1989

CHEMISTRY

YEAR 11

TRIAL EXAM

CHEMISTRY ASSOCIATES
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CANDIDATE'S NAME_____

CHEMISTRY ASSOCIATES

YEAR 11 CHEMISTRY TRIAL EXAMINATION 1989
(not to be used before Monday August 7, 1989)

Time allowed for examination = 2.5 hours.

MULTIPLE CHOICE ANSWER SHEET SECTION A

Instructions: (1) Mark letters with a single pencil line
EXAMPLE A B ~~C~~ D

(2) Completely erase any mistakes.

(3) One and only one letter should be marked for each item.

(1)	A	B	C	D	(16)	A	B	C	D
(2)	A	B	C	D	(17)	A	B	C	D
(3)	A	B	C	D	(18)	A	B	C	D
(4)	A	B	C	D	(19)	A	B	C	D
(5)	A	B	C	D	(20)	A	B	C	D
(6)	A	B	C	D	(21)	A	B	C	D
(7)	A	B	C	D	(22)	A	B	C	D
(8)	A	B	C	D	(23)	A	B	C	D
(9)	A	B	C	D	(24)	A	B	C	D
(10)	A	B	C	D	(25)	A	B	C	D
(11)	A	B	C	D	(26)	A	B	C	D
(12)	A	B	C	D	(27)	A	B	C	D
(13)	A	B	C	D	(28)	A	B	C	D
(14)	A	B	C	D	(29)	A	B	C	D
(15)	A	B	C	D	(30)	A	B	C	D

DETACH THIS ANSWER SHEET AT THE START OF THE EXAMINATION

CHEMISTRY ASSOCIATES CANDIDATE'S NAME _____

YEAR 11 CHEMISTRY TRIAL EXAMINATION 1989

Time allowed for examination = 2.5 hours

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

SECTION	NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	PERCENTAGE
A	30	30	30
B	12	12	70

There is a Multiple Choice Answer Sheet attached to the front of this booklet.

DIRECTIONS TO CANDIDATES

(1) Answer ALL questions.

(2) Section A questions must be answered on the Multiple Choice Answer Sheet provided.

(3) Section B questions must be answered in the spaces provided.

(4) At the end of the examination, place the Multiple Choice Answer Sheet inside the back cover of this booklet and hand them in.

(5) Please ensure that you write your name on this booklet AND on the Multiple Choice Answer Sheet.

(6) Approved calculators may be used.

SPECIFIC INSTRUCTIONS FOR SECTION A

(1) Section A consists of 30 multiple choice items and is worth 30 marks and therefore 30% of the total marks available for this examination.You should therefore spend about 45 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.

(4) Jottings should be done in the WORKING SPACES in this booklet.

Item 1
The fundamental particles found outside the nucleus of the atom are
A. protons only.
B. neutrons only.
C. protons and neutrons.
D. electrons only.

Item 2
An atom becomes a NEGATIVE ion when
A. its atomic number changes.
B. its mass number changes.
C. it gains protons.
D. it gains electrons.

Item 3
The electronic configuration of the ion , N^{3-}, is
A. $1s^2\ 2s^2\ 2p^6$
B. $1s^2\ 2s^2\ 2p^6\ 3s^1$
C. $1s^2\ 2s^2\ 2p^2$
D. $1s^2\ 2s^2\ 2p^4$

Item 4
The Pauli Principle states that
A. orbitals must have either 1 or 2 electrons.
B. orbitals may have up to 2 electrons.
C. orbitals must contain 2 electrons.
D. orbitals must follow the octet rule.

Item 5
A GROUP in the period table is identified as
A. a row of the periodic table.
B. a column of the periodic table.
C. elements with the same electronegativity.
D. elements with different numbers of valence electrons.

Item 6
Sodium (Na) and Fluorine (F) have very different chemical properties because
A. they have different numbers of outershell electrons.
B. they have different shells as their outershell.
C. they have atoms that are different in size.
D. they have different mass numbers.

Item 7
Covalent bonding involves
A. a sharing of electrons usually between a metal and a non-metal.
B. a sharing of electrons usually between two non-metals.
C. a transfer of electrons usually between two non-metals.
D. a transfer of electrons usually between a metal and a non-metal.

