1995

CHEMISTRY

UNIT 1

TRIAL EXAM

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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
1995 TRIAL EXAMINATION

(not to be used before Wednesday May 31, 1995)

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 material most resistant to scratching would be

A. ice.

B. diamond.

C. wood.

D. glass.

Item 2

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

A. solid magnesium oxide

B. sodium metal

C. salt water

D. steel

Item 3

The fundamental particles found in 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, $^{16}_{8}O^{2-}$, the numbers of protons, neutrons and electrons are respectively

A. 8, 8, 10.

B. 8, 16, 2.

C. 8, 10, 8.

D. 8, 8, 6.

Section A Question 1

Item 5
Sodium (Na) and chlorine (Cl) have very different chemical properties because they 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 oxygen and hydrogen atoms together in molecules of water 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 of water, are best described by

1 = most rapid motion; 2 = medium motion; 3 = slowest motion

	SOLID	**LIQUID**	**GAS**
A	**1**	**2**	**3**
B	**2**	**1**	**3**
C	**1**	**3**	**2**
D	**3**	**2**	**1**

Item 8
Ionic bonding is best described as a

A. an attraction between oppositely charged ions.

B. a repulsion between oppositely charged ions.

C. an attraction between positively charged ions.

D. a repulsion between negatively charged ions.

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 chloride.

B. ethene.

C. water.

D. ethane.

Item 10
A solution of ammonium sulfate, $(NH_4)_2SO_4$ (aq), contains

A. an equal number of ammonium and sulfate ions.

B. twice as many ammonium ions as sulfate ions.

C. four times as many ammonium ions as sulfate ions.

D. eight times as many ammonium ions as sulfate ions.

Item 11
A sample of water passing through copper pipes is found to have a concentration of copper(II) ions, Cu^{2+}(aq), of 6 ppb. The mass of copper present in 1000 g of this water is

A. $1000 \times \frac{10^9}{6}$ g.

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

C. $1000 \times \frac{6}{10^9}$ g.

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

Item 12
Which one of the following is a physical property of pure water? Pure water

A. has a low surface tension.

B. is an excellent conductor of electricity.

C. boils at less than 100^oC at high altitude.

D. readily dissolves both polar and non-polar molecules.

Section A Question 1

Item 13
The hydrogen bonding in water is an example of

A. metallic bonding.

B. intramolecular bonding.

C. dipole-dipole bonding.

D. ionic bonding.

Item 14
Sodium chloride dissolves in water because the attractions between the sodium ions and the water molecules and between the chloride ions and the water molecules are

A. greater than the attractions between the sodium ions and the chloride ions.

B. equal to the attractions between the sodium ions and the chloride ions.

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

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

Item 15
Solids show varying solubility in water. Which one of the solids listed below is **least** soluble?

A. $NaNO_3$

B. KCl

C. $(NH_4)_3PO_4$

D. $BaSO_4$

Item 16
A sample of water is cloudy due to the presence of small suspended particles in the water. The first stage in the treatment of this water to remove the suspended particles would be the addition of

A. calcium fluoride.

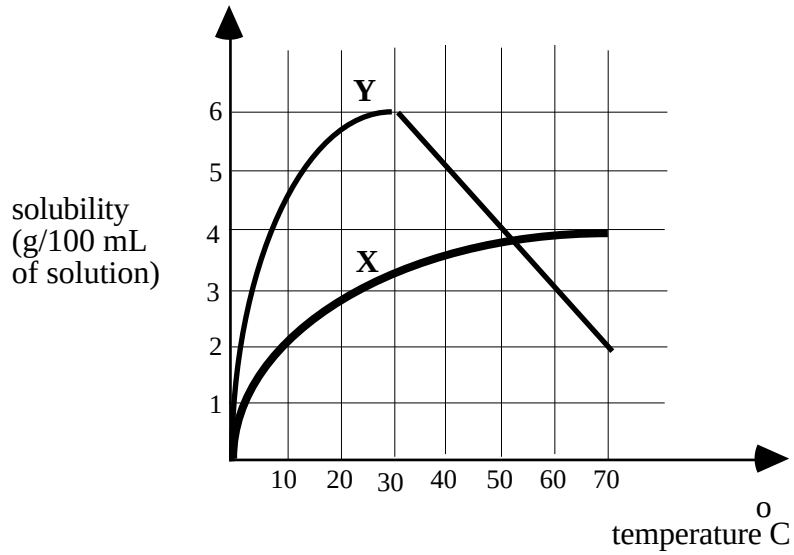
B. aluminium sulfate.

