Date

CH:15 Organic Chemistry

↳ the word organic comes from a greek word 'organikos' meaning organ and is gene gernalized to the organ of living organism

* the branch of chemistry dealing with the study of ~~organic~~ hydrocarbon and its derivatives

carbon should be directly bonded with the hydrogen

→organic compounds: composed of organic element

⇒inorganic compounds: composed of elements other than carbon

↳**Vital force theory:**

Jons Jacob Berzelius said that organic compounds originate from living things (Plants and animals)

He added that organic compounds can be synthesized only from ~~organic~~ living matter

⇒He though that living things had a mysterious ~~vit~~ spiritual force called the vital force which was needed for the prepration of organic compounds

e.g: Urea

↳**Fredick Wohler**: synthesized urea in the ~~laboratory~~ laboratory

He wanted to prebare ammonium cyanate (NH_4OCN)

$$AgOCN + NH_4Cl \longrightarrow NH_4OCN + AgCl$$

silver cyanate — ammonium chloride — ammonium cyanate — silver chloride

*At High temperature:

$$NH_4OCN \longrightarrow NH_2 - CO - NH_2$$

ammonium cyanate — urea

He obtained a white powder which was not Ammonium cyanate (NH_4OCN) but urea (NH_2CONH_4)

→Ammonium cyanate (NH_4OCN) isomerized into urea (NH_2CONH_4) at high temp

↳synthesized an organic C ~~to ino~~ from inorganic compound

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→ Ammonium cyanate (NH_4OCN) and Ured (NH_2CONH_2) are isomers

- roughly there are almost 20 m carbon compounds known so far

⇒ isomerism was discovered by Fedrick Wohler

↳ Catenation :

Self linking ability of carbon

derived from a word 'catena' which means chains

→ the ability of carbon atoms to form long chains or rings is called chains

silicon also forms small chains :] → compared to C

sulphur forms small rings

$$n[-C-C-C-C-C-C-]_n$$

Importance:

:) Catenation helps carbon to make multiple or single bond with itself with no specific limit

:) support kinetic stability of organic compound

:) attach with other elements (functional group)

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Representation of organic molecules :-

* Formula:

Chemical formula of a compound represent the symbol of each element in a compound and the ratio in between them.

e.g - Glucose ($C_6H_{12}O_6$)

types of formula:

→ Molecular formula:-

shows the **actual no of elements.**

→ A Molecular formula shows the actual type of an atom and the actual ratio between the atoms of different elements in an organic compound.

ethanol: C_2H_6O

Glucose: $C_6H_{12}O_6$

→ Empirical formulae:

shows the **simplest ratio.**

→ Emperical formula is the symbolic representation of organic compounds which shows simplest whole number ratio between elements in them.

glucose: CH_2O

ethyne: $C_2H_2 = CH$.

→ structural Formulae:

tells us about **arrangement of atom** and **type of functional group.**

→ A structural Formula tells us about the type and arrangement of the atom and the functional group in it.

↳ Condesed structure Formulae:

shows relative position of the structure

Methane: CH_4

propane: $CH_3-CH_2-CH_3$

Ethane: CH_3-CH_3

→ Condense structural formula shows us the relative position of atoms in an molecule with showing the single covalent bond.

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→ each carbon atom is shown individually with H attached to it.

:) shown in brackets : functional group, methylene group (CH_2)

side chain or functional group is shown in bracket along with the carbon it is attached to.

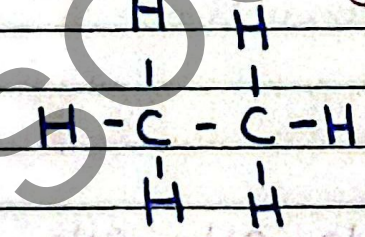
Alkane	CSF	Alkane	CSF
Methane	CH_4	Hexane	$CH_3(CH_2)_4CH_3$
Ethane	CH_3-CH_3	Heptane	$CH_3(CH_2)_5CH_3$
Propane	$CH_3-CH_2-CH_3$	Octane	$CH_3(CH_2)_6CH_3$
Butane	$CH_3(CH_2)_2CH_3$	nonane	$CH_3(CH_2)_7CH_3$
Pentane	$CH_3(CH_2)_3CH_3$	decane	$CH_3(CH_2)_8CH_3$

Full structural formula:

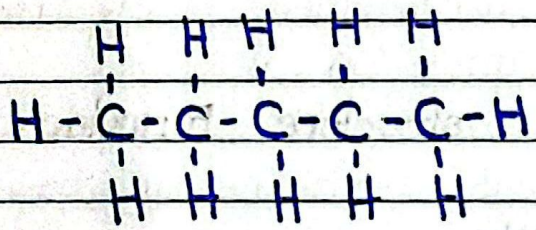
→ Shows all the atoms and bonds in the formula

→ It is 2 dimensional formula and is also called 2D displayed formula.

A 2D formula tells us the arrangement on x and y planes only.



ethane



pentane

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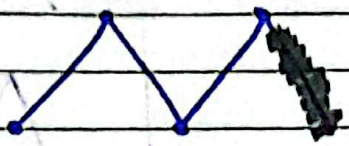
→ Skeletal formula:

→ Skeletal formula shows us skeletal structure or
→ skeleton of the molecule.

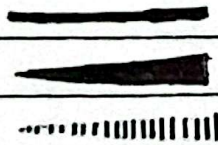
- it is used for very large and complex organic molecules
- each end of the line represents a carbon atom. Each carbon atom is assumed to be bonded with enough hydrogen to complete its valency

*Butane: 

*Propene: 

→ Steriochemical formula:

Steriochemical formula is a formula that shows the arrangement of ~~met~~ atoms in a molecule in 3 dimension.



= along the plane
= out of the plane
= inside the plane

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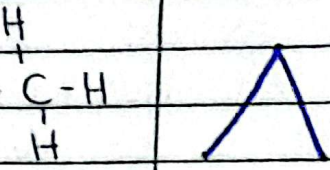
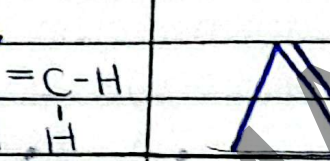
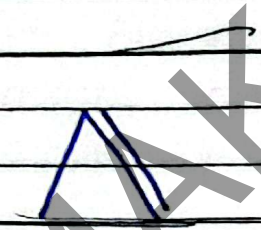
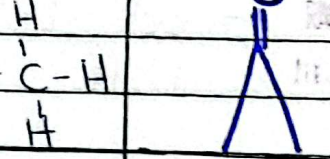
Name	MF	CST	DF	SF
→ Propane :	C_3H_8	$CH_3CH_2CH_3$		
→ Propene	C_3H_6	$CH_3CH=CH_2$		
→ Propan 2-ol	C_3H_8O	$CH_3CH(OH)CH_3$		
→ Propanal	$C_3H_6=O$	CH_3CH_2CHO		
→ Propanone	C_3H_6O	CH_2COCH_3		

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Combustion Analysis:

E.g 1:

- Data:

Carbon = 38.4% empirical formula = ?
Hydrogen = 4.8% (simplest ratio)
Clorine = 56.8%

- Solution:

Step 1: calculates moles of each element

no of moles = $\frac{\text{Mass in g}}{\text{molar mass}}$

carbon: $\frac{38.4}{12}$ = 3.2 moles

Hydrogen: $\frac{4.8}{1}$ = 4.8 moles

Clorine: $\frac{56.8}{35.5}$ = 1.6 moles

Step 2: find least no of moles & devide all with it
= 1.6 moles.