Item 8
The main type of force holding the molecules of water together in ice (solid water) is
A. nuclear.
B. gravitational.
C. electrostatic.
D. magnetic.

Item 9
The most important types of chemical bonding present in a sample of solid sodium chloride are
A. covalent bonding and hydrogen bonding.
B. ionic bonding and hydrogen bonding.
C. ionic bonding and dispersion forces.
D. ionic bonding and covalent bonding.

Item 10
Metal M forms a compound with the formula M_2CO_3.Which one of the following formulae is correct?
A. MCl
B. $M(OH)_2$
C. MSO_4
D. M_2NO_3

Item 11
Which one of the following is an empirical formula?
A. C_3H_8
B. C_2H_6
C. N_2H_4
D. $C_6H_{12}O_6$

Item 12
The elements carbon and hydrogen make up a compound. 28 g of this compound contains 24 g of carbon and 4 g of hydrogen. Given that the relative atomic masses of carbon and hydrogen are 12 and 1 respectively, the empirical formula of this compound is
A. CH
B. CH_2
C. CH_3
D. CH_4

Item 13
In one mole of $Ca(H_2PO_4)_2$ there is

A. two mole of calcium atoms.
B. two mole of hydrogen atoms.
C. four mole of phosphorus atoms.
D. eight mole of oxygen atoms.

Item 14
Two molecules of ethanol, CH_3CH_2OH, contain a total of

A. 6 atoms.
B. 9 atoms.
C. 18 atoms
D. 24 atoms.

Item 15
The molar mass of $Ca_3(PO_4)_2$ is (O = 16 , P = 31, Ca = 40)

A. 199.
B. 279.
C. 310.
D. 430.

Item 16
If one mole of oxygen atoms contains 6×10^{23} oxygen atoms, then the number of molecules of ozone (O_3) that can be produced from one mole of oxygen atoms is

A. 2×10^{23}
B. 3×10^{23}
C. 6×10^{23}
D. 18×10^{23}

Item 17
A solution of iron(II) nitrate, $Fe(NO_3)_2$, contains

A. equal numbers of iron and nitrate ions.
B. twice as many nitrate ions as iron ions.
C. three times as many nitrate ions as iron ions.
D. six times as many nitrate ions as iron ions.

Item 18
The molar mass of hydrated copper(II) sulfate,$CuSO_4.5H_2O$, is
(H = 1, O = 16, S = 32, Cu = 63.5)

A. 177.5
B. 185.5
C. 201.5
D. 249.5

Item 19

One mole of hydrogen atoms has a mass of 1.0 g. What mass of hydrogen molecules can be produced from 1.0g of hydrogen atoms? (Hydrogen molecules are diatomic, H_2, and the relative atomic mass of hydrogen = 1.0)

A. 0.5 g
B. 1.0 g
C. 2.0 g
D. 4.0g

Item 20

A gas occupies 6.0 dm^3 at STP. At 25^{o}C and 120000 Pa, this volume would be

A. (120000/101325) x (273/298) x (1/6) dm^3
B. (120000/101325) x (273/298) x 6 dm^3
C. (120000/101325) x (298/273) x (1/6) dm^3
D. (101325/120000) x (298/273) x 6 dm^3

Item 21

5 g of hydrogen chloride is dissolved in 5 dm^3 of water. The molarity of the chloride ion in solution is approximately

(Molar mass of HCl = 36.5 g mol^{-1})

A. 0.03 M
B. 0.70 M
C. 1.03 M
D. 1.70 M

Item 22

A acid would best be described as

A. a proton donor.
B. a proton acceptor.
C. an electron donor.
D. an electron acceptor.

Item 23

Which one of the following is a conjugate acid-base pair?

