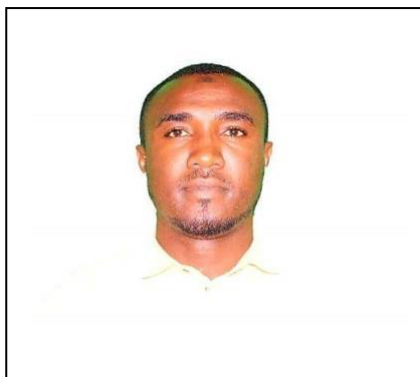


PREFACE

Thanks for omnipotent Allah for my wonderful creation.

All praise is to Allah alone who endowed me with sensory organs and helped me to summarize

This Advantageous book (**revision- chemistry- form four**).

ACKNOWLEDGEMENT

First I would like to thank the teachers who took part or encouraged me in production this advantageous book (**Revision- chemistry- form four**).

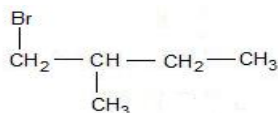
I hope that this book will be effectively develop the knowledge and practical achievements of the **form four exams** of the ministry of culture and higher education of Somalia.

Second I record my gratitude to my following colleagues for their recommendation and their unrelated efforts.

1. **Senior biology teacher**; Hassan-kaafi Osman
2. **Senior Geo/History teacher**; Abdi- Nour Ahmed
3. **Senior chemistry teacher**; Abdi-kani Abuukar

CHAPTER ONE: INTRODUCTION TO HYDROCARBONS**SECTION-1: CIRCLE ONLY THE CORRECT ANSWER**

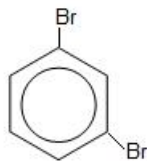
1. The type of bonding in ethane gas is:
 - a. SP
 - b. SP^2
 - ☒ c. SP^3
2. Which of the following organic compounds is saturated:
 - a. Butene
 - ☒ b. Butane
 - c. 2-methylpentene.
3. Which name is a correct answer of this compound



- ☒ a. 1-Bromo-2-methylbutane
 - b. 2-bromoprpane
 - c. 3-methy-1-bromohexane.
4. Which formula represents an aromatic compound:
 - a. C_6H_2
 - ☒ b. C_6H_6
 - c. C_4H_{10}
 5. Which of the following compounds is an an Alkane?
 - ☒ a. CH_3-CH_3
 - b. CH_3-O-CH_3
 - c. CH_3-COOH
 6. To which family of organic compound does $CH_3-CH_2-CH_2-CH_3$
 - ☒ a. Alkane
 - b. Ether
 - c. Ketones

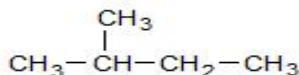
7. The general formula of alkyne is:
- R-CHO
 - R-O-R
 - ☒ C_nH_{2n-2}
8. Benzene was discovered 1825 by
- ☒ Michael Faraday
 - Friedrich August Kekule
 - Einstein.
9. The general formula of Alkyl is
- C_nH_{2n+2}
 - ☒ C_nH_{2n+1}
 - C_nH_{2n}
10. The General formula of Aromatics is:
- ☒ C_nH_{2n-6}
 - C_nH_{2n+2}
 - C_nH_{2n-2}
11. Covalent bond is force of attraction between atoms:
- Electron transfer
 - Proton transfer
 - ☒ Electron share
 - Proton share
12. Which one of the following hydrocarbons is unsaturated?
- Butane
 - ☒ Hexene
 - Methane
13. Removal of water molecule is:
- ☒ Dehydration
 - Dehydrogenation
 - Dehydrohalogenation

14. the name of the following structure is:



- ☒ a. 1,3-dibromobenzene
- b. 1,3-dimethylbenzene
- c. 1-bromo-3-bromobenzene

15. the name of the following structure is:



- a. 3-methylbutane
- ☒ b. 2-methylbutane
- c. 2,2-dimethylbutane.

16. The another name of alkynes is

- ☒ A. acetylene
- B. paraffins
- C. olefines

17. Molecules that have same molecular but different structural formula are:

- ☒ A. structural isomers
- B. alkanes
- C. hybridization.

18. How many different possible structures of trichlorobenzene exist?

- A. 1
- B. 2
- ☒ C. 3

SECTION-2: DIRECT QUESTIONS

1. Define hydrocarbons?
 - Are compounds that contain carbon and hydrogen only
2. List at least three common uses of hydrocarbons?
 - Fuels
 - candle wax
 - gasoline
3. List at least three hydrocarbon compounds?
 - methane
 - propene
 - pentyne
4. Differentiate between saturated and unsaturated hydrocarbons?
 - **Saturated**- are hydrocarbons that contain only c-c single bonds
 - **Un-saturated**- are hydrocarbons that contain c-c multiple bonds(double or triple bonds)
5. What is the most common classification of hydrocarbons?
 - Aliphatic hydrocarbons
 - Aromatic hydrocarbons
6. How does a branched hydrocarbon differ from a normal hydrocarbon?
 - Because the surface area of alkane decreases with branching.
7. Without referring to a table, predict which has higher boiling point between hexane and octane? Explain your answer.
 - Octane, because of increasing number of carbon and molecular mass.
8. Name the most important reaction of alkane?
 - Combustion
9. If 25ml of hexane were added to 200ml of water in a beaker, which of the following would you expect to happen?
 - Hexane would not dissolve in the water and would float on the top.

10. Which is principle difference and similarity in properties between alkenes and alkanes?

- Alkanes are saturated
- Alkenes are unsaturated

11. If C_4H_8 reacts with HBr , what is the molecular formula of the product?



12. Do alkynes show Cis-Trans isomers? Explain.

- No, triple bond carbons can only form one other bond.

13. Briefly describe the bonding in benzene?

- Valence electrons are shared equally by all six carbon atoms.

14. Explain why the name 1-propene is incorrect, what is the proper name for this molecule?

- Because of the position of double bond 1-propene is incorrect. the correct name is propene

15. Differentiate between aliphatic and aromatic hydrocarbons?

- **Aliphatic hydrocarbons**-are compounds that have open chain structure.
- **Aromatic hydrocarbons**-are compounds that have close-chain structure.

16. How many ways can hydrocarbons are classified?

- By bond (saturated and unsaturated)
- By structure (cyclic and Acyclic)
- By sources (Aliphatic and Aromatic)

17. Define Alkanes?

- **Alkanes** - are saturated hydrocarbons containing only carbon-carbon single bonding

18. What is the general formula of Alkane?

- The general formula of alkane is C_nH_{2n+2} .

19. How can number of carbon and hydrogen atoms of alkane be calculated by?

- The hydrogen atoms can be calculated by this formula $H = 2n + 2$
- The carbon atoms can be calculated by this formula $C = \frac{H - 2}{2}$

20. Find the number of hydrogen atoms of alkane with 5 carbon atoms?

Solution

Given $n = 5$ $H = ?$

$$\begin{aligned} H &= 2n + 2 \\ &= 2(5) + 2 \\ &= 10 + 2 \\ &= 12 \end{aligned}$$

21. Find the number of carbon atoms of an alkane with 10 hydrogen atoms?

Solution

Given $H = 10$ $n = ?$

$$2n + 2 = H$$

$$2n + 2 = 10$$

$$2n = 10 - 2$$

$$2n = 8$$

$$n = 4$$

22. List classification of Alkanes?

- Straight chain alkanes
- Branched chain alkanes

23. Differentiate between Straight chain and branched chain alkanes?

- **Straight chain alkanes**- are alkanes in which each carbon atom is bonded to not more than two carbon atoms
- **Branched chain alkanes**- are alkanes in which at least one carbon atom is bonded to more than two other carbon atoms.

24. Structurally, branched chain alkanes are classified into two, Name each?

- Parent chain
- Side-chain

25. Differentiate between Parent chain and Side-chains?

- **Parent chain**- is the longest straight carbon-carbon chain of carbon atoms.
- **Side chain** - is the short chain attached to the parent chain.

26. Define alkyl group?

- **Alkyl group**- is an alkane that has one hydrogen less.

27. How many ways can alkanes be named?

- IUPAC SYSTEM
- COMMON SYSTEM

28. Define isomers

- **Isomers**- are compounds that have same molecular formula but different structural formula.

29. What are the reactions that alkanes undergoes:

- Substitution reaction
- Combustion reaction
- Elimination reaction

30. Why alkanes sometimes called paraffines?

- Because they have little affinity.

31. Define cycloalkanes?

- **Cycloalkanes**- are cyclic hydrocarbons with only carbon-carbon single bonds

32. Define Alkenes?

- **Alkenes**- are unsaturated hydrocarbons containing at least one carbon-carbon double bond between carbon atoms

33. What is the general formula of Alkene?

- The general formula of Alkene is: C_nH_{2n}

34. State classification of Alkenes?

- Symmetrical Alkenes
- Asymmetrical Alkenes

35. Differentiate between Symmetrical and Asymmetrical Alkenes?

- **Symmetrical alkenes**- are alkenes in which two same groups are being attached to the carbon-carbon double bond.
- **Asymmetrical Alkenes**- are alkenes in which two different groups are being attached to carbon-carbon double bonds.

36. What does the Markonikov's rule state?

- States that halogen is added to the carbon atom of the double bond with the greatest number of carbon atoms.

37. Differentiate between polymer and monomer?

- **Polymer** - is large molecule
- **Monomer** - is the small molecule.

38. Define Alkynes?

- **Alkynes**- are unsaturated hydrocarbons containing at least one triple bond between carbon atoms.

39. What are uses of alkynes?

- Manufacturing of plastics and rubbers

40. Define BENZENE?

- Are cyclic organic compounds that contain at least one aromatic ring that resembles benzene.

41. Differentiate between Benzenoid and non-benzenoid?

- **Benzenoid** - are aromatic hydrocarbons that contain benzene ring structure.
- **Non-benzenoid** - are aromatic hydrocarbons that do not contain benzene ring structure.

42. What is meant by the word phenyl?

- When benzene becomes substituent is called phenyl group.

43. Who was discovered by benzene?

- Michael faraday in 1825.

44. Briefly describe the bonding in benzene?

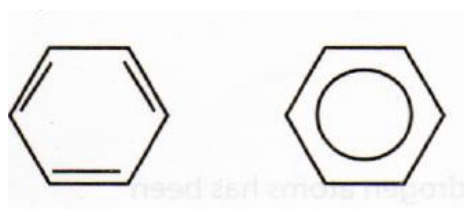
- Is alternating single and double bonds.

45. What does the circle "Mean" in the chemist's representation of benzene?

- It states that the compound is aromatic.

46. What was recognized representation of benzene?

-



47. How many types are classified into benzenes according to their substituent's?

- Monosubstitutents
- Disubstituents
- Polysubstituents

48. What is meant by fractional distillation?

- **Fractional distillation** - is a process of separating mixtures into its components.

49. What is the main component of natural gas?

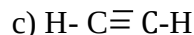
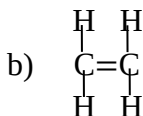
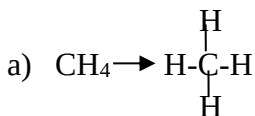
- Carbon and hydrogen (hydrocarbons)

SECTION-3: CHAPTER PROBLEMS

1) How many sigma bonds and pi bonds(π) are there in these compounds?