$\frac{3.2}{1.6} = 2$ $\frac{4.8}{1.6} = 3$ $\frac{1.6}{1.6} = 1$

Step 3: Put the nos in the formula:

$C_2H_3Cl_1$

Eg 2:-

- Data:

empirical formula = CH
Molecular mass = 78 amu
Molecular formula = ?

- Solution:

M.F = n x E.F $n = \frac{\text{Molecular mass}}{\text{E.F mass}}$

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n = molecular mass / E.F = 78 / 13 = 6 moles

E.F mass = 12(1) + 1(1) = 13 amu (of CH)

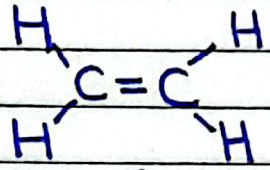
Molecular mass = 6 x (CH)

= C_6H_6 = Benzene

Concept Assessment 15.1:

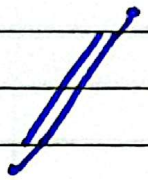
i) Ethene:

=> displayed:



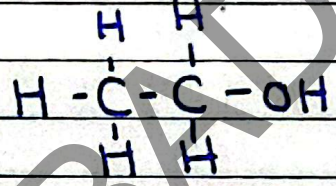
=> Condensed : ~~C_2 $(CH_2)_2$~~ $CH_2=CH_2$

=> Skeletal Formula:



ii) Ethanol:

=> displayed:



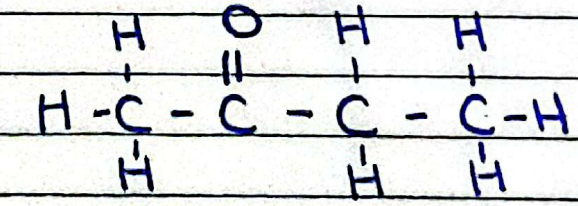
=> condensed: $CH_3CH_2(OH)$.

=> Skeletal :

Ketone = $R-\overset{\overset{O}{\|}}{C}-R$

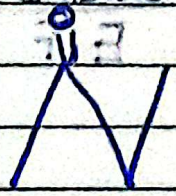
iii) butanone:

=> displayed:



=> condensed: $CH_3(C.O)CH_2CH_3$

=> Skeletal:



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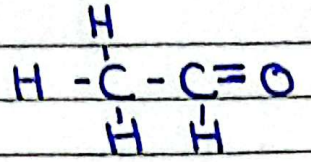
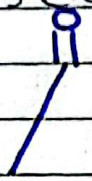
iv) ethanal: aldehyde = R=O

-> displayed:



-> condensed: CH_3CHO

-> skeletal formula:

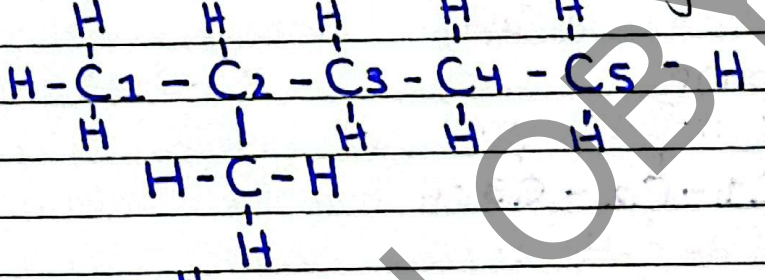


Q/s 2:

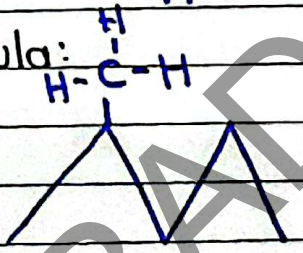
i) 2-methylpentane

-> displayed formula:

methyl = 

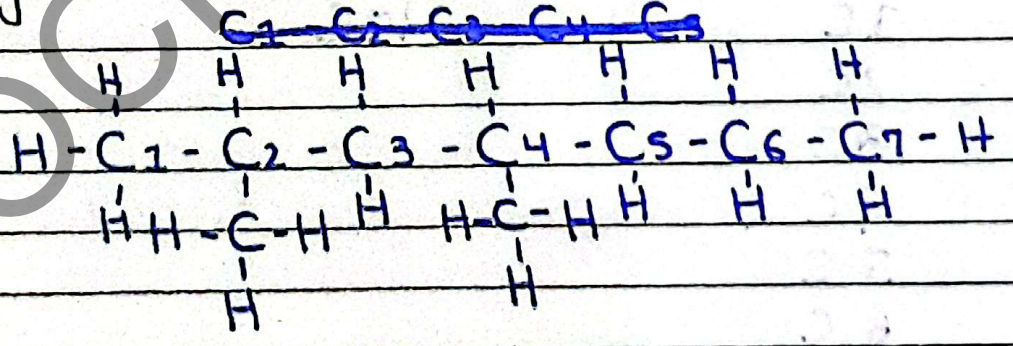


-> skeletal formula:

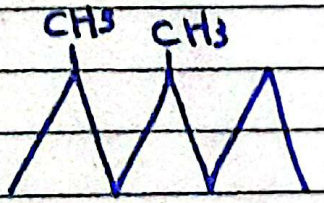


ii) 2,4-dimethylheptane:

-> displayed formula:



-> skeletal formula:



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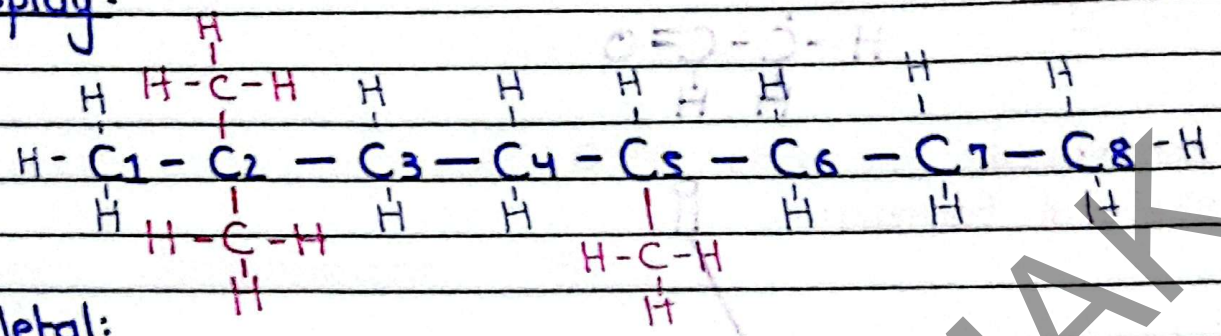
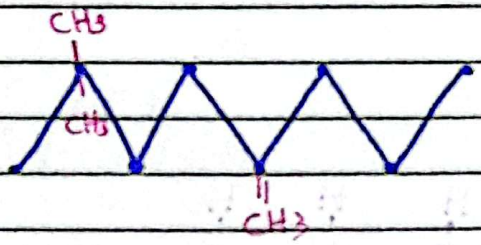
→ 2,2-5 trimethyloctane:

• 2D display:

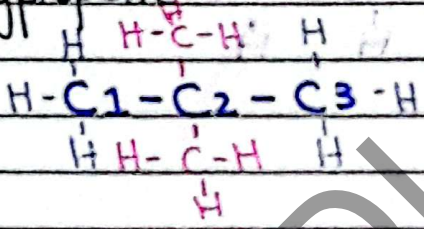


⇒ Skeletal:

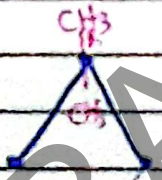


→ 2,2-dimethypropane

• 2D display:



• Skeletal:



(Additional Revision):

- Meth- = 1C
- Eth- = 2C
- Prop- = 3C
- But- = 4C
- Pent- = 5C
- hex- = 6C
- hep- = 7C
- oct- = 8C
- non- = 9C
- dec- = 10C.

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Functional Group :-

→ An atom or group of atom which is attached to carbon chains and rings and determines the characteristic properties of the organic compound is called functional group

All organic compounds have 2 parts:

→ reactive functional group

→ unreactive relatively unreactive carbon network

Since chemical reaction take place on the functional group so we can say that chemical properties of a organic compound depend upon its functional group.

→Homologous series:

adjacient series differ by CH_2.

* a series of organic compound having same functional group in which adjacent member differ by methylene (CH_2) unit.

features of Homologous series:

1. Each homologous series has its own functional group
2. They differ by one methylene group ($-CH_2$) in adjacent molecules
3. Each series has its own general formula, for eg:

alkanes = C_nH_{2n+2} **alkenes** = C_nH_{2n}

alcohol = C_nH_{2n+1}.

4. All members have similar chemical properties (Same functional group)
5. gradual change in physical properties with increase in the size of carbon chain.
6. They have similar method of preparetion.

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Homologous Series of Alcohols.

Name	M.F	Condensed formulae
→ Methanol	CH_4O	CH_3OH
Ethanol	~~CH_3C~~ C_2H_6O	CH_3CH_2OH
propanol	C_3H_8O	$CH_3CH_2CH_2OH$
Butanol	$C_4H_{10}O$	$CH_3(CH_2)_2CH_2OH$
pentanol	$C_5H_{12}O$	$CH_3(CH_2)_3CH_2OH$
hexanol	$C_6H_{14}O$	$CH_3(CH_2)_4CH_2OH$
heptanol	$C_7H_{16}O$	$CH_3(CH_2)_5CH_2OH$
nonanol	$C_8H_{18}O$	$CH_3(CH_2)_6CH_2OH$
dectanol	$C_9H_{20}O$	$CH_3(CH_2)_7CH_2OH$

Assessment 15.2

→ Write the functional group and general formula:

- **alcohols:**

⇒ General formula = R-OH $C_nH_{2n+1}OH$

⇒ functional group = hydroxyl group (-OH)

- **Aldehydes:**

⇒ General formula = $C_nH_{2n+1}COH$

⇒ functional group = $R-\overset{O}{\overset{\|}{C}}-H$ $R-CO.H$ (Aldehyde group)

- **ketones:**

⇒ General formula = $C_nH_{2n+1}CO.C_mH_{2m+1}$

⇒ functional group = $R-\overset{O}{\overset{\|}{C}}-R$, (R-CO-R), (ketone group)

- **Ethers:**

⇒ General formula: $C_nH_{2n+1}OC_mH_{2m+1}$

⇒ functional group: R-O-R (ether group

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Homologous Series	General Formula	Functional Group	Example
Alkanes R-H	$C_{2n}H_{2n+2}$	none	CH_3-CH_3 ethane
Alkene $>C=C<$	C_nH_{2n}	$>C=C<$ double bond	$H_2C=CH_2$ ethene
Alkyne $-C\equiv C-$	C_nH_{2n-2}	$-C\equiv C-$ triple bond	$HC\equiv CH$ ethene
Halogenoalkanes R-X	$C_nH_{2n+2}X$	-X halo group	CH_3CH_2Cl chloroethane
Alcohol R-OH	$C_nH_{2n+2}OH$	-OH hydroxyl-group	CH_3CH_2OH ethanol
Ethers R-O-R	$C_nH_{2n+2}OC_mH_{2m+2}$	-O- ether group	CH_3-O-CH_3 methoxymethane
Amines $R-NH_2$	$C_nH_{2n+1}NH_2$	$-NH_2$ amine group	CH_3NH_2 methylamine
Nitrites $R-C\equiv N$	$C_{2n}H_{2n+1}CN$	$-C\equiv N$ nitrile group	CH_3CN ethanenitrile
Aldehydes $R-C(=O)-H$	$C_nH_{2n+1}CHO$	$-C(=O)-H$ aldehyde group	CH_3CHO ethanal
ketone $R-C(=O)-R$	$C_nH_{2n+1}CO$ C_mH_{2m+1}	$-C(=O)-R$ ketone group	CH_3COCH_3 propanone

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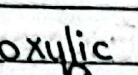
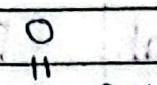
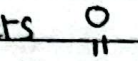
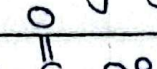
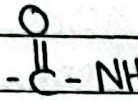
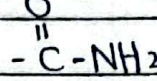
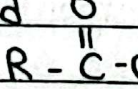
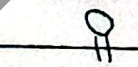
carboxylic acid 	$C_nH_{2n+1}COOH$	 carboxyl group	CH_3CH_2COOH propanoic acid
Esters 	$C_nH_{2n+1}COO$ C_mH_{2m+1}	 ester group	$CH_3-COOCH_3$ methyl acetate
Amides 	$C_nH_{2n+1}CONH_2$	 amide group	CH_3-CONH_2 ethanamide
Acid halid 	$C_nH_{2n+1}COX$	 Acid halide group	CH_3-COCl ethanoyl chloride
Arenes  X= complex	C_nH_{2m-6m} m = no of rings	 phenyl group	$C_6H_5CH_2CH_3$ ethylbenzene

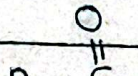
- **Carboxylic acids:**

⇒ General formula = $C_nH_{2n+1}COOH$

⇒ functional group =  (R-COOH), (carboxylic acid).

- **Esters:**

⇒ General formula: $C_nH_{2n+1}COOC_mH_{2m+1}$

⇒ functional group:  (R-COOR) (ester group)

- **Amides**

⇒ General formula: $C_nH_{2n+1}CONH_2$.