A. HNO_3 and HNO_2
B. NH_3 and OH^-
C. HNO_3 and H_2O
D. H_2O and OH^-

WORKING SPACE

Item 24
The AVERAGE oxidation number of carbon in glucose, $C_6H_{12}O_6$, is
A. -1
B. 0
C. +1
D. +2

Item 25
Which one of the following reactions represents a REDOX reaction?
A. $Al(OH)_3(aq) + 3HCl(aq) = AlCl_3(aq) + 3H_2O(l)$
B. $CaCO_3(s) = CaO(s) + CO_2(g)$
C. $2Ag^+(aq) + Cu(s) = 2Ag(s) + Cu^{2+}(aq)$
D. $OH^-(aq) + H^+(aq) = H_2O(l)$

Item 26
Nitrogen reacts with hydrogen to produce ammonia according to the equation:

$$x\ N_2(g) + y\ H_2(g) = z\ NH_3(g)$$

The values of x , y , z which will balance this equation are respectively
A. 2 , 3 , 1
B. 2 , 1 , 3
C. 1 , 3 , 2
D. 3 , 2 , 1

Item 27
The balanced equation for the reaction between aluminium hydroxide and sulfuric acid is
A. $2Al(OH)_3 + 3H_2SO_4 = Al_2(SO_4)_3 + 6H_2O$
B. $2AlOH + 3H_2SO_4 = 2AlSO_4 + 3H_2O$
C. $2Al(OH)_3 + 3HSO_4 = 2AlSO_4 + 5H_2O$
D. $2AlOH + 3H(SO_4)_2 = 2Al(SO_4)_2 + 6H_2O$

Item 28
The chemical formulae for ethane and ethene are respectively:
A. C_2H_6 and C_3H_8
B. C_3H_8 and C_4H_{10}
C. C_3H_6 and C_4H_8
D. C_2H_6 and C_2H_4

Item 29

When one mole of benzene (C_6H_6) reacts completely with oxygen gas, the products are

A. 3 mole of carbon dioxide and 6 mole of water.
B. 1 mole of carbon dioxide and 3 mole of water.
C. 6 mole of carbon dioxide and 3 mole of water.
D. 3 mole of carbon dioxide and 1 mole of water.

Item 30

The number of structural isomers of the substituted **alkane**, $C_2H_4Cl_2$, is

A. 1
B. 2
C. 3
D. 4

END OF SECTION A

SPECIFIC INSTRUCTIONS FOR SECTION B

(1) Section B consists of 12 questions and is worth 70 marks and therefore 70% of the total marks available for the examination. You should therefore spend about 105 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) You should show all working in numerical questions. No credit can be given for incorrect answers unless they are accompanied by details of the working.

(4 Full credit will **not** be given for unsimplified answers. When stating an answer, appropriate precision (number of significant figures) must be used and the units included.

(5) 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 1 (9 minutes, 6 marks)

Write balanced molecular chemical equations for each of (a) to (d):

(a) silver nitrate solution is added to hydrochloric acid and a precipitate forms.

_____

(b) propane gas (C_3H_8) burns in oxygen gas to produce carbon dioxide gas and water vapour.

_____

(c) An aqueous solution of hydrogen peroxide decomposes to produce oxygen gas and water liquid.

_____

(d) dilute nitric acid is neutralised by potassium hydroxide solution.

_____

(e) write the IONIC EQUATION for the reaction in (d)

_____

(f) write the IONIC EQUATION for the reaction in (a)

_____

QUESTION 2 (7 minutes, 5 marks)
Name the following compounds:

(a) $NaNO_3$ _____

(b) K_2CO_3 _____

(c) $Fe_2(SO_4)_3$ _____

(d) H_2SO_3 _____

(e) Na_2O _____

(f) $HgCl_2$ _____

(g) K_2CrO_4 _____

(h) $KMnO_4$ _____

(i) CH_3OH _____

(j) H_2S _____

QUESTION 3 (7 minutes, 5 marks)
The element silver occurs as two isotopes. The isotope with a relative mass of 106.9 has an abundance of 51.8%. The relative atomic mass of silver is 107.9. Calculate the relative mass of the other isotope.

QUESTION 4 (8 minutes, 5 marks)
Write the electronic configuration of each of the following:

(a) H _____ (b) Li _____

(c) C _____ (d) Na _____

(e) K^+ _____ (f) F^- _____

(g) Ca^{2+} _____ (h) S^{2-} _____

(i) N^{3-} _____ (j) He _____

QUESTION 5 (11 minutes, 7 marks)
Outline the main ideas contained in DALTON'S ATOMIC THEORY. In your discussion, indicate any changes that would have to be made in the theory to fit in with the modern day picture of the atom.