- a) CH_4 {**methane**} b) $\text{CH}_2=\text{CH}_2$ {**Ethene**} c) $\text{CH}\equiv\text{CH}$ {Ethyne}

Solution

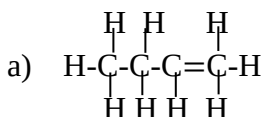


a: Methane	b: Ethene	C: Ethyne
An: 4-sigma bonds	An: 5 -sigma bonds and 1 -pi bond	An: 3 -sigma bonds & 2-pi bond

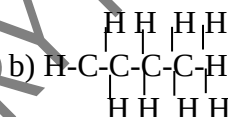
2) How many sigma bonds and pi bonds(π) are there in these compounds?

- a) $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3$ b) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_3$

Solution



An: 12-sigma bonds
& 1 pi-bond



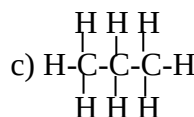
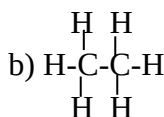
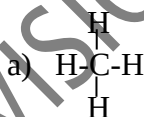
An: **13 sigma bonds**

Remember Always!			
1	Two regions	sp	4 Five regions sp³d
2	Three regions	sp²	5 Six regions sp³d²
3	Four regions	sp³	6 Seven regions sp³d³

3) What is the types of hybridization of carbon one in the following hydrocarbons?

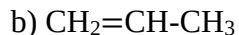
- a) CH_4 b) CH_3-CH_3 c) $\text{CH}_3-\text{CH}_2-\text{CH}_3$

Solution

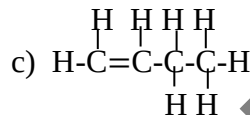
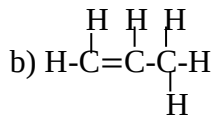
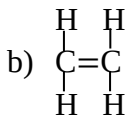


A) CH_4	B) CH_3-CH_3	C) $\text{CH}_3-\text{CH}_2-\text{CH}_3$
An: sp³	An: sp³	An: sp³

4) What is the types of hybridization of carbon one in the following hydrocarbons?

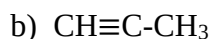


Solution

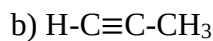
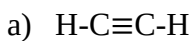


A) CH_4	B) CH_3-CH_3	C) $\text{CH}_3-\text{CH}_2-\text{CH}_3$
An: sp^2	An: sp^2	An: sp^2

5) What is the types of hybridization of carbon one in the following hydrocarbons?



Solution



An: Sp

An: Sp

1: Alkane {C-C}

6) Define **Homologous series**?

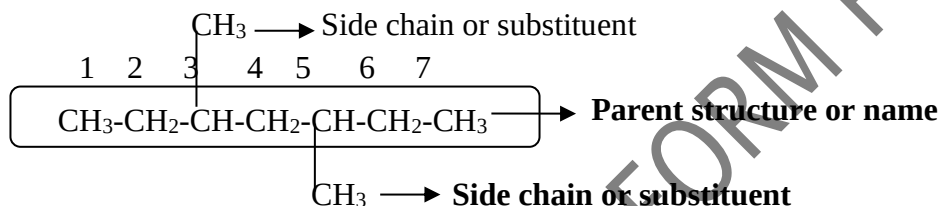
- **Homologous series** is a group of molecules each differing from the next number by constant group.

Homologous series of alkanes				
N	Formula	Condensed formula	IUPUC name	Common name
1	CH_4	CH_4	Methane	N-methane
2	C_2H_6	CH_3-CH_3	Ethane	N-ethane
3	C_3H_8	$\text{CH}_3-\text{CH}_2-\text{CH}_3$	Propane	N-propane
4	C_4H_{10}	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_3$	Butane	N-butane
5	C_5H_{12}	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$	Pentane	N-pentane
6	C_6H_{14}	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$	Hexane	N-hexane
7	C_7H_{16}	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3$	Heptane	N-heptane
8	C_8H_{18}	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-(\text{CH}_2)_3-\text{CH}_3$	Octane	N-Octane
9	C_9H_{20}	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-(\text{CH}_2)_4-\text{CH}_3$	Nonane	N-Nonane
10	$\text{C}_{10}\text{H}_{22}$	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-(\text{CH}_2)_5-\text{CH}_3$	Decane	N-Decane

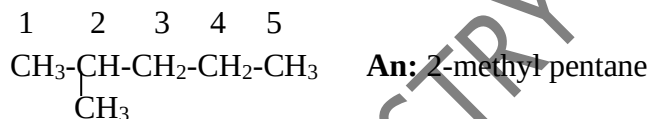
Remember Always these Alkyl groups				
N	Formula	Condensed formula	IUPAC name	Suffix
1	-CH ₃	-CH ₃	Methyl	yl
2	-C ₂ H ₅	-CH ₂ -CH ₃	Ethyl	yl
3	-C ₃ H ₇	-CH ₂ -CH ₂ -CH ₃	Propyl	yl
4	-C ₄ H ₉	-CH ₂ -CH ₂ -CH ₂ -CH ₃	Butyl	yl

7) List the Rules of International Union of pure and applied chemistry (IUPAC)?

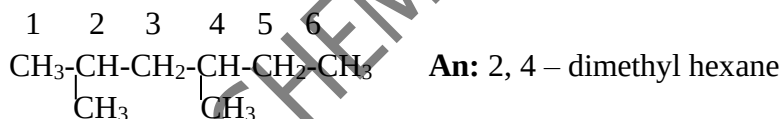
A: Choose the longest continuous chain of carbon atoms in the molecule.



B: Indicate the position of the side chains by the lowest possible numbers.



C: If the **same** substituents appears more than **once**, use the prefixes such as: “di, tri, tetra etc”, before the substituents names to show how many of these substituents are there.



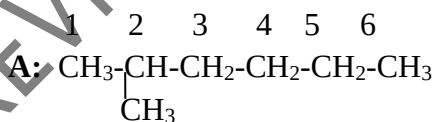
D: Numbers are separated by **commas**, Numbers and letters are separated by hyphens.

E: Arrange the side chain either by alphabetical order of their names or increasing order size.

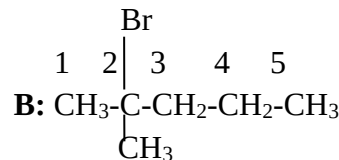
Alphabetical order: ethyl before methyl, bromo before chloro.

Size order: Methyl, Ethyl, isopropyl etc.

8) Give the IUPAC names of the following structures:



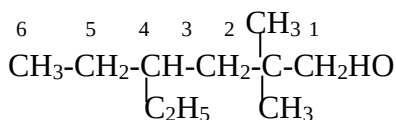
An: 2- methyl hexane



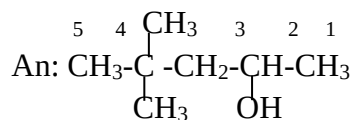
An: 2-bromo – 2- methyl pentane

9) Draw the structures of the following names:

a) A: 4-ethyl-2,2-dimethyl-1-hexanol



B: 4,4-dimethyl-2-pentanol



10)

A: Combustion Reaction:

The total **Combustion** of any hydrocarbon ends up in the formation of **CO₂** and **H₂O** and a great deal of energy. The total oxidation of alkanes is governed by the general formula: $\text{C}_n\text{H}_{2n+2} + \left\{\frac{3n+1}{2}\right\} \text{O}_2 \longrightarrow n\text{CO}_2 + \{n+1\}\text{H}_2\text{O} + \text{Heat}$.

NB: Where **n** is the number of carbon atoms in the alkane molecule.

Example 1: Complete the following equations and then balance:

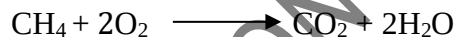
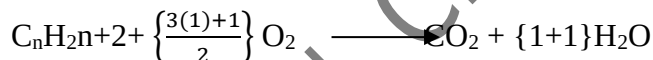
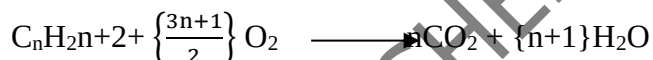


Solution:



Now we try to balance it! By using this formula:

Given: **N: 1**



We also checking by using their atomic masses	
Right side of the equation	Left side of the equation
12 + 4(1) + 4(16)	12 + 2(16) + 4(1) + 2(16)
12 + 4 + 64 = 80	12 + 32 + 4 + 32 = 80

First: Look here!			
Sym	Right	Left	Equal
C	1	1	Yeah
H	4	3	No
O	2	3	No

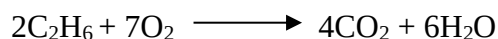
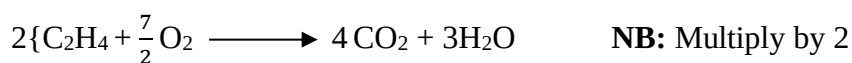
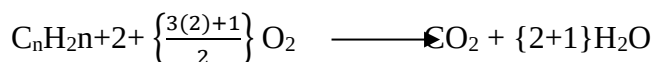
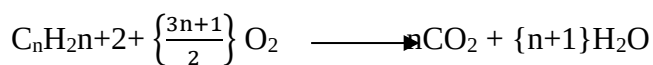
Second: Look here!			
Sym	Right	Left	Equal
C	1	1	Yeah
H	4	4	Yeah
O	4	4	Yeah

Solution:



Now we try to balance it! By using this formula:

Given: N: 2



First: Look here!			
Sym	Right	Left	Equal
C	2	1	No
H	6	2	No
O	2	3	No

We also checking by using their atomic masses	
Right side of the equation	Left side of the equation
$4(12) + 12(1) + 14(16)$	$4(12) + 8(16) + 12(1) + 6(16)$
$48 + 12 + 224 = 284$	$48 + 128 + 12 + 96 = 284$

Second: Look here!			
Sym	Right	Left	Equal
C	4	4	Yeah
H	12	12	Yeah
O	14	14	Yeah

11) Calculated the number of isomers of saturated aliphatic hydrocarbon?

A: C_4H_{10} **Butane**

c: C_6H_{14} **Hexane**

b: C_5H_{12} **Pentane**

d: C_7H_{16} **Heptane**

Formula	By using this: $2^{N-4} + 1$	it draws
A C_4H_{10}	$2^{4-4} + 1 = 2^0 + 1 = 2$	Have two possible structure
B C_5H_{12}	$2^{5-4} + 1 = 2 + 1 = 2 + 1 = 3$	Have three possible structure
C C_6H_{14}	$2^{6-4} + 1 = 2^2 + 1 = 4 + 1 = 5$	Have five possible structure
D C_7H_{16}	$2^{7-4} + 1 = 2^3 + 1 = 8 + 1 = 9$	Have nine possible structure

2: Alkene C = C

Homologous series of alkenes

Formula	Condensed formula	IUPAC name	Common name
C ₂ H ₄	CH ₂ =CH ₂	Ethane	Ethylene
C ₃ H ₆	CH ₃ -CH=CH ₂	Propene	Propylene
C ₄ H ₈	CH ₃ -CH ₂ -CH=CH ₂	1-Butene	Butylene
C ₅ H ₁₀	CH ₃ -CH ₂ -CH ₂ -CH=CH ₂	1-Pentene	Pentylene
C ₆ H ₁₂	CH ₃ -CH ₂ -CH ₂ -CH ₂ -CH=CH ₂	1-Hexene	Hexylene
C ₇ H ₁₄	CH ₃ -CH ₂ -CH ₂ -CH ₂ -CH ₂ -CH=CH ₂	1-Heptene	Heptylene
C ₈ H ₁₆	CH ₃ -CH ₂ -CH ₂ -CH ₂ -CH ₂ -CH ₂ -CH=CH ₂	1-Octene	Octylene
C ₉ H ₁₈	CH ₃ -CH ₂ -CH ₂ -CH ₂ -(CH ₂) ₃ -CH=CH ₂	1-Nonene	Nonylene
C ₁₀ H ₂₀	CH ₃ -CH ₂ -CH ₂ -CH ₂ -(CH ₂) ₄ -CH=CH ₂	1-Decene	Decylene

B: An Alkene containing more one double bond is named as: **a__diene, triene, tetraene** etc depending on the number of double bonds present.