⇒ Functional group:  ($R-CONH_2$) (nitrile group)

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Hydrocarbons:-

-> compounds that have only hydrogen and carbons

• carbon act like backbone and hydrogen acts like the skin of the molecules

Alkanes have no functional group, all the other organic compounds are less reactive because

-> The C-C and C-H bonds are non-polar so they cannot be attacked by other polar ~~sub~~ reagents

-> The C-C and C-H bonds are very strong and hard to break

• If a functional group is attached to H.C, they become reactive.

C-C = 346 kj/mol O-O = 142 kj/mol

N-N = 167 kj/mol

Classification of H.C:

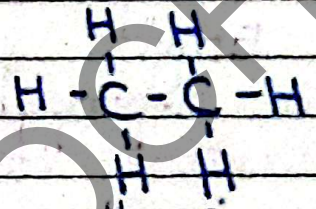
① Saturated hydrocarbon:

-> hydrocarbons having only a single covalent bond in between all of its carbon atoms

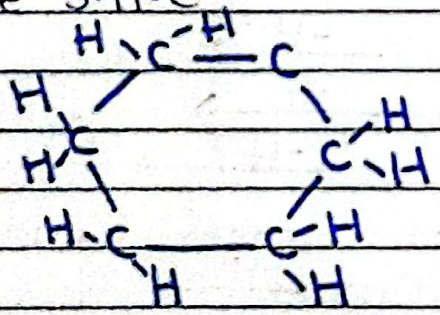
-> All alkanes are S.H.C

-> All cycloalkanes are S.H.C

e.g:



• ethane



• cyclohexane

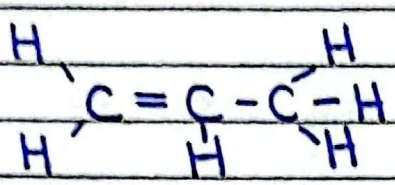
Date

② Unsaturated hydrocarbons.

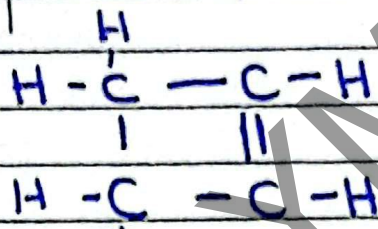
→ Hydrocarbons which have double or triple or multiple bonds of carbons.

→ "Unsaturated" = more atoms can be added to C atoms

→ Unsaturated hydrocarbons show addition reaction because more atoms can be added to them across carbon atoms having multiple bond.



propene



cyclobutene.

Alkyl Group (R-)

→ A group obtained by removing one H atom from any alkane is called Alkyl group (R-).

* Alkyl replace the sufix 'ane' of alkane's with 'yl'

Examples:

- Methane $CH_4 \xrightarrow{-H} CH_3$ Methyl
- Ethane $CH_3CH_3 \xrightarrow{-H} CH_2CH_3$ Ethyl
- Propane $CH_3CH_2CH_3 \xrightarrow{-H} CH_3CH_2CH_2$ n-propyl

When carbon H is removed from terminal C = n-

- Propane $CH_3CH_2CH_3 \xrightarrow{-H} CH_3CHCH_2$ iso-propyl

When H is removed from central C = iso-

- Butane $CH_3CH_2CH_2CH_3 \xrightarrow{-H} CH_3CH_2CH_2CH_2$ n-butyl (n-Butane)

Date _____

• Butane $CH_3CH_2CH_2CH_3 \xrightarrow{-H} CH_3CH_2\dot{C}HCH_3$

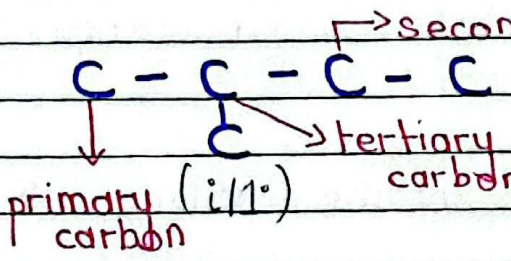
*When H is removed from second carbon = iso / secondary- Ryl.

secondary-butyl.
iso-butyl.

-> Primary: carbon attached to only one carbon is called primary carbon

=> Secondary: a carbon attached to two carbon is called secondary carbon

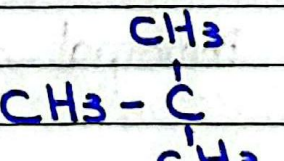
-> Tertiary carbon: a carbon attached to 3 carbon.



-> hydrogen connected on them are nammed according to the carbon,

-> In secondary alkyl, secondary hydrogen is removed and soon.

isobutane.



primary butyl.

Naming Compounds.

Prefix	Root/Stem name	Suffix	suffix of principal group
↓	→ no of carbon atom in parent chain.	→ family (ane - ene eyn)	
↳ position and substituent (branch)			

→ **Prefix:** Prefix tells us about the branch or substituent attached to the main carbon chain & its position.

→ **Stem or Root name:** tell us the number of carbon atom in the main chain

→ **Suffix:** Suffix like -en -eyne of -ene tell us about the saturation and unsaturation of the compound

→ **Suffix of Principal group:** indicates the family name

Date _____

Class/family	Preffix/suffix	Examples
• Alkane	Suffix :, -ane	$CH_3CH_2CH_3$ propane
• Alkenes	Suffix , -ene	$CH_2 = CH_2$ ethene
• Alkyne	Suffix , -yne	$CH \equiv CH$ ethe yne
• Halogenoalkanes	Preffix , -halo	$CH_3CH(Cl)CH_3$ 2-cloroethane
• Alcohol	Suffix, -ol	CH_3OH Methanol
• Ethers	Prefix = alkoxy	CH_3OCH_3 e methoxymethane
• Aldehydes	suffix, -al	~~CH_3COCH_3~~ CH_3COH e methanal
• Ketone	suffix, one	$CH_3(CO)CH_3$ ethane Acetone.
• Amines	suffix, amine	CH_3NH_2 methanamine
• Nitriles	suffix, nitrile	CH_3CN methanenitrile
• Carboxylic acic	suffix, oic acid	CH_3COOH methaoic acid
• Acid halides	suffix, oyl halide	CH_3COCl methanoyl halide
• Amides	suffix, amide	CH_3CONH_2 methanamide
• Arenes	Suffix= benzene Preffix= phenyl	$C_6H_5CH_3$ methylbenzene.

Date

Nomenclature of O.C

→Aliphatic organic compounds:

Aliphatic organic compounds can either be straight or branched chains. Cyclic compounds except benzene are also A.O.C

⇒ $CH_3-CH(CH_3)-CH_3$ =isobutane (common name)
= 2-methybutane (IUPAC)

⇒ $CH_3-C(CH_3)_2-CH_3$ =neopentane (common name)
= 2, 2-methylpentane (IUPAC)

TUPAC (International union of pure and applied chemistry) introduced the systematic names for compounds

Nomenclature of Alkanes

⇒Rules for systamatic names of alkanes:

(1) Identify the longest/Parent chain in a compound. The number of carbon atoms in the parent chain give us root number of the compound.

e.g:

$CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$

7 C atom= hept- (root name)

$CH_3-CH_2-CH(CH_3)-CH_2-CH_3$ 7C atom=hep(root).

