the solution is 1.5 L, the mass of solute **Y** which will be precipitated = $2 \times \frac{1500}{200}$ = 15g **ANS**

SUGGESTED SOLUTIONS **Section B**

Question 2

FORMULA	NAME	FORMULA	NAME
$MgCl_2(s)$	magnesium chloride solid	K(s)	potassium solid
$Na_2O(s)$	sodium oxide solid	C(s)	graphite solid
Cu(s)	copper solid	$H_2(g)$	hydrogen gas
$C_2H_4(g)$	ethene gas	$(C_2H_4)_n(s)$	polyethene solid
$C_2H_6(g)$	ethane gas	HCl(aq)	dilute hydrochloric acid
$(NH_4)_2SO_4(aq)$	ammonium sulfate dissolved in water	NaOH(aq)	sodium hydroxide dissolved in water
$C_{12}H_{22}O_{11}(s)$	sucrose (disaccharide)	$CaCO_3(s)$	limestone
$(CH_2O)_6(s)$	glucose (monosaccharide)	$N_2(g)$	nitrogen gas
$CH_3CH_2OH(l)$	ethanol	$CaCO_3(s)$	chalk

SUGGESTED SOLUTIONS **Section B**

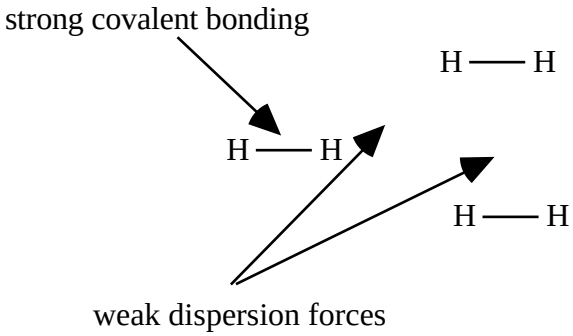
Question 3

Element	Atomic number of atom	Electron configuration	Group in Periodic Table
Magnesium	12	2.8.2	II
Potassium	19	2.8.8.1	I
Silicon	14	2.8.4	IV
Sulfur	16	2.8.6	VI
Beryllium	4	2.2	II
Argon	18	2.8.8	VIII (0)
Nitrogen	7	2.5	V
Phosphorus	15	2.8.5	V
Bromine	35	2.8.18.7	VII

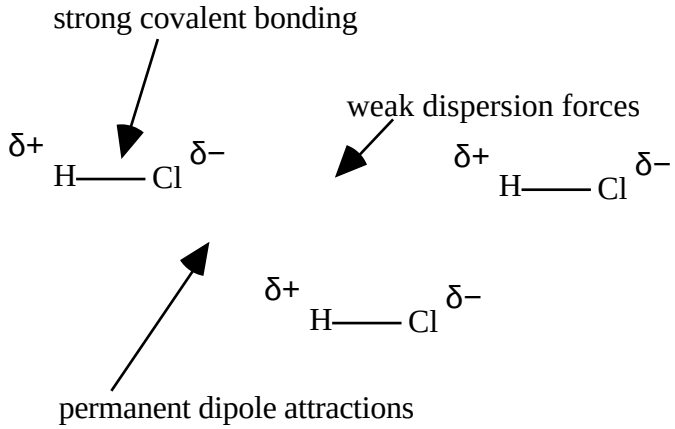
SUGGESTED SOLUTIONS **Section B**

Question 4

a. Weak dispersion forces occur between neighbouring hydrogen molecules. This is in contrast to the strong covalent bonding between the atoms in the hydrogen molecule.