Examples: A. CH₃-CH=C=CH-CH₃

b. CH₃-C(CH₃)=CH-CH₃

An: 2,3 -pentadiene.

An: 2-methyl -1,3 -butadiene.

12) Give the IUPAC names of the following structures:

A: $\begin{array}{ccccccc} & 1 & 2 & 3 & 4 & 5 & 6 \\ & & & & & & \\ \text{CH}_3 & = & \text{C} & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_2 & - & \text{CH}_3 \\ & & | & & & & & & & & \\ & & \text{CH}_3 & & & & & & & & \end{array}$

An: 2- methyl -2-hexene

B: $\begin{array}{ccccccc} & 1 & 2 & 3 & 4 & 5 \\ & & & & & & \\ \text{CH}_3 & - & \text{C} & = & \text{CH} & - & \text{CH} & - & \text{CH}_3 \\ & & & & & & | & & \\ & & & & & & \text{CH}_3 & & \end{array}$

an: 4-bromo- 2-pentene

13) Draw the structures of the following names:

b) A: 4- ethyl -2-methyl -1- hexene

B: 3-methyl-2-Butene

$\begin{array}{ccccccc} & 6 & 5 & 4 & 3 & 1 \\ & & & & & & \\ \text{CH}_3 & - & \text{CH}_2 & - & \text{CH} & - & \text{C} & - & \text{CH} & = & \text{CH}_2 \\ & & & & & & | & & & & \\ & & & & & & \text{C}_2\text{H}_5 & & & & \end{array}$

An: $\begin{array}{ccccccc} & 4 & 3 & 2 & 1 \\ & & & & & & \\ \text{CH}_3 & - & \text{C} & = & \text{CH} & - & \text{CH}_3 \\ & & & & & & | & & \\ & & & & & & \text{CH}_3 & & \end{array}$

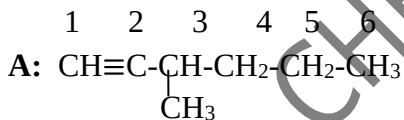
3: Alkyne $C \equiv C$

Homologous series of alkynes

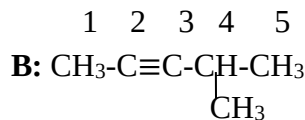
Formula	Condensed formula	IUPAC name	Common name
C_2H_2	$CH \equiv CH$	Ethyne	Acetylene
C_3H_4	$CH_3-C \equiv CH$	Propyne	Methyl acetylene
C_4H_6	$CH_3-CH_2-C \equiv CH$	1-Butyne	Ethylacetylene
C_5H_8	$CH_3-CH_2-CH_2-C \equiv CH$	1-Pentyne	N-Propylacetylene
C_6H_{10}	$CH_3-CH_2-CH_2-CH_2-C \equiv CH$	1-Hexyne	N-Butylacetylene
C_7H_{12}	$CH_3-CH_2-CH_2-CH_2-CH_2-C \equiv CH$	1-Heptyne	N-Pentylacetylene
C_8H_{14}	$CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-C \equiv CH$	1-Octyne	N-Hexylacetylene
C_9H_{16}	$CH_3-CH_2-CH_2-CH_2-(CH_2)_3-C \equiv CH$	1-Nonyne	N-Heptylacetylene
$C_{10}H_{18}$	$CH_3-CH_2-CH_2-CH_2-(CH_2)_4-C \equiv CH$	1-Decyne	N-Octylacetylene

NB: A: The numbering of carbon atoms normally starts at the end nearest to the triple bond.

14) Give the IUPAC names of the following structures:



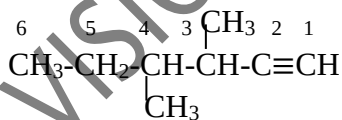
An: 3-methyl-1-hexyne



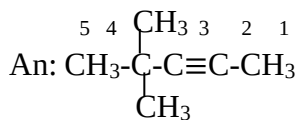
an: 4-methyl-2-pentyne

15) Draw the structures of the following names:

A: 3,4-dimethyl-1-hexyne



B: 4,4-dimethyl-2-pentyne



CHAPTER TWO-THREE: FUNCTIONAL GROUPS**SECTION-1: CIRCLE ONLY THE CORRECT ANSWER**

- Which of the following compounds is ether?
A. $\text{CH}_3\text{-CH}_3$
☒ B. $\text{CH}_3\text{-O-CH}_3$
C. $\text{CH}_3\text{-COOH}$
- To which family of organic compound does $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3$ belong?
☒ A. Alkane
B. Ether
C. Ketones
- The general formula of an aldehyde is:
☒ A. R-CHO
B. R-O-R
C. $\text{C}_n\text{H}_{2n-2}$
- Which of the following compounds is an alcohol?
☒ A. $\text{CH}_3\text{-CH}_2\text{-OH}$
B. $\text{CH}_3\text{-O-CH}_3$
C. $\text{CH}_3\text{-COOH}$
- To which family of organic compound does $\text{CH}_3\text{-COOH}$ belong?
☒ A. Organic acid
B. Ether
C. Ketones
- The general formula of alcohol is:
☒ A. R-CHO
B. R-O-R
C. R-OH

7. The molecular formula of Ethanol is
- ☒ a. C_2H_6O
 - b. $C_3H_{12}O_7$
 - c. $C_4H_5O_{12}$
8. The simplest alcohol is known as:
- a. Ethanol
 - ☒ b. Methanol (CH_3OH)
 - b. Hexanol
9. The oldest known pure organic chemical is:
- a. butanol
 - ☒ b. Ethanol
 - c. Pentanol
10. The phenols that contain only one hydroxyl group ($-OH$) is known as:
- a. Dihydric phenol
 - ☒ b. Monohydric phenol
 - c. Trihydric phenol
11. The molecular formula of **benzanol** is written as:
- ☒ b. C_6H_5OH
 - c. $C_6H_{12}OH$
 - d. $C_6H_{10}OH$
12. When the alkyl groups of ether in either side of oxygen atoms are not same, the compound is known as:
- a. Common system
 - ☒ b. Unsymmetrical ether
 - c. Symmetrical ether.
13. The simplest of carboxylic acid is known as:
- a. Ethanoic acid
 - ☒ b. Methanoic acid
 - c. Hexadecanoic acid

SECTION-2: DIRECT QUESTIONS**1. Define functional group?**

- Is an atom or a group of atom within a molecule that give a certain characteristic to the organic compounds

2. Generally, an organic compound is composed of two parts, Name each?

- Hydrocarbon part
- Active part or functional group

3. Define Alcohols?

- **Alcohols**- are organic compounds which contain hydroxyl group (-OH) as functional group.

4. What is the general formula of Alcohol?

- R-OH (Hydroxyl group)

5. What is the simplest Alcohol?

- The simplest Alcohol is Methanol ($\text{CH}_3\text{-OH}$)

6. How many isomerism does Alcohol show?

- Chain isomerism
- Positional isomerism
- Functional isomerism

7. Define phenols?

- **Phenols**- are compounds that have hydroxyl group bonded directly to benzene

8. What is the general Formula of phenol?

- Ar-OH

9. How many types are classified into phenols according to the number of hydroxyl group?

- Monohydric phenol
- Dihydric phenol
- Trihydric phenol

10. Define Ethers?

- **Ethers** - are organic compounds that contain oxy group as functional group

11. What is the general formula of ethers?

- The general formula of ether is $R-O-R$

12. How many types are classified into ethers according the alkyl groups attached to oxygen atom?

- Symmetrical ether
- Unsymmetrical ether.

13. Differentiate between Aldehyde and ketone?

- **Aldehyde**-is organic compound which contain **aldehydic** carbonyl group at the side.
- **Ketone**- is organic compound which contain **carbonyl group** at the middle.

14. What is the general formula of Aldehyde?

- $RCHO$

15. What is the general formula of Ketone?

- $R-CO-R$

16. Define carboxylic acid?

- **Carboxylic acid**- is an organic compound that contain carboxyl group as functional.

17. What is the general formula of carboxylic acid?

- $RCOOH$

18. What is the IUPAC name of formic acid?

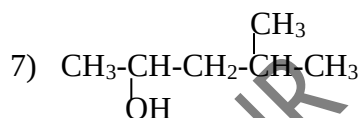
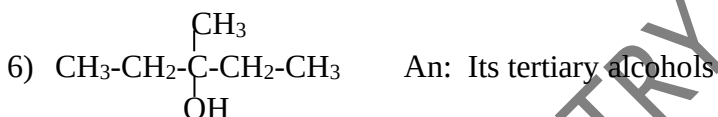
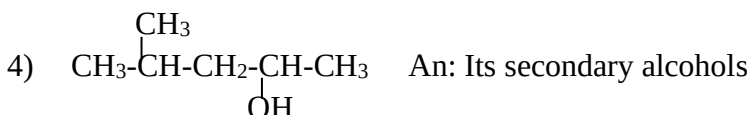
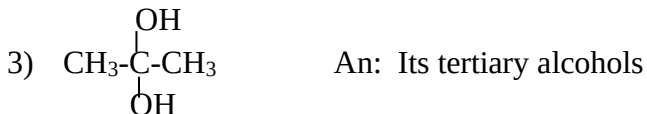
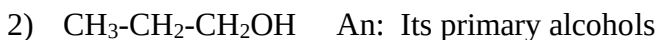
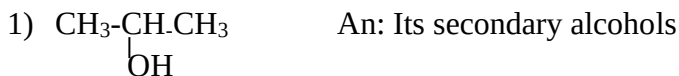
- Methanoic acid

19. Differentiate between mono-carboxylic and Di-carboxylic acids?

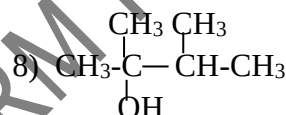
- **Mono-carboxylic acids** - are acids containing only one carboxylic group
- **Di-carboxylic acids** - are acids containing only two carboxylic group

SECTION-3: ALCOHOL PROBLEMS

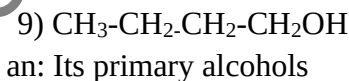
Part one: Classify the following alcohols as **Primary**, **Secondary** and **Tertiary**?