QUESTION 6 (11 minutes, 7 marks)
(a) Describe with the aid of diagrams, the INTRAMOLECULAR and INTERMOLECULAR bonding in hydrogen chloride gas.

(b) Draw the structures of the following molecules and describe the shape of each.

(1) $\mathbf{NH_3}$ (2) $\mathbf{H_2O}$ (3) $\mathbf{CO_2}$ (4) $\mathbf{CCl_4}$

Indicate clearly whether the molecules are POLAR or NON-POLAR.

QUESTION 7 (6 minutes, 4 marks)
A liquid is found to contain 37.5% carbon by mass, 12.5% hydrogen by mass and 50% oxygen by mass. Calculate the empirical formula of the liquid. (C = 12, H = 1, O = 16)

QUESTION 8 (12 minutes, 8 marks)
Copper metal reacts with concentrated nitric acid to produce nitrogen dioxide gas according to the equation:

$$Cu(s) + 4HNO_3(aq) = Cu(NO_3)_2(aq) + 2NO_2(g) + 2H_2O(l)$$

(a) What volume of 14M nitric acid would be required to react exactly with 3.0 g of copper according to the above equation? (Relative atomic mass Cu = 63.5)

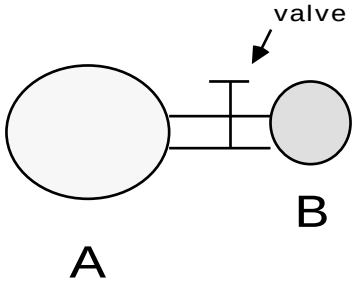
QUESTION 8 (continued)

(b) What volume of nitrogen dioxide gas at STP would be produced in this reaction?
($R = 8.31\ J\ K^{-1}\ mol^{-1}$)

(c) Explain why this reaction is an oxidation-reduction reaction.

QUESTION 9 (9 minutes, 6 marks)

Two flasks are connected by a valve. Flask **A** contains 10.00 dm^3 of hydrogen gas at a pressure of 1 x 10^6 Pa. Flask **B** contains 5.00 dm^3 of helium gas at a pressure of 5 x 10^5 Pa. The temperature is 100 K. This is shown in the diagram below.



(a) Calculate the pressure in flask **A** when the contents of flask **B** are pumped into flask **A**. (Assume that the temperature remains constant).

(b) Calculate the pressure in flask **A** when the contents of flask **B** are pumped into flask **A** and the temperature is doubled to 200 K.

QUESTION 10 (9 minutes, 6 marks)
In each of the following reactions, state whether the first named chemical is acting as an ACID , a BASE or NEITHER. Give a reason for your answer in each case.

(a) $H_2O(l) + NH_3(aq) = NH_4^+(aq) + OH^-(aq)$

_____

_____

_____

(b) $2Na(s) + 2H_2O(l) = 2NaOH(aq) + H_2(g)$

_____

_____

_____

(c) $HPO_4^{2-}(aq) + H_2O(l) = H_2PO_4^-(aq) + OH^-(aq)$

_____

_____

_____

QUESTION 10 (continued)

(d) $Zn(s) + 2H^+(aq) = Zn^{2+}(aq) + H_2(g)$

(e) $H_2O(l) + H_2SO_3(aq) = H_3O^+(aq) + HSO_3^-(aq)$

(f) $NaCl(aq) + AgNO_3(aq) = AgCl(s) + NaNO_3(aq)$

QUESTION 11 (7 minutes, 5 marks)
Calculate the oxidation numbers of CHROMIUM (Cr) and MANGANESE (Mn) in the following:

(a) Cr(s) _____

(b) Cr_2O_3 _____

(c) Cr^{2+} _____

(d) CrO_4^{2-} _____

(e) $Cr_2O_7^{2-}$ _____

(f) Mn(s) _____

(g) Mn^{2+} _____

(h) Mn_2O_3 _____

(i) K_2MnO_4 _____

(j) $KMnO_4$ _____

QUESTION 12 (9 minutes, 6 marks)

(a) What is meant by an HOMOLOGOUS SERIES?

(b) Draw the valence structures of

(1) METHANE **(2) ETHENE** **(3) ETHYNE**

(c) Draw the valence structures of each of the following:

An **example** of a carbon compound containing TWO chlorine atom with:

(1) four single covalent bonds.