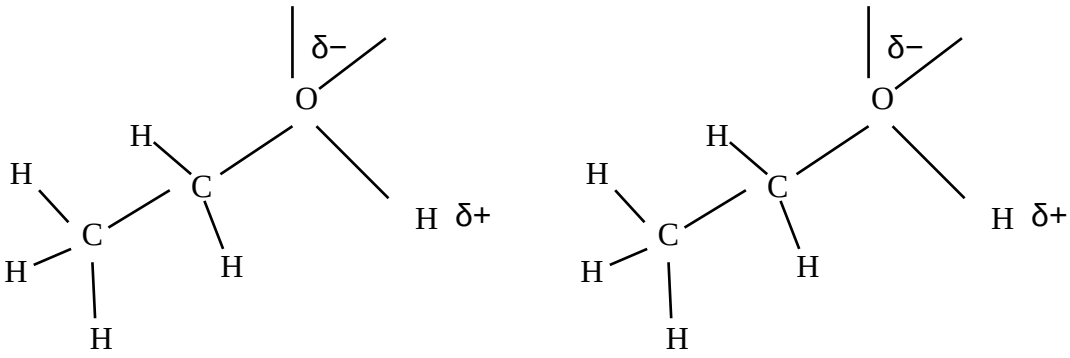
b. Strong covalent bonding occurs between the hydrogen and the chlorine atoms.
Hydrogen chloride is a polar molecule. There are permanent dipoles. The force of attraction between these permanent dipoles is weaker than the covalent bond.
Dispersion forces caused by the instantaneous dipoles in the molecules are the weak forces of attraction (weak bonding) between neighbouring hydrogen chloride molecules.



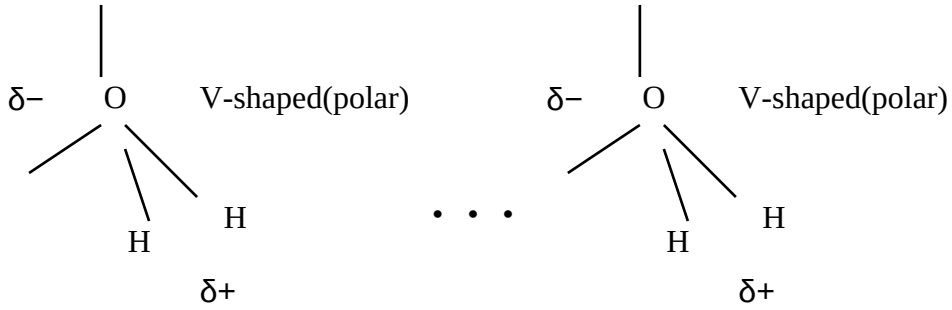
Question 5

a. Both ethanol and water are polar molecules and have hydrogen bonding between molecules. However, water has a stronger dipole-dipole interaction than ethanol. Hence, it has a higher boiling temperature.

hydrogen bonding
between ethanol molecules (weaker)



hydrogen bonding
between water molecules (stronger)



b. The OH grouping at the end of the ethanol molecule (C_2H_5OH) makes ethanol a polar molecule. Hence, the solvent water molecules are able to form hydrogen bonds with the ethanol molecules, thereby separating the ethanol molecules and taking them into solution as illustrated in the diagrams in 5a. Oil is non-polar. Hence, oil and water will not form bonds. Hence, they will not mix.

Question 6

a. $AgNO_3(aq) + HCl(aq) = AgCl(s) + HNO_3(aq)$

b. $Al^{3+}(aq) + 3OH^-(aq) = Al(OH)_3(s)$

c. $2H_2(g) + O_2(g) = 2H_2O(l)$

d. $Ca(OH)_2(aq) + CO_2(g) = CaCO_3(s) + H_2O(l)$

e. $Pb(NO_3)_2(aq) + Na_2S(g) = PbS(s) + 2NaNO_3(aq)$

f. $4Fe(s) + 3O_2(g) = 2Fe_2O_3(s)$ (or similar equation)

Question 7

a. A condensation polymer is formed when monomers add together with the loss of an atom or group of atoms. The formula of the condensation polymer contains less than the sum of the atoms in the monomers. One example is the polymer cellulose.

b. A co-polymer is formed when two or more different monomers combine to form a polymer. A co-polymer may be either an addition polymer or a condensation polymer. One example is the condensation co-polymer, nylon.

c. An addition polymer is formed when monomers add together without the loss of any atoms or molecules. The formula of the addition polymer is the sum of the formulas of the monomers. One example is the polymer ethene.

d. $n\ C_3H_6(g) = (C_3H_6)_n\ (s)$

e. $NH_2CH_2COOH(aq) + NH_2CH(CH_2)COOH(aq) = NH_2CH_2CONHCH(CH_2)COOH(aq) + H_2O(l)$

END OF SUGGESTED SOLUTIONS

1996 CHEMISTRY TRIAL EXAM UNIT 1

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