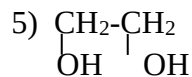
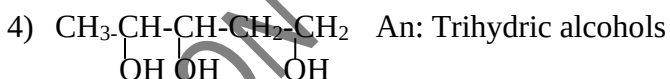
An: Its secondary alcohols



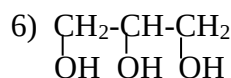
An: Its tertiary alcohols



Part two: Classify the following alcohols as **Monohydric**, **dihydric** and **trihydric**?

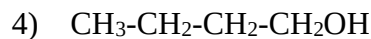


An: Dihydric alcohols



An: Trihydric alcohols

Part three: What is the common name of each of the following alcohols?



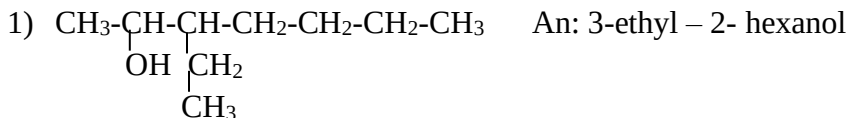
An: Butyl alcohol



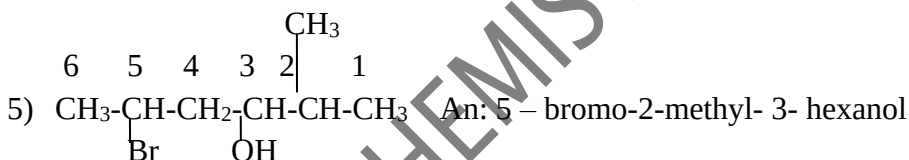
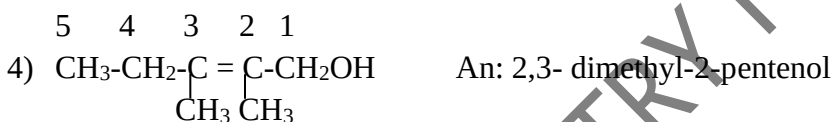
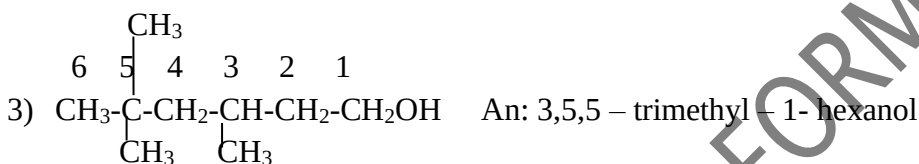
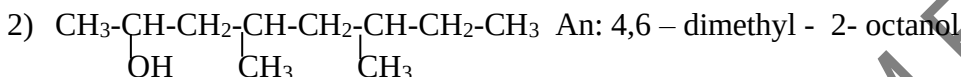
An: pentyl alcohol

Part four: Name the following alcohols using the IUPAC system:

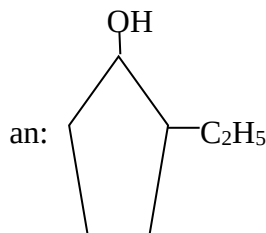
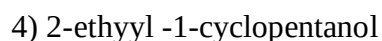
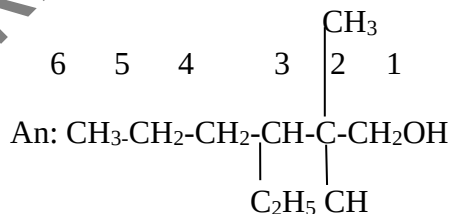
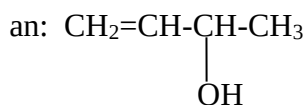
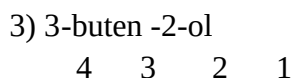
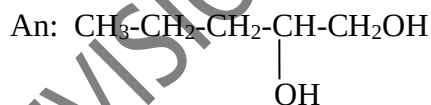
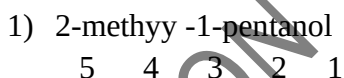
1 2 3 4 5 6 7



1 2 3 4 5 6 7 8



Part five: Draw the structural formula of:



SECTION-4: ALDEHYDE PROBLEMS**Part one:** What is the **IUPAC** name of each of the following aldehydes?

- | | | | |
|---|--------------|--|--------------|
| 1) HCHO | An: Methanal | 4) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CHO}$ | an: butanal |
| 2) $\text{CH}_3\text{-CHO}$ | An: Ethanal | 5) $\text{CH}_3\text{-(CH}_2\text{)}_2\text{-CH}_2\text{-CHO}$ | an: pentanal |
| 3) $\text{CH}_3\text{-CH}_2\text{-CHO}$ | An: Propanal | 6) $\text{CH}_3\text{-(CH}_2\text{)}_3\text{-CH}_2\text{-CHO}$ | an: Hexanal |

Part two: What is the **Common** name of each of the following aldehydes?

- | | | | |
|-----------------------------|------------------|---|---------------------|
| 1) HCHO | An: Formaldehyde | 3) $\text{CH}_3\text{-CH}_2\text{-CHO}$ | an: propionaldehyde |
| 2) $\text{CH}_3\text{-CHO}$ | An: Acetaldehyde | 4) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CHO}$ | an: Butyraldehyde |

Part three: Name the following aldehydes using the **IUPAC** system:

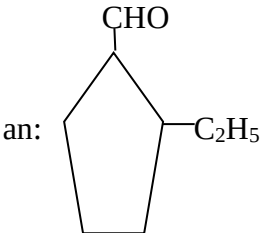
- | | |
|--|---|
| 4 3 2 1
1) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CHO}$
An: -butanal | 6 5 4 3 2 1
2) $\text{CH}_3\text{-CH-CH}_2\text{-CH-CH}_2\text{-CHO}$
OH CH ₃
An: 5-hydroxyl – 3-methyl hexanal |
| 5 4 3 2 1
2) $\text{CH}_3\text{-CH-CH}_2\text{-CH}_2\text{-C-H}$
C ₂ H ₅ O
An: 4-ethyl pentanal | |

Part four: Draw the structural formula of:

- | | |
|---|--|
| 1) 2-Methyl pentanal
5 4 3 2 1
An: $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH-CHO}$

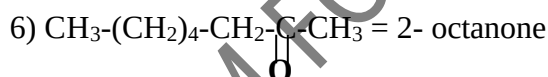
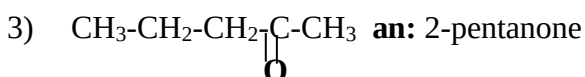
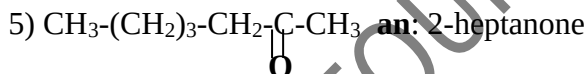
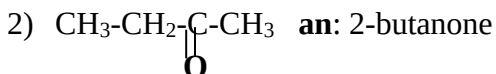
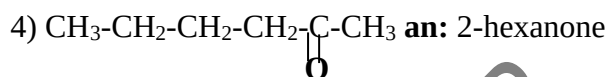
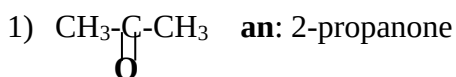
CH ₃ | 3) 3-bromo -2- methylbutanal
4 3 2 1
an: $\text{CH}_3\text{-CH-CH-CHO}$

Br CH ₃ |
| 2) 3-ethyl -2,2-dimethylhexanal
6 5 4 3 2 1
An: $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH-C-CHO}$

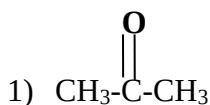
C ₂ H ₅ CH ₃ | 4) 2-ethyl cyclopentanal
an:  |

SECTION- 5: KETONE PROBLEMS

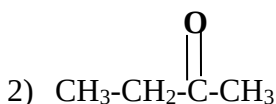
Part one: What is the **IUPAC** name of each of the following **Ketones**?



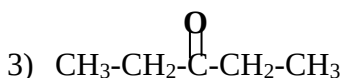
Part two: What is the **Common** name of each of the following **Ketones**?



an: Dimethyl ketone or **Acetone**

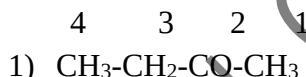


an: methyl ethyl ketone

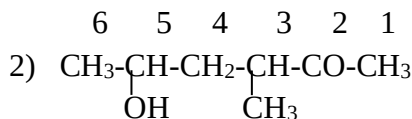


an: Diethyl ketone

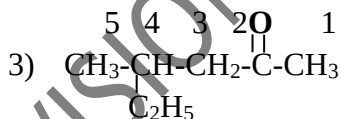
Part three: Name the following **Ketones** using the **IUPAC** system:



An: 2-butanone



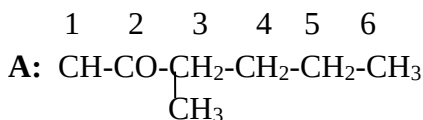
An: 5-hydroxyl – 3-methyl-2- hexanone



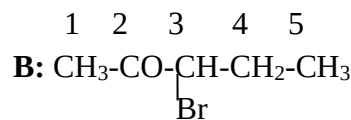
An: 4 – Ethyl-2- pentanone

Part four: Draw the structural formula of:

1) 3- Methyl -2-hexanone



3) 3-bromo– 2-pentanone



SECTION- 6: CARBOXYLIC ACID PROBLEMS

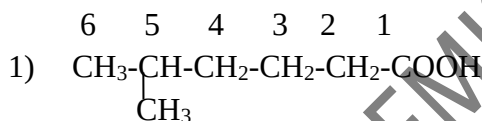
Part one: What is the **IUPAC** name of each of the following **Organic acid**?

- | | |
|---|----------------------------|
| 1) HCOOH | an: Methanoic acids |
| 2) CH ₃ -COOH | an: Ethanoic acid |
| 3) CH ₃ -CH ₂ -COOH | an: Propanoic acids |
| 4) CH ₃ -CH ₂ -CH ₂ -COOH | an: Butanoic acids |
| 5) CH ₃ -CH ₂ -CH ₂ -CH ₂ -COOH | an: Pentanoic acid |

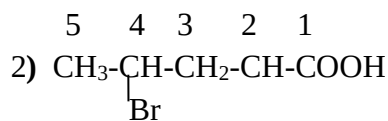
Part two: What is the **Common name** of each of the following **Organic acid**?

- | | |
|---|----------------------------|
| 1) HCOOH | an: Formic acids |
| 2) CH ₃ -COOH | an: Acetic acid |
| 3) CH ₃ -CH ₂ -COOH | an: Propionic acids |
| 4) CH ₃ -CH ₂ -CH ₂ -COOH | an: n-butyric acids |
| 5) CH ₃ -CH ₂ -CH ₂ -CH ₂ -COOH | an: n-valeric acid |

Part three: Name the following **Organic acid** using the **IUPAC** system:



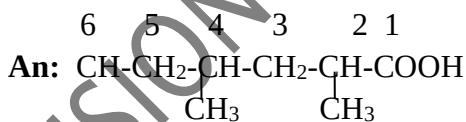
An: 2- Methyl hexanoic acid



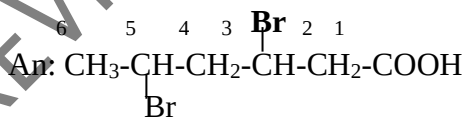
an: 4-bromo pentanoic acid

Part four: Draw the structural formula of:

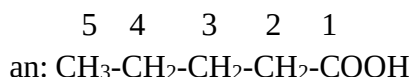
- 1) 4,2- dimethyl hexanoic acid



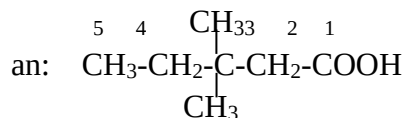
- 2) 3, 5- bromo hexanoic acid



- 3) pentatonic acid



- 4) 3,3 – dimethyl-pentanoic acid



SECTION- 7: ETHER PROBLEMS

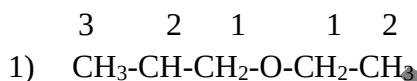
Part one: What is the **IUPAC** name of each of the following **Ethers**?