(2) four single covalent bonds and one double covalent bond.

END OF 1989 CHEMISTRY YEAR 11 TRIAL EXAM

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SECTION A 1D 2D 3A 4B 5B 6A 7B 8C 9C 10A 11A 12B 13D 14C 15C 16A 17B 18D 19B 20D 21A 22A 23D 24B 25C 26C 27A 28D 29C 30B

SECTION B

1. (a) $AgNO_3(aq) + HCl(aq) = AgCl(s) + HNO_3(aq)$
   (b) $C_3H_8(g) + 5O_2(g) = 3CO_2(g) + 4H_2O(g)$
   (c) $2H_2O_2(l) = 2H_2O(l) + O_2(g)$
   (d) $HNO_3(aq) + KOH(aq) = KNO_3(aq) + H_2O(l)$
   (e) $H^+(aq) + OH^-(aq) = H_2O(l)$
   (f) $Ag^+(aq) + Cl^-(aq) = AgCl(s)$

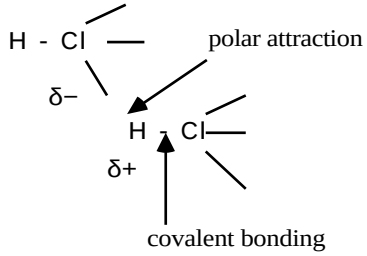
2. (a) sodium nitrate (b) potassium carbonate (c) iron(III) sulfate
   (d) sulfurous acid (dihydrogen sulfite) (e) sodium oxide (f) mercury(II) chloride
   (g) potassium chromate (h) potassium permanganate
   (i) methanol (methyl alcohol) (j) hydrogen sulfide

3. Relative Atomic Mass $= 107.9 = (51.8/100) \times 106.9 + (48.2/100) \times \mathbf{M}$
   $107.9 = (5537.42 + 48.2\mathbf{M})/100$
   $10790 = 5537.42 + 48.2\mathbf{M}$
   $\mathbf{M} = (10790 - 5537.42)/48.2 = 109.0$ ANS

4. (a) $1s^1$ (b) $1s^2\ 2s^1$ (c) $1s^2\ 2s^2\ 2p^2$ (d) $1s^2\ 2s^2\ 2p^6\ 3s^1$ (e) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
   (f) $1s^2\ 2s^2\ 2p^6$ (g) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ (h) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ (i) $1s^2\ 2s^2\ 2p^6$ (j) $1s^2$

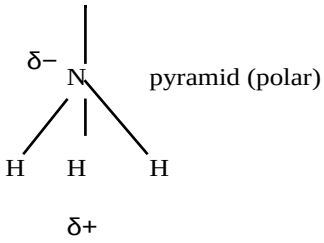
5. **"All matter is composed of atoms"** is an accurate statement but these atoms are made up of protons, neutrons and electrons and hence, are **not** indivisible.Electrons can be removed from or added to atoms in chemical reactions. The nucleus can undergo both fission and fusion reactions thereby changing the numbers of protons and neutrons in the nucleus.
Elements have isotopes - the same number of protons but a different number of neutrons. **Hence, the atoms of a given element are not alike in weight.** For example, the three isotopes of hydrogen, $_1H^1$, $_1H^2$, $_1H^3$.Isotopes have the same chemical properties, that is , they undergo the same chemical reactions, but in any property that depends upon atomic mass (weight), they are different. It is true that different elements have different relative atomic masses. However, the relative **isotopic** masses of two different elements could be very close to each other. Since the relative isotopic mass depends upon the number of protons, neutrons and electrons in the atom, and the mass of the proton is approximately the same as the mass of the neutron (the electron mass is negligible), the mass of an atom with **p** protons and **n** neutrons would be approximately the same as the mass of an atom with **p-1** protons and **n+1** neutrons.
Atoms are not indestructible since they can be broken up into protons, neutrons and electrons (and many other exotic particles). However, it is the number of protons in an atom which determines the element (e.g. 6 protons = carbon, 8 protons = oxygen), and in **chemical** reactions the proton number of atoms does not change. Hence, it is true that atoms preserve their identities in chemical reactions.