C. sodium hydroxide.

D. sodium chloride.

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 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. 2g

B. 20g

C. 50g

D. insufficient information to calculate the amount precipitated.

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
NaCl(s)			sodium solid
MgO(s)			diamond solid
Fe(s)			oxygen gas
$C_2H_6(g)$			polyethene solid
$C_2H_4(g)$			dilute sulfuric acid
$NH_4NO_3(aq)$			sodium hydroxide solid
$C_2H_5OH(l)$			calcium carbonate solid
$C_6H_{12}O_6(s)$			carbon dioxide gas
$C_{12}H_{22}O_{11}(s)$			calcium hydrogen carbonate solution

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
Aluminium	13		
	20	2.8.8.2	
Carbon	6		
	17	2.8.7	
Lithium	3		
	10	2.8	
Phosphorus	15		
	16	2.8.6	
Zinc	30		

Section B

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

a. Use a diagram to illustrate the strong bonding that occurs in NaCl(s).

b. Use diagrams to illustrate the strong and weak bonding that occurs in $C_2H_4(g)$.

Section B

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

a. Ethane is made up of molecules that are larger than water molecules. Even so, ethane is a gas at room temperature and pressure while water is a liquid under these conditions.
Explain why this is so and draw a diagram to illustrate your answer.

_____

_____

_____

_____

_____

b. Ethanol is a **polar solute** that dissolves in water.
Explain what is meant by a **polar solute** and draw a diagram showing how water dissolves ethanol.

_____

_____

_____

_____

_____

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 potassium chloride solution to produce silver chloride solid and potassium nitrate solution.

_____

b. barium ions aqueous react with sulfate ions aqueous to produce barium sulfate solid.

_____

c. iron(III) ions aqueous react with hydroxide ions aqueous to produce iron(III) hydroxide solid.

_____

d. calcium hydroxide aqueous reacts with carbon dioxide gas.

_____

e. iron (II) nitrate aqueous reacts with hydrogen sulfide gas.

_____

f. potassium iodide aqueous reacts with lead nitrate aqueous.

_____

Section B

Question 7 (11 minutes, 2 + 2 + 2 + 1 + 2 = 9 marks)
Polyethene is an **addition** polymer formed from ethene while nylon 6,6 is a **condensation co-polymer** formed from adipic acid and hexamethylene diamine.

a. What is an **addition** polymer?

_____

_____

_____

_____

_____

b. What is a **condensation** polymer?

_____

_____

_____

_____

_____

c. What is a **co-polymer**?

_____

_____

_____

_____

_____

Question 7 (continued)

d. Write a balanced chemical equation showing the formation of polyethene from ethene.

_____

e. Write a balanced chemical equation showing the formation of nylon 6,6 from adipic acid and hexamethylene diamine.

_____

END OF QUESTION AND ANSWER BOOKLET

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SUGGESTED SOLUTIONS **Section A**

Question 1

Item 1 ANS B
The material most resistant to scratching is the hardest material. Of those listed, diamond is by far the hardest.

Item 2 ANS A
A material will be a poor conductor of electricity if there are no free electrons or ions available in the structure. In steel (iron) and 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 salt water ions are present to carry the electric charge. However, n 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 D
Protons **and** neutrons are found in the nucleus of the atom while electrons move outside the nucleus in atomic orbitals.

Item 4 ANS A
In the ion $^{16}_{8}O^{2-}$, the **8** indicates the number of protons in the nucleus and the **16** shows the total number of protons plus neutrons in the nucleus. Hence, there are 8 neutrons in the nucleus. The **2-** shows that there are two more negatively charged electrons 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. Sodium has one outershell electron 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 covalent bonding between oxygen and hydrogen atoms involves the attraction between positive and negative charges. That is, it is electrostatic.

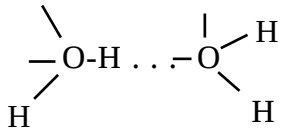
Item 7 ANS D
According to the Particle Model of Materials, the molecules of water are moving most quickly in the gas phase and most slowly in the solid phase. The rapidity of movement in the liquid phase is in between these two extremes.

Item 8 ANS A
Ionic bonding is the electrostatic attraction between oppositely charged ions. The positive and negative ions are produced by a transfer of electron(s) from a metal (to produce a positive ion) to a non-metal (to produce a negative ion). For example Na^+ and Cl^-.

SUGGESTED SOLUTIONS **Section A**

Question 1

Item 9 ANS C
Ethene, water and ethane all have covalent bonding. The formulae are respectively C_2H_4, H_2O and C_2H_6. 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.