- | | |
|--|----------------------------|
| 1) $\text{CH}_3\text{-O-CH}_3$ | an: Methoxy methane |
| 2) $\text{CH}_3\text{-CH}_2\text{-O-CH}_3$ | an: Methoxy ethane |
| 3) $\text{CH}_3\text{-CH}_2\text{-O-CH}_2\text{-CH}_3$ | an: Ethoxy ethane |
| 4) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-O-CH}_2\text{-CH}_3$ | an: Ethoxy propane |
| 5) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-O-CH}_2\text{-CH}_3$ | an: Ethoxy butane |

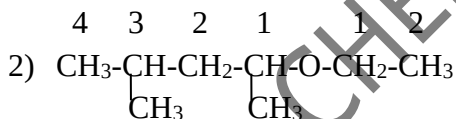
Part two: What is the **Common name** of each of the following **Ethers**?

- | | |
|--|-------------------------------|
| 1) $\text{CH}_3\text{-O-CH}_3$ | an: Dimethyl ether |
| 2) $\text{CH}_3\text{-CH}_2\text{-O-CH}_3$ | an: Ethyl Methyl ether |
| 3) $\text{CH}_3\text{-CH}_2\text{-O-CH}_2\text{-CH}_3$ | an: Diethyl ether |
| 4) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-O-CH}_2\text{-CH}_3$ | an: Ethyl propyl ether |
| 5) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-O-CH}_2\text{-CH}_3$ | an: Ethyl butyl ether |

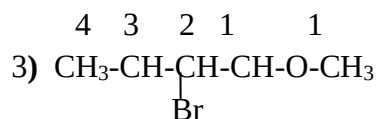
Part three: Name the following **Ethers** using the **IUPAC** system:



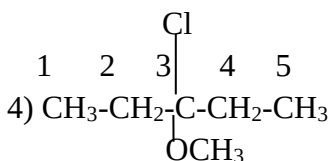
An: ethoxy propane



An: ethoxy -1,3 – dimethyl propane

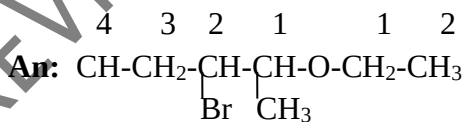


an: Methoxy-2-bromo butane

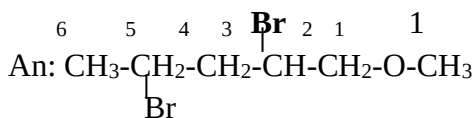


Part four: Draw the structural formula of:

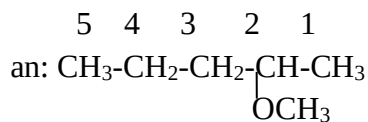
1) ethoxy -3-bromo-2-methyl butane



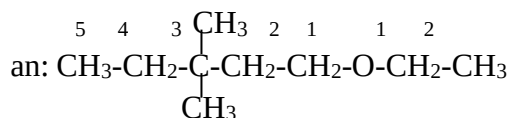
3) methoxy-3, 4- bromo hexane



3) 2-Methoxy pentane

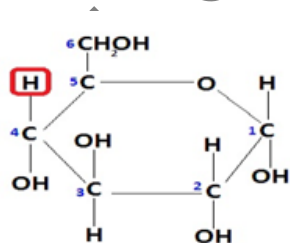


4) ethoxy 4,4 – dimethyl pentane



CHAPTER FOUR: BIOCHEMISTRY**SECTION-1: CIRCLE ONLY THE CORRECT ANSWER**

1. Which of the following is a polysaccharide?
☒ A. Cellulose
B. Fructose
C. Glucose
D. Sucrose
2. What elements make up carbohydrates?
A. Carbon, hydrogen, nitrogen and oxygen
B. Sulfur, carbon, hydrogen
C. Glucose, and fructose
☒ D. Carbon, hydrogen and oxygen.
3. $C_6H_{12}O_6$ is the molecular formula for what carbohydrate?
A. Sucrose
B. Glucose
C. Fructose
☒ D. Both glucose and fructose
4. Which molecule is this picture of:



- A. Protein
- B. Nucleic acid
- C. Lipid
- ☒ D. carbohydrate

5. the formation for protein synthesis is stored in:
- A. amino acids
 - B. fats
 - C. glucose
 - ☒ D. nucleic acids
6. the repeating units in both DNA and RNA are called:
- A. amino acids
 - B. hydrogen bonds
 - ☒ C. nucleic acids
 - D. nucleotides
7. the sugar that is in the backbone of DNA is called
- a. Delta glucose
 - ☒ b. Deoxyribpse
 - c. Fructose
 - d. Ribose
8. The RNA molecule is:
- A. Double helix
 - B. Double-stranded molecule
 - C. None of the choices
 - ☒ D. Single-stranded molecule
9. Adenine bonds with: _____
- A. Guanine
 - ☒ B. Thymine
 - C. Cytosine
 - D. Adenine
10. Guanine bonds with: _____
- A. Adenine
 - B. Guanine
 - ☒ C. Cytosine
 - D. Thymine

11. Nucleotides are made up of a sugar, phosphate and
- ☒ A Nitrogenous base
 - B. Nucleic acid
 - C. Cholesterol
 - D. Fatty acid
12. Which one of the following is a monosaccharide?
- ☒ A Fructose
 - B. Glycogen
 - C. Lactose
 - D. Sucrose
13. Which compound is found in all sphingosine or sphingolipid?
- A. A carbohydrate
 - B. A negative charge
 - C. A phosphate group
 - ☒ D. An amino alcohol
14. Which of these is not a lipid?
- A. Fats
 - B. Oils
 - ☒ C. Proteins
 - D. Waxes
15. What are the functions of lipids:
- A. Provide energy to the body
 - B. Form part of cellular membrane
 - C. Control metabolism
 - ☒ D. All options given are correct

SECTION -2: DIRECT QUESTIONS

1. Define biochemistry?

20. **Biochemistry** - is an integrated science of biology and chemistry.

2. Define biomolecules?

21. The chemical constituents of the living system are called biomolecules.

3. What are the major types of biomolecules?

22. Carbohydrates

23. Proteins

24. Lipids

25. Nucleic acids

4. What are the fields' of biochemistry?

- Structural biology
- Enzymology
- Metabolism

5. Why is biochemistry studied under the field of chemistry?

- It studies the chemical constituents and chemical processes in the living organisms.

6. Differentiate between metabolism, structural biology and enzymology?

- **Metabolism**- is the chemical processes that occur in the living system.
- **Structural biology**- is branch of biochemistry concerned with enzymes.
- **Enzymology**- is the study of the structure of biomolecules.

7. What are carbohydrates?

- Are polyhydorxy aldehyde or ketone.
- Are most abundant organic compounds in nature.

8. What is the general formula of carbohydrates?

- $C_x(H_2O)_y$

9. What foods are found in glucose and fructose?

- **Glucose** - found in the blood
- **Fructose** - found in fruits

10. How many types are classified into carbohydrates, on basis of the behavior of hydrolysis?

- Monosaccharides
- Oligosaccharides
- Polysaccharies

11. On basis of taste, how many are classified into carbohydrates?

- Sugar
- Non-sugar

12. Differentiate between sugar and non-sugar?

- **Sugar**- is a carbohydrate that has a sweet taste.
- **Non-sugar**- is a carbohydrate that has not sweet taste.

13. State the three structures of monosaccharide?

- Full structural formula
- Haworth structure
- Fischer structure

14. On basis of number of carbons, how many types are classified into monosaccharides?

- Triose - ($C_3H_6O_3$)
- Tetrose - ($C_4H_8O_4$)
- Pentose - ($C_5H_{10}O_5$)
- Hexose - ($C_6H_{12}O_6$)

15. Differentiate between full structural, Haworth and Fischer structures?

- **Full structural**- is the formula that represents the atoms and bond of the molecule.
- **Fischer structure**- is the formula that represents the straight-chain structures of monosaccharide.
- **Haworth structures**- is the formula that represents the cyclic structure of monosaccharide.

16. Differentiate between monosaccharide, Disaccharide and polysaccharides?

•

Monosaccharides	Disaccharides	Polysaccharides
the simplest carbohydrate which cannot be hydrolysis.	carbohydrates which undergo hydrolysis into 2-10 molecule of monosaccharide.	carbohydrates that give large number of monosaccharide on hydrolysis
Examples are: Glucose, Fructose and galactose	Examples are: sucrose, lactose and maltose	Examples are: starch, cellulose and glycogen.

17. Why players given more carbohydrates a day before a game? Apply the concept from the lesson?

- They get for energy

18. Write example of fruits in your area and identify the type sugar present in?

- **Mango** - contains fructose sugar
- **Maize** - contains maltose

19. Define amino acids?

- The building units of proteins are called amino acids.

20. What are proteins?

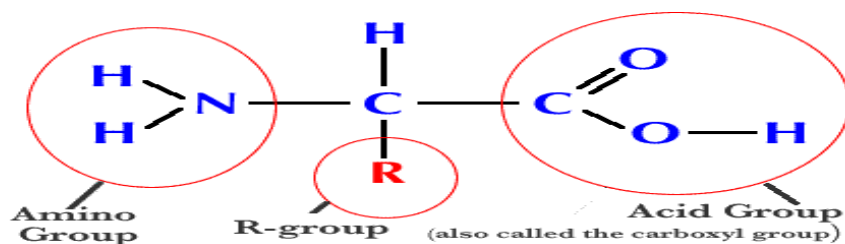
- **Proteins**- are polymers of amino acids with very high molar masses.

21. State some foods found in proteins?

- Eggs
- Fish
- Meat and milk

22. Draw the general formula of amino acids?

•



23. What is the simplest amino acid?

- Glycine

24. List types of amino acids?

- Essential amino acids
- Non-essential amino acids.

25. Differentiate between essential and non-essential amino acids?

•

Essential amino acids	Non-essential amino acids
✓ Arginine ✓ Lysine ✓ Histidine ✓ Methionine ✓ Isoleucine ✓ Threonine ✓ Leucine ✓ Phenylalanine ✓ Valine ✓ Tryptophan.	✓ Alanine ✓ Glycine ✓ Asparagine ✓ Proline ✓ Aspartate ✓ Serine ✓ Glutamate ✓ Cysteine ✓ Glutamine ✓ Tyrosine.

26. Based on their molecular, how many are classified into proteins?

- Globular proteins
- Fibrous proteins

26. How many structures are classified into proteins?

- Primary structures
- Secondary structures
- Tertiary structures
- Quaternary structures

27. State the two most common types of secondary structure of proteins?

- Alpha helix
- Beta pleated sheets

28. Define lipids?

- **Lipids**- are organic chemical compounds that are insoluble in water but soluble in non-polar solvents.