6. (a) hydrogen chloride gas



6.(b)

(1)



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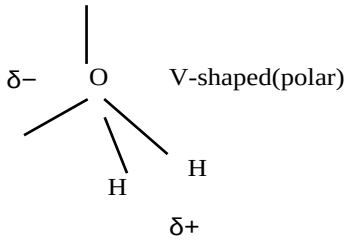
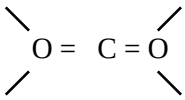
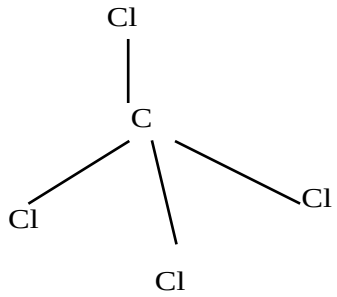


(3)



linear (non-polar)

(4)



tetrahedral (non-polar)

7. n(C) : n(H) : n(O) = (37.5/12) : (12.5/1) : (50/16) = 3.125 : 12.5 : 3.125

Simplest whole number ratio = 1 : 4 : 1

Hence, empirical formula is CH_4O

8. (a) $n(HNO_3) = 4 \times n(Cu) = 4 \times (3.0/63.5)$

$V(HNO_3) = n/c = 4 \times (3.0/63.5) \times (1000/14) = 13.5\ cm^3$

$= 14\ cm^3$ (2 significant figures) ANS

(b) $n(NO_2) = 2 \times n(Cu) = 2 \times (3.0/63.5)$

$V(NO_2)$ at STP $= n(NO_2) \times 22.4\ dm^3 = 2 \times (3.0/63.5) \times 22.4$

$= 2.1\ dm^3$ (2 s.f.) ANS

(c) The oxidation number of Cu has changed from 0 to +2 and the oxidation number of N has changed from +5 to +4.

9. (a) $n(H_2) = PV/RT = 10^6 \times 10/RT$ and $n(He) = PV/RT = 5 \times 10^5 \times 5/RT$

$= 10^7/RT$ $= 2.5 \times 10^6/RT$

Pressure in **A** $= nRT/V$

$= 1.25 \times 10^7/RT \times RT/10$

$= 1.25 \times 10^6$ Pa ANS

(b) Pressure in **A** $= nRT/V = (1.25 \times 10^7/100R) \times (200R/10)$

$= 2.5 \times 10^6$ Pa ANS

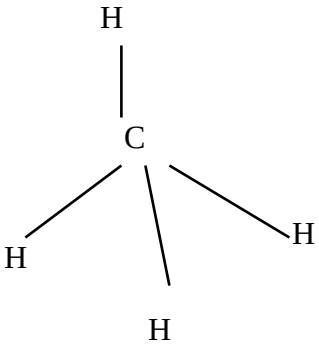
10. (a) acid - proton donor (b) neither- no transfer of protons
(c) base - proton acceptor (d) neither - no transfer of protons
(e) base - proton acceptor (f) neither - no transfer of protons

11. (a) 0 (b) +3 (c) +2 (d) +6 (e) +6 (f) 0 (g) +2 (h) +3
(i) +6 (j) +7

12. (a) An homologous series is a series of carbon compounds in which each successive member differs by a CH_2 unit from the previous member. For example, the alkanes make up an homologous series.

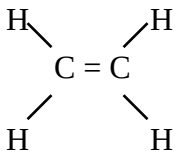
(b)

(1)

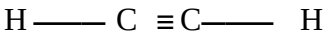


tetrahedral (non-polar)

(2)

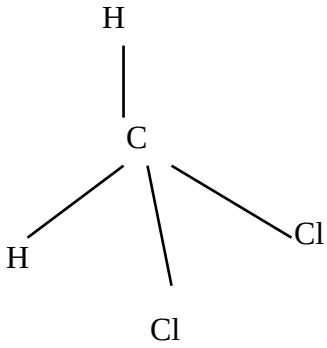


(3)



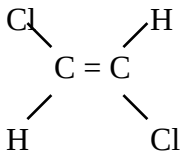
(c)

(1)



tetrahedral (polar)

(2)



END OF 1989 CHEMISTRY YEAR 11 TRIAL EXAM SOLUTIONS

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