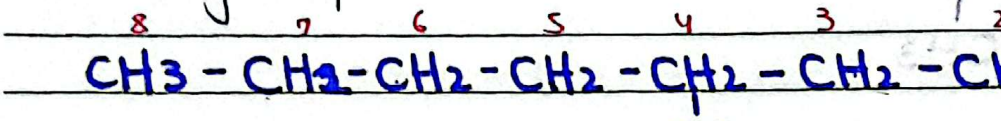
We can make this structure straight= unbranched. Also check the saturation and unsaturation

Date

② Identify the substituent (branches) or branch chain and determine their position and use them as prefixes of the IUPAC name.

Start the numbering of the C in parent chain from the carbon closest to the substitute.

In alkanes, alkyl groups (CH_3) are attached to parent chain. The position of the substitute is the locant number. We always opt for a shorter locant no.



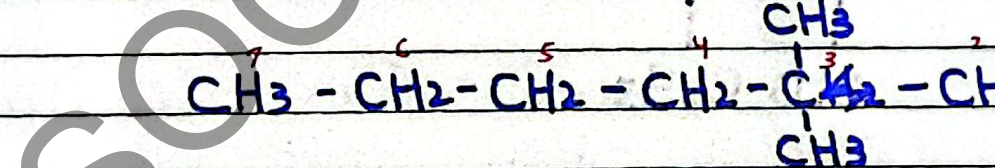
4-Methyloctane

- a lettre and a no are seprated by hyphen
- number and a number are sep by comma
- first word after hyphen is capital.

③ • If there are two or more identical substituent attached to parent chain, then use the prefixes **di, tri and tetra ... etc**

• If two identical substituent are bonded to the same carbon atom, repeat that locant.

• If identically substituent are bonded to different carbon atom, write their locants seprately



3,3-dimethylheptane

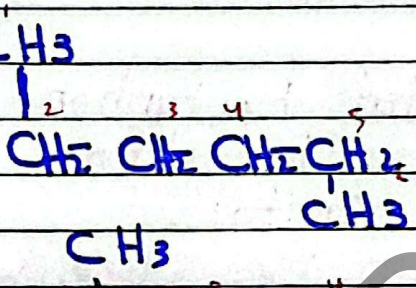
Date _____

(5) If there are two or more different substituents in a molecule, whether on same different C in the parent chain,
We write their locants seprately
Put their names in alphabetical orders,

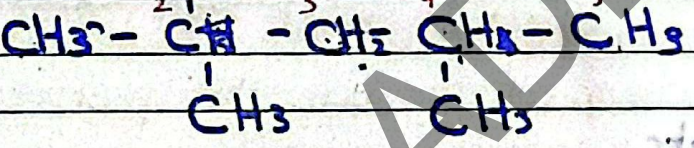
⇒ Practice example:

(1) $CH_3 - CH_2 - CH(CH_3) - CH_2 - CH_3$

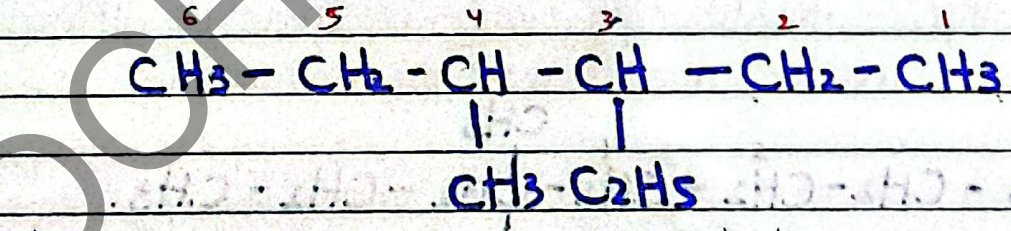
⇒ 3-Methylpentane

(2) 

⇒ hexane

(3) 

⇒ 2,2,4-Tetrimethylbutane

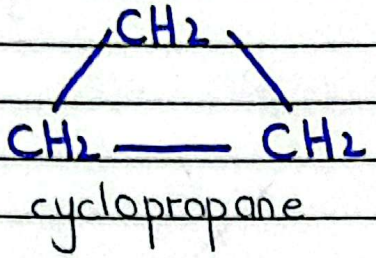
(4) 

⇒ Start the num from the bulky group
Answer: 3-Ethyl-4-Methylhexone

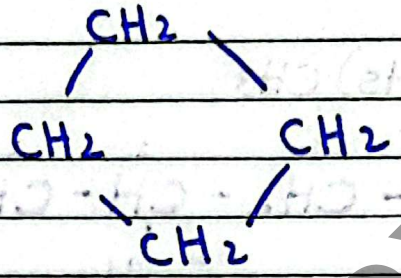
Date _____

Nomenclature of cycloalkanes :

(1) While writting cycloalkaned, their stem name is prefixed by 'cyclo'
In closed chain no of H decreases by 2

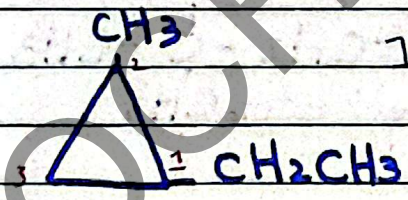


cyclopropane

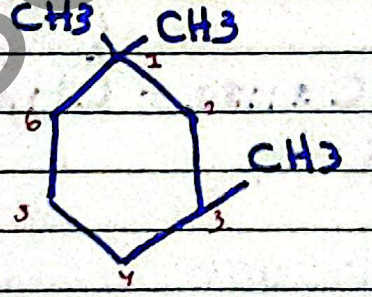


cyclobutane,

(2) In the case of substituted cycloalkane, the name of substituent are put before cycloalkane along with their position on the carbon ring.
If there are more than one given substituent, we put them in alphabetical order.
⇒One substituent should be given the position 'one' (the heavy substituent, with more carbon atom) and then the numbering should continue either clockwise or anticlockwise so the remaining substituent get the lowest ~~num~~ locant,

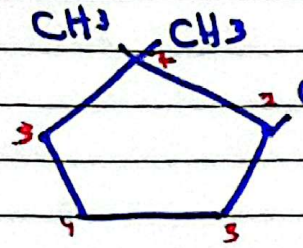


1-Ethyl-2-Methyl ~~ane~~ cyclopropane.