29. List three chemical compositions of lipids?

- Simple lipids
- Compound lipids
- Derived lipids

30. State the two types of simple lipids?

- Triglycerides
- Waxes

31. What are fatty acids?

- **Fatty acids**- are aliphatic organic acids which usually contain an even number of carbon atoms.

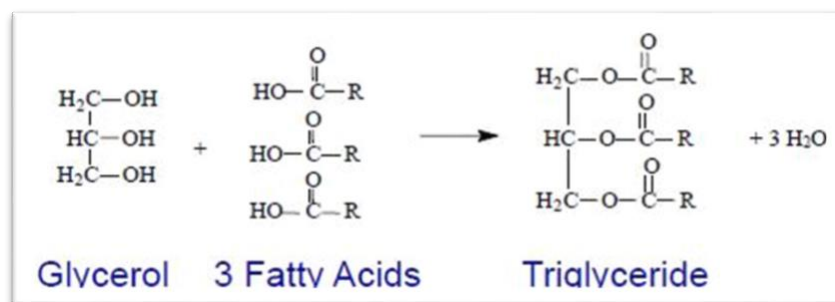
32. Differentiate between saturated and unsaturated fatty acids?

- When the fatty acid has no double bond is saturated
- When the fatty acid has double bond is un-saturated

33. Define waxes?

- **Waxes** - are soft solids with low melting points which are insoluble in water.

34. Draw the process produced by triglycerides?



35. What are the major types of phospholipids?

- Glycerophospholipids
- Sphingolipids

36. List types of compound lipids?

- Glycolipids
- Lipoproteins
- Phospholipids

37. Define nucleic acids?

- **Nucleic acids**- are polynucleotide that occurs in the nuclei of the living cells.

38. What are two divisions of nucleic acids?

- DNA
- RNA

39. What is the function of nucleic acids?

- They control protein synthesis.

40. What molecules do both DNA and RNA contain?

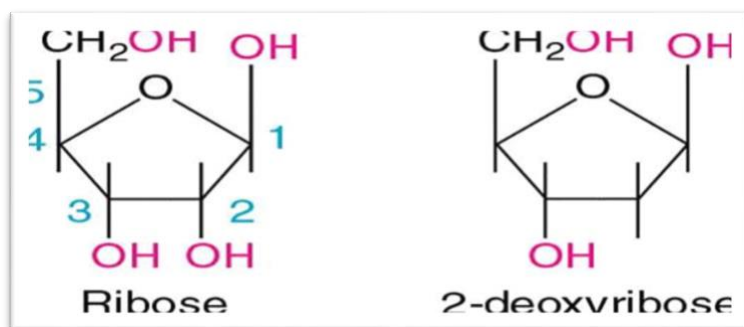
- Adenine
- Guanine
- Cytosine

41. What nucleotide base does the RNA contain but DNA does not?

- Uracil base

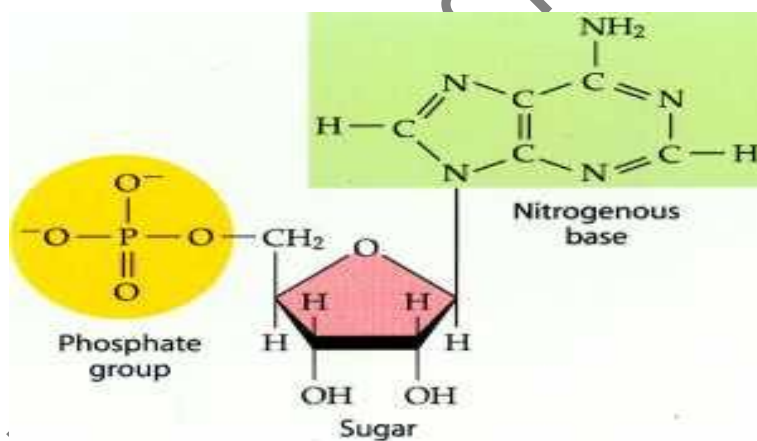
42. What are the main structures of DNA and RNA?

•



43. What are the complete structures of nucleotides?

•



CHAPTER-FIVE: P-BLOCK ELEMENTS**SECTION-1: CIRCLE THE CORRECT ANSWER**

1. GROUP-13: on the periodic table is the:
☒ A. Boron family
B. Noble gases
C. Transition metals
D. Inner transition metals
2. GROUP-13: on the periodic table have how many valence electrons?
☒ A. 3
B. 8
C. 18
D. 13
3. What is the valence electron configuration of group-13:
A. $ns^2 np^2$
☒ B. $ns^2 np^1$
C. $ns^2 np^4$
D. $ns^2 np^5$
4. Which one is a group 13 elements?
A. Sn
☒ B. In
C. Cd
D. Ge
5. Which elements is metalloid in group 13 element:
☒ A. B
B. Gn
C. Al
D. Ti

6. Group-18 on the periodic table are also called:
- A. Alkali metals
 - B. Alkaline earth metals
 - C. Transition metals
 - ☒ D. Noble gases
7. Name the group that contains inert (non-reactive) elements:
- ☒ A. Noble gases
 - B. Halogens
 - C. Alkali metals
 - D. Alkaline earth metals
8. Group-17 on the periodic table are called:
- A. Transition metals
 - B. Metalloids
 - ☒ C. Halogens
 - D. Alkali metals
9. Which group has the most reactive non-metals?
- A. Alkali metals
 - B. Noble gases
 - C. Metalloids
 - ☒ D. Halogens
10. Which of the following is not true for the halogens?
- ☒ A. They are non-metals
 - B. They show the -1 oxidation number
 - C. The electronic configuration of their outermost shell is $ns^2 np^6$
 - D. Their compounds with metals are generally ionic in nature
 - E. Elemental halogens exist as diatomic molecules.

SECTION-2: DIRECT QUESTIONS

1. Define p-block elements?
 - P-block elements - are those in which the last electron enters the outermost p-orbital.
2. What is the total number of p-block elements?
 - Group-13 _____ Group-18
3. Define boron family?
 - Boron is the lightest of the elements in this group.
4. What is electronic configuration of boron family?
 - ns^2np^1
5. Identify the position of boron family in the periodic table?
 - The position of boron family is right in the period table.
6. Write at least three physical properties of boron family?
 - In nature, boron is metalloid
 - At room temperature, the physical state of boron family is solid
 - Boron has a high melting point.
7. State at least three common uses of boron family?
 - Boron- is used in Pyrex and making bullet proof vest
 - Gallium- is used in manufacture of compact-disc players
 - Thallium- is extremely toxic and has no commercial use.
8. Define carbon family?
 - Carbon is the fourth most abundant element on the earth.
9. What is electronic configuration of carbon family?
 - ns^2np^2
10. Write at least three physical properties of carbon family?
 - In nature, carbon is non-metal
 - At room temperature, the physical state of carbon family is solid
 - The melting and boiling point of group-13 are much higher than those of group-13 in the periodic table.

11. State at least three uses of carbon family?

- Carbon is used in pencils and electrochemical cells
- Tin is used electroplated on steel cans
- Lead is used in car batteries.

12. Define nitrogen family?

- Nitrogen family- all lightest groups in periodic table are suffocating in nature.

13. What is electronic configuration of nitrogen family?

- ns^2np^3

14. Write three physical properties of nitrogen family?

- All nitrogen family shows allotropes except nitrogen and bismuth.
- Nitrogen and phosphorous are non-metals
- Arsenic, bismuth and antimony are metals.

15. State common uses of nitrogen family?

- Nitrogen and phosphorous are used for fertilizers
- Antimony and bismuth are used chiefly in metal alloys

16. Define oxygen family?

- Oxygen - is the most abundant element by mass in both the earth's crust.

17. What is the electronic configuration of oxygen family

- ns^2np^4

18. Write at least three physical properties of oxygen family?

- At room temperature, oxygen is gas
- Other members of this group are solids.
- Oxygen, sulfur and selenium are non-metals, while tellurium and polonium are metalloids.

19. State at least three uses of oxygen family?

- Oxygen is essential for respiration in animals and plants
- Ozone (O_3) protects the atmosphere from harmful UV.
- Tellurium has no much use.

20. Define halogens?

- Halogens - are salt makers.

21. What is electronic configuration of halogen family?

- ns^2np^5

22. Write at least three physical properties of halogens?

- Halogen family are poor conductors of electricity
- The halogens are diatomic
- Halogens have low melting and boiling points

23. State some common uses of halogens?

- Chlorine is used bleaching agent in paper industry and textile
- Halogen family also in the manufacture of plastics and insecticides

24. Define noble gases?

- The group-18 in the periodic table is called noble gases.

25. What is the electronic configuration of noble gases family?

- $ns^2 np^6$

26. Where is the position of noble gases in the periodic table?

- Group-18 in the periodic table

27. Write at least three physical properties of noble gases?

- Noble gases exist as gaseous states
- Noble gases are non-metals
- Slightly soluble in water.

28. State some common uses of noble gases?

- Helium is used to fill aero-plane and balloon for meteorological
- Radon is used in radiotherapy for treatment of cancer.

CHAPTER-SIX: CHEMICAL KINETICS**SECTION-1: DIRECT QUESTIONS****1. What is chemical kinetics?**

- The branch of physical chemistry that deals with the study of the rate of the reactions, the factors affecting these rates and the mechanisms by which reaction occurs is called **chemical kinetics**.

2. Why do we study chemical kinetics?

- In order to know how quickly chemical reactions occur.

3. If you put your colored shirt on the sun for a month, would its color change? Explain why?

- The shirt turns its color because there is a chemical reaction occurs.

4. Define reaction rate?

- The speed of the reaction at which the reactants disappear or Products appear is called **reaction rate**.

5. What is the general formula of rate?

- The formula of rate is as follows:

$$\text{Rate} = \frac{C_2 - C_1}{T_2 - T_1}$$

6. State some factors that affect rate of reaction?

- Nature of reactants
- Temperature
- Concentration of reactants
- Surface area
- The presence of catalyst

7. What is activation energy?

- **Activation energy** - is the minimum Amount of energy that is required to activate atoms or molecules to a condition in which they can undergo reaction.

8. Define catalyst?

- **Catalyst**- is a substance that takes part in chemical reaction and speeds up the reaction without undergoing a net chemical change itself.

9. What is reaction rate law?

- **Reaction rate law** - is an experimentally determined equation that expresses the rate of chemical reaction in the terms of molecular concentrations of the reactant.

10. Define rate constant?

- **Rate constant**- is defined as the specific rate of reaction when molar concentrations of the reactants are taken to be unity.

11. Define order of a reaction?

- **Order of a reaction**- is the experimental exponent of a reactant in the Rate equation.

12. What are the conditions that required for a reaction to occur?

- Collision
- Orientation
- Energy

13. What does collision theory state?

- **Collision theory**- states that speed or the rate of a chemical reaction is proportional to the number of collisions between reactants.

14. Define mechanism of a reaction?

- **Mechanism of a reaction** - is the sequence of elementary steps that together make a complete chemical reaction

15. Define effective collisions?

- **Effective collisions**- are those in which result in a chemical reaction.