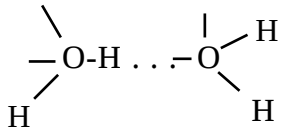


Item 10 ANS B
When ammonium sulfate dissolves in water, two $NH_4^+(aq)$ ions are produced for every one $SO_4^{2-}(aq)$ ion according to the equation: $(NH_4)_2SO_4 + aq = 2NH_4^+(aq) + SO_4^{2-}(aq)$

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

Item 12 ANS C
Pure water has a high surface tension, is a poor conductor of electricity and will not dissolve non-polar materials. At high altitude, the boiling temperature of water is less than 100^oC.

Item 13 ANS C
In water, the negative oxygen end of the water molecule is attracted to the positive hydrogen end of a neighbouring water molecule. 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 sodium ions are surrounded by the negative oxygen ends of the water molecules while the negative chloride 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 sodium ions and the chloride ions.

Item 15 ANS D
Nitrates are soluble. Potassium and ammonium compounds are usually soluble. Barium sulfate is insoluble.

Question 1

Item 16 ANS B

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 D

At 70^{o}C, solute **X** contains 4 g per 100 mL of solution.

Hence, in 2.0L there will be $4 \times \frac{2000}{100}$ g = 4 x 20 = 80 g.

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 100 mL** of solution will be precipitated. However, the volume of the solution is not given in the question. Hence, there is insufficient information to calculate the amount precipitated.

Question 2

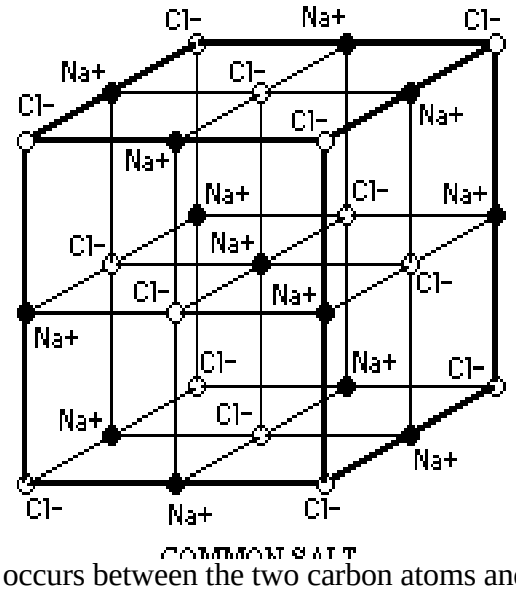
FORMULA	NAME	FORMULA	NAME
NaCl(s)	sodium chloride solid	Na(s)	sodium solid
MgO(s)	magnesium oxide solid	C(d)	diamond solid
Fe(s)	iron solid	$O_2(g)$	oxygen gas
$C_2H_6(g)$	ethane gas	$(C_2H_4)_n(s)$	polyethene solid
$C_2H_4(g)$	ethene gas	$H_2SO_4(aq)$	dilute sulfuric acid
$NH_4NO_3(aq)$	ammonium nitrate solution	NaOH(s)	sodium hydroxide solid
$C_2H_5OH(l)$	ethanol liquid	$CaCO_3(s)$	calcium carbonate solid
$C_6H_{12}O_6(s)$	glucose solid	$CO_2(g)$	carbon dioxide gas
$C_{12}H_{22}O_{11}(s)$	sucrose solid	$CaHCO_3(aq)$	calcium hydrogen carbonate solution

Question 3

Element	Atomic number of atom	Electron configuration	Group in Periodic Table
Aluminium	13	2.8.3	III
Calcium	20	2.8.8.2	II
Carbon	6	2.4	IV
Chlorine	17	2.8.7	VII
Lithium	3	2.1	I
Neon	10	2.8	VIII (0)
Phosphorus	15	2.8.5	V
Sulfur	16	2.8.6	VI
Zinc	30	2.8.18.2	transition element

Question 4

a. Strong ionic bonding occurs between positively charged sodium ions and negatively charged chloride ions. Each sodium ion is surrounded by six chloride ions and each chloride ion is surrounded by six sodium ions.