~~1,1-Dimethyl-3-Methylhexcyclohexane~~
1,1,3-Trimethylcyclohexane

Date _____



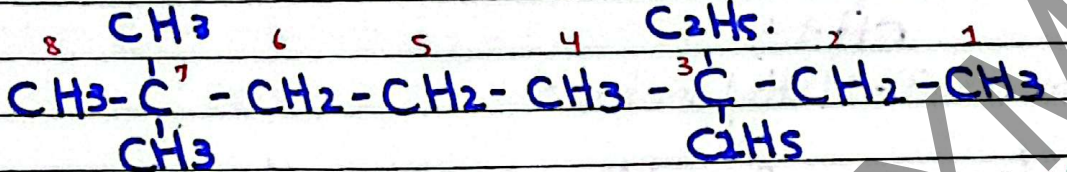
either, 2+2+1 = 5 or

1+1+2 = 4 → lowest locant

~~1-Ethyl-2,2-dimethylcyclopentane~~

2-Ethyl-1,3-dimethylcyclopentane.

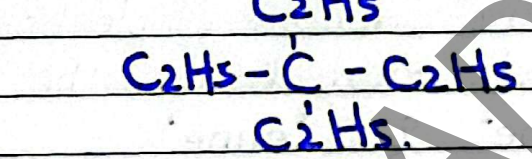
vi) $(CH_3)_3C(CH_2)_3C(C_2H_5)_3$



→ Prefer the heavy group to come first (ethyl)

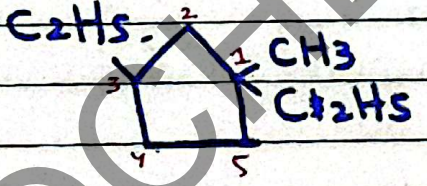
IUPAC: 3,3-~~Di~~ethyl-7,7-Dimethyloctane

vii) $C(C_2H_5)_4$



IUPAC name: 1,1,1,1-Tetraethylmethane.

viii)



IUPAC name: 1,3-~~E~~Di-Ethyl-1-Methylcyclopentane

Date _____

ii) $CH_3CH_2CH(C_2H_5)CH_3$

=> $CH_3 - CH_2 - \underset{C_2H_5}{CH} - CH_3$ or

=> $CH_3 - CH_2 - \overset{3}{\underset{\overset{2}{CH_2}}{CH}} - CH_3$ (5, 4, 3)

CH_3 (1)

IUPAC name: 3-Methylpentane

Nomenclature of alkenes and alkynes:-

Alkenes and Alkynes follow the same IUPAC names as alkanes but they have a functional group (carbon double & triple bond) so it is put in the name

1. The parent chain must have double, triple bond The position be of the bond must follow the root name immediately = 'ene' & 'eyne'

$CH_2=CH_2$ ethene / eth-1-ene

$CH\equiv CH$ ethyne / eth-1-eyne

2. Numbering must start from where double, triple bond is close

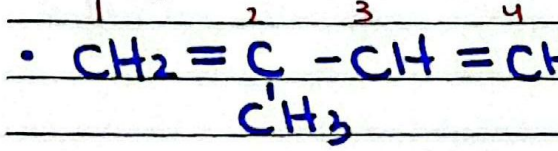
$CH_2^1=CH^2 - CH_2^3 - \underset{CH_3}{CH^4} - CH_3^5$

IUPAC name: 4-Methylbut-1-ene

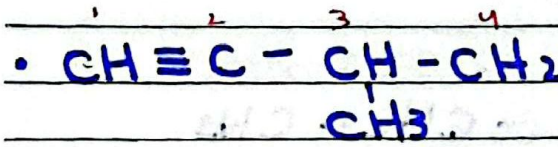
$CH^1\equiv C^2 - CH_2^3 - CH_2^4 - \underset{CH_3}{CH^5} - CH_3^6$ IUPAC: 5-Methylhex-1-ene

Date

(3) If there are more than one multiple bond in an molecule, add word 'a' to the stem name and put di, tri, tetra before 'ene' & 'yne'.



IUPAC : 2-Methylbuta-1,3-diene

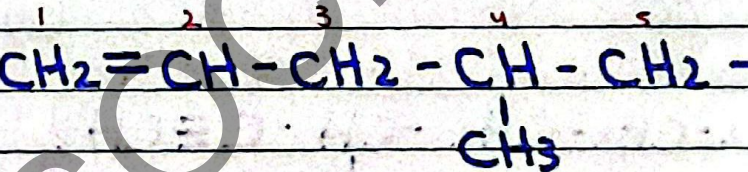


IUPAC : 3-Methylhexa-1,5-Dieyne

(4) For namming and putting substituets in order, same rules are applied as for alkanes

(5) If a molecule has both 'double' and 'triple' bond we put double bond first in the name & end the name with 'eyne' and use en for alkene. We will start the numbering from double bond.

(6) Start the numbering fro from the side where multiple bonds come closer If a molecule has both double and triple bond, start from the side closer to double bond.



IUPAC : 4-Methyloct-1-en-7-eyne.

Date

Concept 15.4:

1) But-1-ene:

$CH_2 = CH - CH_2 - CH_3$

2) pent-1,2-diene.

$CH_2 = CH = CH - CH_2 - CH_3$

3) 5-methylhepta-1,3-diyne:

$\overset{1}{C}H \equiv \overset{2}{C} - \overset{3}{C} \equiv \overset{4}{C} - \overset{5}{C}H - \overset{6}{C}H_2 - \overset{7}{C}H_3$

CH_3

6) hex-1-en-4-yene.

$CH_2 = CH - CH_2 - C \equiv C - CH_3$

Q/2.

i) $CH_2 = CH(CH_2)_3 C \equiv CCH_3$

* Structure:

$\overset{1}{C}H_2 = \overset{2}{C}H - \overset{3}{C}H_2 - \overset{4}{C}H_2 - \overset{5}{C}H_2 - \overset{6}{C} \equiv \overset{7}{C} - \overset{8}{C}H_3$.

* TUPAC name: Oct-1-en-6-yne

ii) $CH_2 = CH(CH_2)_4 CH(CH_3) C \equiv CH$.

* Structure:

$\overset{1}{C}H_2 = \overset{2}{C}H - \overset{3}{C}H_2 - \overset{4}{C}H_2 - \overset{5}{C}H_2 - \overset{6}{C}H_2 - \overset{7}{C}H - \overset{8}{C} \equiv \overset{9}{C}H$.

CH_3

* TUPAC name: 7-Methylnon-1-en-8-yne.

Date

iii) $CH_3CH=C=CH_2$

* Structure:

$$CH_3 - CH = C = CH_2$$

(4) (3) (2) (1)

* IUPAC name: Buta-1,2-Diene.

iv) $(CH_3)CH=C(CH_3)CH(CH_3)_2$

* Structure:

$$CH_3-CH=\overset{CH_3}{\overset{|}{C}}-\overset{H}{\overset{|}{C}}H$$

(5) (4) (2) (3) (1) (2)

$$CH_3 \quad CH_3$$

(1)

* IUPAC name: 2,3-DiMethylpent-3-ene

Nomenclature of Halogenoalkanes :-

General formula: $C_nH_{2n+1}-X$

$X = F_2, Cl_2, Br_2, I_2$

F = prefix = Flaro

Cl = prefix = Chloro

Br = prefix = Bromo

I = prefix = Iodo

- Halogenoalkanes
- alkyl Halides
- Haloalkanes

-> Halogenoalkanes are those organic compounds in which one or more hydrogen atom is replaced by a halogen atoms (X)

-> If only one Hydrogen is replaced by a halogen atom = **alkyl halides / monohaloalkane.**

-> halo group (-X) is treated as a substitute

***Rule:-**

(1) Use suitable prefixes for specific halo groups.