16. Which two factors govern whether a collision between reacting particles will effective?

- Before collisions
- After collisions

SECTION-2: CHAPTER PROBLEMS

1. The hypothetical reaction of $A + B \longrightarrow C$, the initial concentration of $[A]$ is $0.0054M$ and final concentration of $[A]$ is $0.032M$, after 1.5 minutes, calculate the rate of the reaction in M/Sec ?

Solution:

$[A]$ = initial concentration $C_1 = 0.054M$

$[A]$ = Final concentration $C_2 = 0.032M$

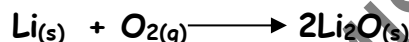
Time=? Time = $1.5 \times 60 = 90Sec$.

Calculate rate of the reaction: ?

$$\text{Rate} = - \frac{C_2 - C_1}{T_2 - T_1}$$

$$\text{Rate} = - \frac{[0.032M - 0.054M]}{0 - 90} = 0.00024M/s$$

2. The following reaction takes place:



After two minutes, 4g of lithium has been used. Calculate the rate of the reaction?

Solution:

- Calculate the number of moles of lithium that are used in the reaction:

$$\text{Number of moles} = \frac{[\text{Mass (m)}]}{\text{Molar mass (M)}} = \frac{4g}{6.94g/\text{Mole}} = 0.576\text{Mole}$$

- Calculate the time in seconds for the reaction

$$T = 2\text{minutes} = 2 \times 60 \text{ Seconds} = 120Sec$$

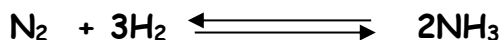
- Calculate the rate of the reaction.

$$\text{Rate of lithium used} = \frac{\text{Moles of lithium used}}{\text{Time}}$$

$$\frac{0.576\text{Mole}}{120Sec} = 0.00483\text{Mol.s}$$

3. For the reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$. The rate of appearance of NH_3 is $4.0 \times 10^{-3} \text{ Mol/L.s}$, calculate the rate of disappearance of H_2 and H_2 ?

Solution:



The rate of appearance of $\text{NH}_3 = 4.0 \times 10^{-3} \text{ Mol/L.s}$,

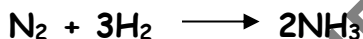
Rate of disappearance of $\text{H}_2 = \frac{\text{Coefficient of the required}}{\text{coefficient of given}} \times \text{rate of given}$

$$\frac{3}{2} \times 4.0 \times 10^{-3} \text{ Mol/L.s} = 6.0 \times 10^{-3} \text{ Mol/L.s}$$

Rate of disappearance of $\text{N}_2 = \frac{\text{Coefficient of the required}}{\text{coefficient of given}} \times \text{rate of given}$

$$\frac{1}{2} \times 4.0 \times 10^{-3} \text{ Mol/L.s} = 2.0 \times 10^{-3} \text{ Mol/L.s}$$

4. Consider the following reaction:

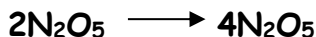


At a certain point in the reaction, hydrogen gas is being used at a rate of **0.096M/Sec.** what is the rate of formation of Ammonia at this point?

Solution:

- ✓ Three moles of hydrogen react every mole of nitrogen. The rate of reaction for nitrogen is **0.032M/sec.**

5. The decomposition of N_2O_5 is described by the following reaction:



If O_2 is being formed at rate of **2.40Mol/min.** what is the rate at which N_2O_5 is being used?

Solution:

- ✓ **0.48Mol/min**

CHAPTER-SEVEN: CHEMICAL EQUILIBRIUM**SECTION-1: CIRCLE ONLY THE CORRECT ANSWER**

1. System of a reaction in which no reactant leaves reaction mixture is termed as:
 - A. Open system
 - ☒ B. Closed system
 - C. Semi-open system
 - D. Partially closed system
2. Reactions in which products cannot turn back into reactants are termed as:
 - ☒ A. Irreversible reactions
 - B. Reversible reactions
 - C. Equilibrium reactions
3. On increasing concentration of one or more reactants, more products will be generated until:
 - ☒ A. Equilibrium
 - B. Closed system
 - C. Open system
 - D. All of above
4. Position of equilibrium explains amounts of:
 - A. Products
 - B. Reactants
 - C. Catalyst
 - ☒ D. Both A and B
5. Reversible reactions are those in which products react together to give original:
 - ☒ A. Reactants
 - B. Products
 - C. Enzymes
 - D. All of above

6. In equilibrium state, backward and forward reactions take place at:
- A. Same time
 - B. Simultaneously
 - C. One time
 - ☒ D. All of above
7. Le chateliers' principle states that if one or more factors disturbs equilibrium, position of equilibrium will shift where change will be:
- A. Reduced
 - B. Induced
 - ☒ C. Increased
 - D. Oxidized
8. System will not be in equilibrium when there is an increase in concentration of:
- ☒ A. Reactants
 - B. Products
 - C. Catalysts
 - D. Activation energy
9. Catalysts speed up reactions but when equilibrium is reached it has:
- A. Huge effect
 - ☒ B. No effect
 - C. Slow effect
 - D. Ended
10. The experimental exponent of a reaction in the rate equation is called:
- ☒ A. Order of a reaction
 - B. Reaction law
 - C. Concentration of reactants
11. Collisions are those which result in a chemical reaction:
- ☒ A. Effective collisions
 - B. Orientations
 - C. Energy

SECTION-2: DIRECT QUESTIONS**1. Define chemical equilibrium?**

- **Chemical equilibrium-** is a state in which the rates of the forward and reverse reactions are equal to and the concentration of reactants and products remain constant.

2. Differentiate between reversible and irreversible reactions?

- **Reversible reactions-** are reactions those can proceed in both the forward and backward reactions.
- **Irreversible reactions-** are reactions those cannot proceed in both the forward and backward reactions.

3. What are the possibilities of the reaction?

- Reaction that goes to completion
e.g. $\text{Mg} + 2\text{HCl} \longrightarrow \text{MgCl}_2 + \text{H}_2$.
- No reaction takes place
e.g. $\text{Cu} + \text{HCl} \longrightarrow \text{No reaction.}$
- Reaction that appears to stop before reaching to completion
e.g. $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$.

4. What are the conditions necessary for the reaction to attain equilibrium?

- The reaction must be in a closed system
- The reaction must occur at a constant temperature
- The reaction must be reversible
- The rate of forward reaction must equal to the rate of reverse reaction.

5. On basis of the phase of reactants and the products, how many categories are classified into chemical equilibrium?

- Homogeneous chemical equilibrium
- Heterogeneous chemical equilibrium

6. Differentiate between homogeneous and heterogeneous chemical equilibrium?

- **Homogeneous chemical equilibrium**- when the reactants and products are all the same phase.
- **Heterogeneous chemical equilibrium**- when the reactants and products are all present in different phases.

7. Define equilibrium constant (K_c)?

- K_c - ratio of the equilibrium concentrations of products over the equilibrium concentrations of reactants each raised to the power of their stoichiometric coefficients.

8. What is the general formula of K_c ?

- **Equilibrium constant (K)** $K = \frac{P}{R}$ or $K = \frac{(C)(D)}{(A)(B)}$

9. Define reaction Quotient?

- **Reaction Quotient**- is the quantity that provides a measurement of the relative amounts of products and reactants present in a reaction at given time.

10. What was Le Chatelier's principle?

- Change in concentration
- Change of temperature

11. Why are solids and liquids not included in the chemical equilibrium?

- Because their concentration can't change to any great degree in an equilibrium.

12. What are the two relationships observed between the amounts of reactants and products in the equilibrium?

- In the mid 1860s, Norwegian scientists C.M. Goldberg and P. Waage.

13. Differentiate between Endothermic and Exothermic reactions?

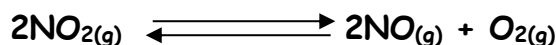
- **Exothermic reaction**- is the reaction that releases energy
- **Endothermic reaction**- is the reaction that absorbs energy

SECTION-3: CHAPTER PROBLEMS

1. For the reaction $\text{CO}_{(g)} + 2\text{H}_{2(g)} \rightleftharpoons \text{CH}_3\text{OH}_{(g)}$ describe what is happening for this reaction.

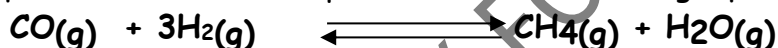
- The reaction between carbon monoxide and hydrogen gas is in equilibrium because the double arrows indicate that this is equilibrium.

2. Write the equilibrium constant expression of the following equation.



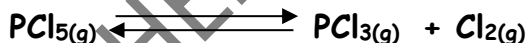
• SOLUTION: $K = \frac{[\text{NO}]^2 [\text{O}_2]}{[\text{NO}_2]^2}$

3. Write the equilibrium constant expression of the following equation.



• SOLUTION: $K = \frac{[\text{CH}_4][\text{H}_2\text{O}]}{[\text{CO}][\text{H}_2]^3}$

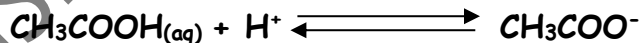
4. What is the equilibrium constant, K_{eq} if the equilibrium concentrations are as follows PCl_5 is 0.0096M, PCl_3 is 0.0247M and Cl_2 is 0.0247M?



Solution:

$$K = \frac{[\text{C}][\text{D}]}{[\text{A}][\text{B}]} = \frac{[\text{PCl}_3][\text{Cl}_2]}{[\text{PCl}_5]} = \frac{[0.0247\text{M}][0.0247\text{M}]}{[0.0096\text{M}]} = 0.06355\text{M}$$

5. Acetic acid dissociates in water. If K_{eq} is equal to 1.80×10^{-3} and the equilibrium concentration of acetic acid is 0.09986M, what is the concentration of H^+ and CH_3COO^-



Solution: $K = \frac{[\text{C}][\text{D}]}{[\text{A}][\text{B}]} = 1.80 \times 10^{-3} = \frac{[\text{H}^+][\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]}$

$$1.80 \times 10^{-3} \frac{[\text{X}][\text{X}]}{[0.09986]} = \text{X}^2 = 0.09986 \times 1.80 \times 10^{-3} \quad \text{X}^2 = 1.79748 \times 10^{-6}$$

$$\sqrt{\text{X}^2} = \sqrt{(1.79748 \times 10^{-6})} \quad \text{X} = 1.34 \times 10^{-3}$$

$$\text{The concentration of } \text{H}^+ = 1.34 \times 10^{-3}$$

$$\text{The concentration of } \text{CH}_3\text{COO}^- = 1.34 \times 10^{-3}$$

6. the reaction, $\text{CO(g)} + 3\text{H}_2\text{(g)} \rightleftharpoons \text{CH}_4\text{(g)} + \text{H}_2\text{O(g)}$,
calculate K_c from the following equilibrium concentrations:

$$[\text{CO}] = 0.0613\text{M} \quad [\text{H}_2] = 0.1839\text{M} \quad [\text{CH}_4] = 0.0387\text{M} \quad [\text{H}_2\text{O}] = 0.0387\text{M}$$

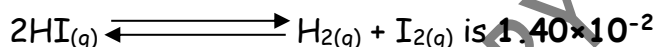
SOLUTIONS:

$$K_c = \frac{[\text{C}][\text{D}]}{[\text{A}][\text{B}]} = \frac{[\text{CH}_4][\text{H}_2\text{O}]}{[\text{CO}][\text{H}_2]^3}$$

$$\frac{[0.0387\text{M}][0.0387\text{M}]}{[0.0613\text{M}][0.1839\text{M}]^3}$$

$$\text{Answer} = 3.93$$

7. At given temperature, the equilibrium constant for the reaction stated below is 1.40×10^{-2}

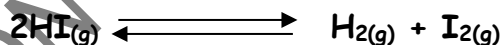


If the concentrations of both H_2 and I_2 at equilibrium are $2.00 \times 10^{-4}\text{M}$,
find the concentration of HI ?