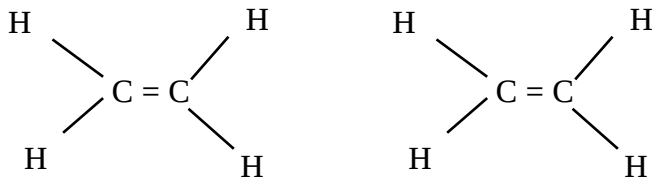


COMMON SALT

b. Strong covalent bonding occurs between the two carbon atoms and between the carbon atoms and the hydrogen atoms. Ethene is a non-polar molecule. There are no permanent dipoles. Dispersion forces caused by the instantaneous dipoles in the molecules are the weak forces of attraction (weak bonding) between neighbouring ethene molecules.

C_2H_4 planar, non-polar dispersion forces

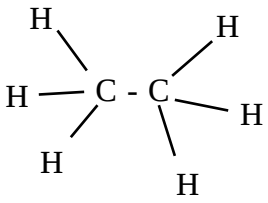
↓



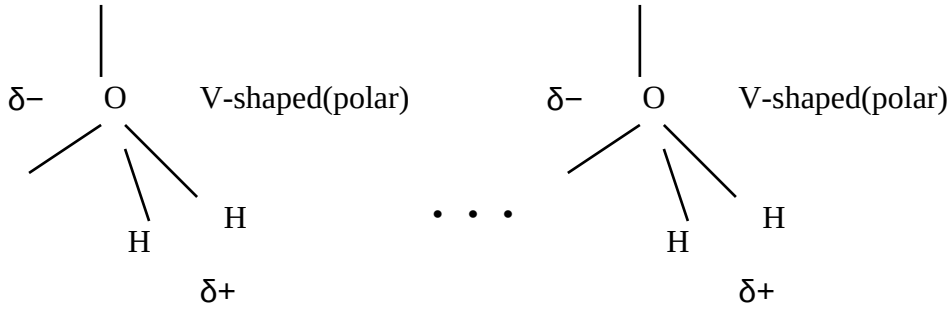
Question 5

a. Ethane is a non-polar molecule. Hence, only dispersion forces (weak bonding) exist between neighbouring molecules and ethane is a gas at room temperature and pressure. On the other hand, water is a polar molecule and hydrogen bonding bonds the neighbouring molecules more closely. Water is a liquid at room temperature and pressure.

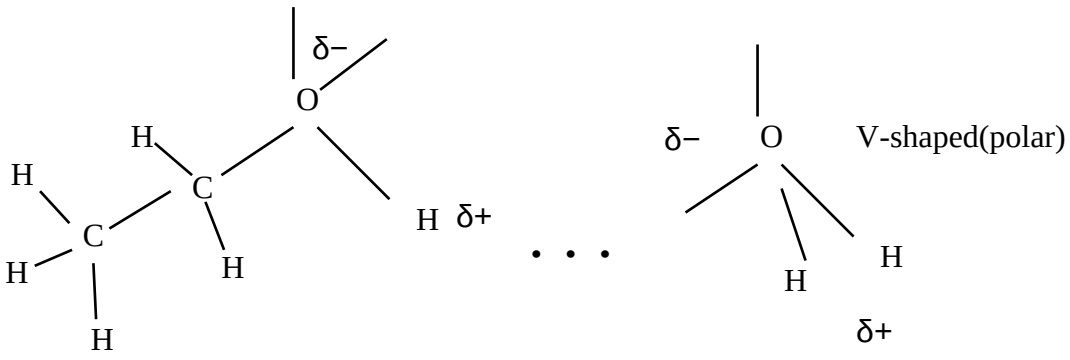
ethane



hydrogen bonding
between water molecules



b. The OH grouping at the end of the ethanol molecule (C_2H_5OH) makes ethanol a polar molecule. It is a solute because it is being dissolved in the solvent, water. 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. This is shown in the diagram below.



Question 6

a. $AgNO_3(aq) + KCl(aq) = AgCl(s) + KNO_3(aq)$

b. $Ba^{2+}(aq) + SO_4^{2-}(aq) = BaSO_4(s)$

c. $Fe^{3+}(aq) + 3OH^-(aq) = Fe(OH)_3(s)$

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

e. $Fe(NO_3)_2(aq) + H_2S(g) = FeS(s) + 2HNO_3(aq)$

f. $2KI(aq) + Pb(NO_3)_2(aq) = PbI_2(s) + 2KNO_3(aq)$

Question 7

a. 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.

b. 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.

c. 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.

d. $n\ C_2H_4(g) = (C_2H_4)n\ (s)$

e. $HOOC(CH_2)_4COOH + H_2N(CH_2)_6NH_2 = HOOC(CH)CONH(CH_2)_6NH_2 + H_2O$

END OF SUGGESTED SOLUTIONS

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