(2) Start the numbering from where the halo group is closer (Functional group)

Date

→ CH_3-I

IUPAC = iodomethane

common = methyliodide

→ CH_3-CH_2-Cl

IUPAC = chloroethane

common = ethylcloride

→ $CH_3-\underset{Cl}{\overset{|}{CH}}-CH_3$

IUPAC : ~~2-Methylprop ehloro~~ 2-chloropropane

→ $CH_3-\underset{CH_3}{\overset{|}{CH}}-CH_2-Br$

IUPAC : ~~2-Methyl-1-Bromopropane~~

1-Bromo-2-Methylpropane

→ $CH_3-CH_2-\underset{Cl}{\overset{|}{CH}}-CH_2-\underset{Br}{\overset{|}{CH}}-CH_3$

IUPAC name : 2-Bromo-4-Chlorohexone.

→ $CH_3-\underset{CH_3}{\overset{|}{CH}}-CH_2-\underset{Br}{\overset{|}{CH}}-CH_3$

IUPAC name : 2-Bromo-4-Methylpentane.

→ $CH_3-CH_2-\underset{Cl}{\overset{|}{CH}}-CH_2-\underset{CH_3}{\overset{|}{CH}}-CH_3$

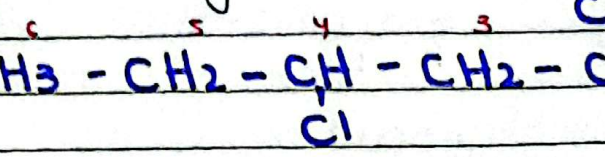
IUPAC name : 3-Chloro-5-Methylhexane

→ $CH_3-\underset{Br}{\overset{|}{\underset{CH_3}{\overset{|}{C}}}}-CH_3$

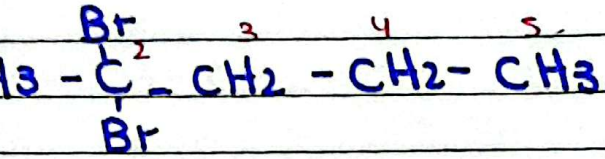
IUPAC : 2-bromo-2-Methylpropane.

Date _____

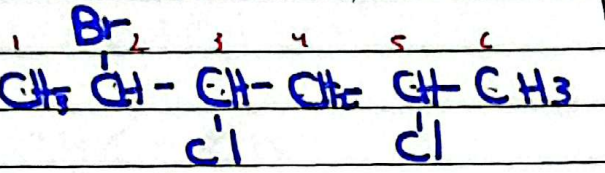
(3) If a halogenoalkane has more than one halo group so you use di, tri, tetra.



IUPAC name: 2,4-Dichlorohexane.



IUPAC name = 2,2-Dibromopentane.



IUPAC name: 2-Bromo-3,5-Dichlorohexane.

Nomenclature of Alcohols:-

General formula: $C_nH_{2n+1}OH$ • Alkanol

→ Alcohols are organic compounds having hydroxyl group attached to the carbon parental chain,

*Rules:

(1) Start the numbering in parental chain from the side closer to the functional group (OH)

(2) 'e' in 'alkane's is replaced by 'ol' and location of th (OH) group is also written

(3) If there is only ~~a~~ one ~~two~~ carbon atom in the parental carbon chain, & locant is not written before the suffix

Date _____

→ CH_3-CH_2-OH ethanol

$CH_3-CH(OH)-CH_3$ propan-2-ol.

→ $CH_3-C(CH_3)(OH)-CH_3$ IUPAC = 2-Methlypropan-2-ol.

→ $CH_3-CH(CH_3)-CH_2-OH$

IUPAC: 2-Methlypropan-1-ol.

→ $CH_3-C(CH_3)_2-CH_2-CH_2-OH$

IUPAC: 3,3-Dimethylbutan-1-ol.

→ $CH_3-C(CH_3)(OH)-CH_3$

IUPAC name: 2-Methylpropan-2-ol

(4) If there are more than one OH group, repeat the locant for each and write the words di, tri, tetr before the suffix 'ol' - last alphabet 'e' of ~~propane~~ alkane is written

→ $CH_2(OH)-CH_2(OH)$

IUPAC name: ethane-1,2-Diol.

→ $CH_3-C(CH_3)(OH)-CH_2-CH_2(OH)$

IUPAC name = 3-Methylbutane-1,3-Diol

Date

→ $CH_3-\underset{OH}{CH}-\underset{OH}{CH_2}$ $\quad$ $\overset{OH}{}$

IUPAC name: Propane-1,2,3-Triol

(5) If there is double bond in the parent chain suffix ene comes before the locant and suffix "ol"

→ $CH_2=CH-OH$

IUPAC name: ethenol or : eth-1-ene-1-ol

→ $CH_2=CH-CH_2-OH$

IUPAC name: prop-2-En-1-ol

Concept Assessment 15.5:

i) $(CH_3)_2CHCH(Br)CH_2CH_3$

~~CH_3-CH~~
~~CH_3~~ $CH_3-\overset{2}{C}H(CH_3)-\overset{3}{C}H(Br)-\overset{4}{C}H_2-\overset{5}{C}H_3$

IUPAC: ~~2-Methyl~~ 3-Bromo-2-Methylpentane

ii) $CH_3CH(OH)CH_2CH_3$

$\overset{1}{C}H_3-\overset{2}{C}H(OH)-\overset{3}{C}H_2-\overset{4}{C}H_3$

IUPAC: Butan-2-ol

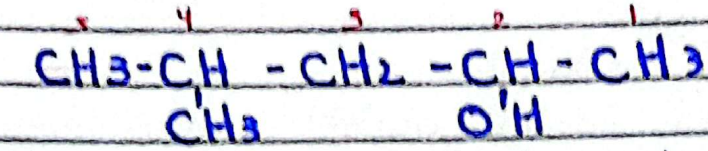
iii) $CH_3CH(OH)CH(CH_3)CH_2CH_3$

$\overset{1}{C}H-\overset{2}{C}H(OH)-\overset{3}{C}H(CH_3)-\overset{4}{C}H_2-\overset{5}{C}H_3$

IUPAC name: 3-Methylpentan-2-ol

Date

iv) $CH_3CH(CH_3)CH_2CH(OH)CH_3$.