SOLUTIONS:

$$K_c = 1.40 \times 10^{-2} \quad [\text{H}_2] = 2.00 \times 10^{-4}\text{M} \quad [\text{I}_2] = 2.00 \times 10^{-4}\text{M}$$

$\text{HI} = ?$



$$K_c = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2} = \frac{[2.00 \times 10^{-4}\text{M}][2.00 \times 10^{-4}\text{M}]}{[\text{HI}]^2}$$

$$1.40 \times 10^{-2} = \frac{[2.00 \times 10^{-4}\text{M}][2.00 \times 10^{-4}\text{M}]}{[\text{HI}]^2}$$

$$[\text{HI}]^2 = \frac{[2.00 \times 10^{-4}\text{M}][2.00 \times 10^{-4}\text{M}]}{1.40 \times 10^{-2}} \quad \int [\text{HI}]^2 = \int (2.86 \times 10^{-6})$$

$$\text{Answer} = 1.69 \times 10^{-3}$$

8. For the reaction, $\text{H}_{2(g)} + \text{F}_{2(g)} \rightleftharpoons \text{HF}_{2(g)}$, $K_c = 1.15 \times 10^2$ at certain temperature, suppose **3.00M** of H_2 and **6.00M** of F_2 are placed in **3.00L** container, what are the equilibrium concentration of H_2 , F_2 and HF ?

Solutions:

1. First find molarity = $\frac{\text{MOLE}}{\text{VOLUME}}$

$$\text{H}_2 = \frac{3.00\text{M}}{3.00\text{M}} = 1 \text{ Mol/L}$$

$$\text{F}_2 = \frac{6.00\text{M}}{3.00\text{M}} = 2 \text{ Mol/L}$$

2. Find the ICE for (Initial Change Equilibrium)

$\text{H}_{2(g)}$ +	$\text{F}_{2(g)}$ =	$2\text{HF}_{2(g)}$
1MOL	2MOLE	0
-X	-X	+2X
1-X	2-X	2X

3. Substitute the equilibrium concentrations into the equilibrium expression given:

$$K = 1.15 \times 10^2 = \frac{[2x]^2}{[1-x][2-x]}$$

$$(1.15 \times 10^2) x^2 - (3.45 \times 10^2) + 2.30 \times 10^2 = 0$$

The relevant of the two roots is $X = 0.968 \text{ Mol/L}$

$$[\text{H}_2] = 1 - X = 1 - 0.968 = 0.032$$

$$[\text{F}_2] = 2 - X = 2 - 0.968 = 1.032$$

$$[\text{HF}] = 2 (2 \times 0.968) = 1.936$$

9. If the $K_c = 1.0$, $[CO_2] = 2.0M$, $[H_2] = 2.0M$, $[CO] = 1.0M$, $[H_2O] = 1.0M$ for the reaction of $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$, What is the Q value for this reaction and which direction will reaction shift?

SOLUTIONS:

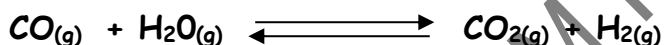
$$K_c = 1.0$$

$$[CO_2] = 2.0M$$

$$[H_2] = 2.0M,$$

$$[CO] = 1.0M$$

$$[H_2O] = 1.0M$$



$$K_c = \frac{[2.0][2.0]}{[1.0][1.0]} = 4.0$$

4.0 > 1.0, then $Q > K$ therefore the reaction shifts to the left toward the reactant

10. Find the value of Q and determine which side will the reaction shift,

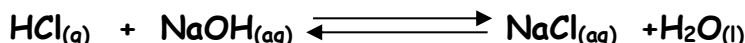
if $K_c = 0.5$ of the reaction, $HCl_{(g)} + NaOH_{(aq)} \rightleftharpoons NaCl_{(aq)} + H_2O_{(l)}$ and the concentration of HCl , $NaOH$ and $NaCl$ are **3.2M**, **4.3M** and **6M** respectively?

SOLUTIONS:

$$[HCl] = 3.4 M$$

$$[NaOH] = 4.3 M,$$

$$[NaCl] = 6 M$$



$$K_c = \frac{[6M]}{[3.4][4.3]} = 0.44$$

Since **0.44 < 0.5** then $Q < K$ therefore the reaction shifts to the right toward the product to achieve equilibrium

CHAPTER-EIGHT: NUCLEAR CHEMISTRY**SECTION-1: DIRECT QUESTIONS**

1. Define nuclear chemistry?
 - **Nuclear chemistry**- is the concerned with the structure of atomic nuclei and changes they undergo.
2. Differentiate between chemical and nuclear reactions?
 - **Chemical reaction**- occurs when bonds are broken and formed.
 - **Nuclear reaction**- occurs when nuclei combine, split and emit radiation.
3. How was discovered by radiation?
 - Henry Becquerel in 1896
4. Define mass defect?
 - **Mass defect**- is the difference between the sum of masses of the nuclear components and the mass of corresponding nucleus.
5. What is the easiest way; you can protect yourself from harmful effects of natural sources of radiation?
 - To reduce radiation exposure
 - Close windows and doors
6. Differentiate between nuclear fusion and nuclear fission?
 - **Nuclear fission**- is the splitting of the nucleus of an atom into lighter parts
 - **Nuclear fusion**- is the process of combining two or more nuclei to form a large nucleus.
7. Define radioactive decay?
 - **Radioactive decay**- is the breakdown of an unstable nuclide.
8. List types of radioactive decay?
 - Alpha decays
 - Beta decays
 - Gamma decays

9. Define transmutation?

- Transmutation- is the change in the identity of a nucleus as a result of a change in the number of its protons.

10. Distinguish between natural and artificial radioactive nuclides?

- Natural radioactivity- occur in nature
- Artificial radioactivity- produced in nuclear reactors.

11. What type of nuclear reaction takes place in stars?

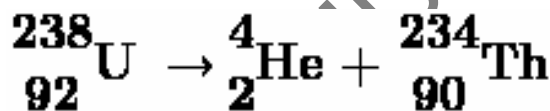
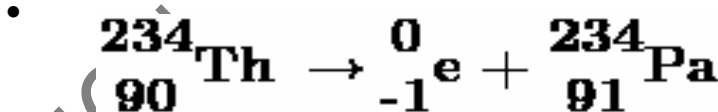
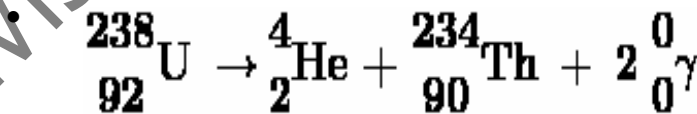
- Fusion reactions

12. Determine the number of protons and number of neutrons of Mg-24?

- Number of proton-12
- Number of neutrons-12

13. Define radiation?

- Radiation- is energy given off by matter in the form of rays or high-speed particles

14. Write the nuclear equation of the alpha decay of U-238?**15. Write the nuclear reaction of the beta decay of Thorium-234****16. Write the nuclear reaction of Gamma decay of U-238**

SECTION-2: CHAPTER PROBLEMS

1. **Phosphorous-32**, a radioisotope used in the treatment of **leukemia**, has a half-life of **14.3 days**. If the sample contains **8.0 mg** of phosphorous-32, how many milligrams of phosphorous-32 remain after **42.9 days**?

1 Mg of phosphorous-32 remains after 42.9 days.

Amount of phosphorous-32	Number of half-life	Time in days
8.0 Mg	0	0
4 Mg	1	14.3
2 Mg	2	28.6
1 Mg	3	42.9

2. The half-life of polonium-218 is **3.04 min**. A sample of polonium contains 0.00558 g of polonium-218, what mass of polonium-218 will remain after **18.24min**?

Solution:

$$\checkmark \text{ Number of half-lives} = \frac{\text{Time Elapsed}}{\text{Half-life}} = \frac{18.24 \text{ min}}{3.04 \text{ min}} = 6.00 \text{ half-lives}$$

3. **Determining the mass remaining from the half-life.**

- N_t = is the mass remaining
- N_0 = is the initial mass
- n = number of half-life.

4. **What are formulas of half-lives?**

- $N_t = N_0 \left(\frac{1}{2}\right)^n$
- $N_0 = N_t (2)^n$
- $n = \frac{T}{T_{1/2}}$
- $T_{1/2} = [T] \left(\frac{\log(2)}{\log \left[\frac{N_0}{N_t} \right]} \right)$

5. The half-life of radium 226 is about 1600 yrs, how many grams of 2.00g of sample will remain after 4800yrs?

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Solutions:

Given:

$$T_{\frac{1}{2}} = 1600 \text{ yrs}$$

$$T = 4800 \text{ yrs}$$

$$N_0 = 2.00 \text{ g}$$

$$N_t = ?$$

$$N_t = N_0 \left(\frac{1}{2}\right)^n$$

$$n = \frac{T}{T_{1/2}}$$

$$N_t = N_0 \left(\frac{1}{2}\right)^{\frac{T}{T_{1/2}}}$$

$$N_t = 2.00 \text{ g} \left(\frac{1}{2}\right)^{\frac{4800 \text{ yrs}}{1600 \text{ yrs}}}$$

$$N_t = 2.00 \text{ g} \left(\frac{1}{2}\right)^3$$

$$N_t = 0.25 \text{ g.}$$

6. Sodium-24 has half-life about **15 hours**, how much of **16g** sample of sodium-24 will remain after **60 hours**?

Solutions:

$$T = 60 \text{ hours}$$

$$T_{\frac{1}{2}} = 15 \text{ hours}$$

$$N_0 = 16 \text{ g}$$

$$N_t = ?$$

$$N_t = N_0 \left(\frac{1}{2}\right)^n$$

$$n = \frac{T}{T_{1/2}}$$

$$N_t = N_0 \left(\frac{1}{2}\right)^{\frac{T}{T_{1/2}}}$$

$$N_t = 16 \text{ g} \left(\frac{1}{2}\right)^{\frac{60 \text{ hours}}{15 \text{ hours}}}$$

$$N_t = 16 \text{ g} \left(\frac{1}{2}\right)^4$$

$$N_t = 1 \text{ g.}$$

7. Radioactive isotope decayed from 24 g to 0.75g in 40 yrs, what is the half-life of isotope?

Solutions:

$$N_t = 0.75 \text{ g}$$

$$T = 40 \text{ yrs}$$

$$T_{\frac{1}{2}} = ?$$

$$T_{\frac{1}{2}} = [40 \text{ yrs}] \left(\frac{\log(2)}{\log \left[\frac{24 \text{ g}}{0.75 \text{ g}} \right]} \right)$$

$$N_0 = 24 \text{ g}$$

$$= \frac{0.301}{1.505} = T_{\frac{1}{2}} = (40 \text{ yrs})(0.2) = 8 \text{ yrs.}$$