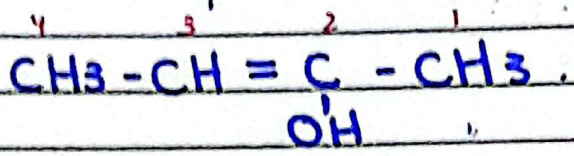


TUPAC name: 4-Methylpentan-2-ol

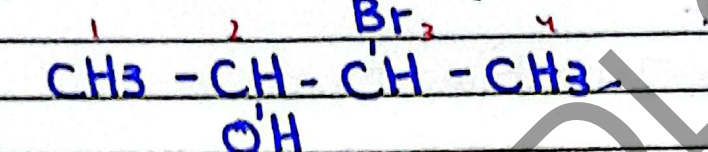
v) $CH_3CH=C(OH)CH_3$.

TUPAC name:

Structure: Prop-2-ene-2-ol.



vi) $CH_3CH(OH)CH(Br)CH_3$



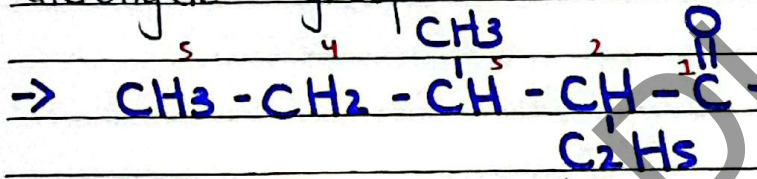
TUPAC name: 3-Bromo-propan-2-ol.

Date

Nomenclature of Aldehydes

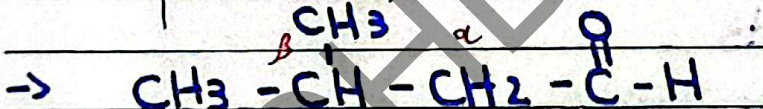
aldehyde group = $R-\overset{\overset{O}{\|}}{C}-H$ (-CHO) (carbonyl group $\overset{\overset{O}{\|}}{C}$)

1. Aldehyde group is terminal so it will be a part of the parent chain. (ending position)
2. Carbon of aldehyde will have "1" position always.
3. "e" of alkane is replaced by "al"
   We don't write the position of aldehyde group because it always comes first in the parent chain.
   C of Aldehyde will be counted in parent chain
4. If substituents are attached along with aldehyde in the parent chain, start the numbering from the aldehyde group.

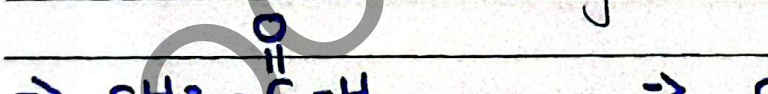


IUPAC name: 2-Ethyl-3-Methylpentane

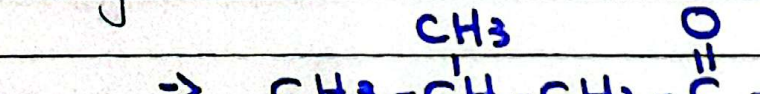
5. carbon next to the aldehyde carbon are called α (alpha) & β (beta) and so on → for common names



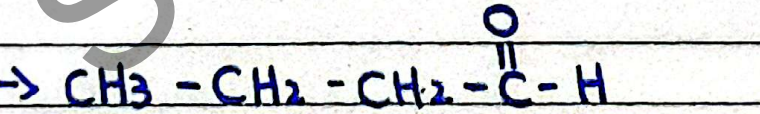
IUPAC name: 3-Methylbutanal.



IUPAC name: ethanal



IUPAC name: 3-Methybutanal.



IUPAC name: Butanal

Date

→ Nomenclature of Ketones :-

(1) Ketone = $R-\overset{\overset{O}{\|}}{C}-R$ G.F = $C_nH_{2n+1}COC_mH_{2m+1}$.

(1) Ketone is always inside the main chain

(2) Start the numbering from the side closer to the substituent or ketone group.

(3) Suffix 'one' is added, replacing the 'e' from alkane

(4) Parent chain of the first two member of ketone are not nummered

First two member of ketone: Propanone
Butanone

→ $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$

IUPAC = ~~butanone~~, Propanone

→ $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

IUPAC = Butanone

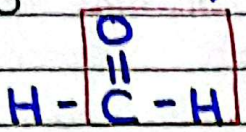
→ $CH_3-\underset{CH_3}{CH}-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$

IUPAC = 2-Methylpentan~~e~~-3-one

Date _____

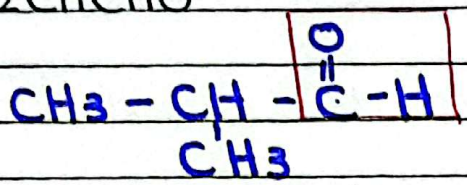
Concept Assessment:

i) HCHO

→  aldehyde

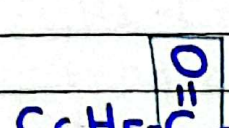
IUPAC name: Methanal

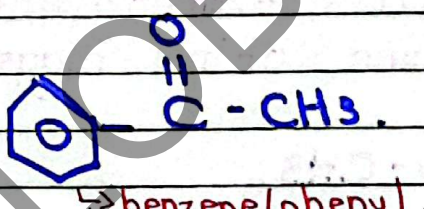
ii) $(CH_3)_2CHCHO$



IUPAC name: 2-Methylpropanal

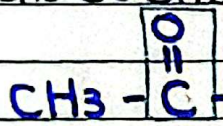
iii) $C_6H_5COCH_3$.

 ketone



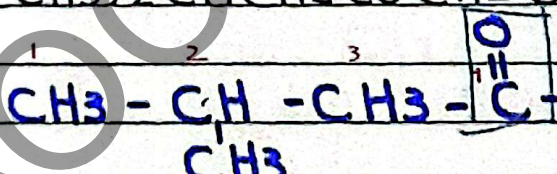
IUPAC name: 1-Phenyl-Ethanone ↳ benzene/phenyl.

iv) $CH_3COCH_2CH_3$.



IUPAC name: Butan-2-one.

v) $(CH_3)_2CHCH_2COCH_2CH_3$.



IUPAC name: 2-Methylhexa-4-one

Date

Nomenclature of Ethers :- (COC)

R-O-R = Ether. Formula = $C_nH_{2n+1}OC_mH_{2m+1}$

-> Ether is a functional group in which two carbon chains have oxygen in between them.

-> alkoxy = prefix

Methoxy = 1
Ethoxy = 2
Propoxy = 3

-> Smaller alkyl group will be alkoxy

CH_3-O-CH_3

Methoxymethane = dimethylether

Write the name of the bigger chain.

-> $CH_3CH_2-O-CH_3$.

IUPAC = Methoxyethane = ethylmethyether

-> $CH_3-CH_2-O-CH_2-CH_3$.

IUPAC = Ethoxyethane = dimethylether.

Date _____

Nomenclature of Amines :-

Amine group = $R-NH_2$ $C_nH_{2n+1}NH_2$

When ~~one~~ Hydrogen is removed from ammonia, an amine group is formed

- Primary amine: C-NH_2 C is connected to 1 carbon.
- Secondary amine: C-NH_2 C is connected to 2 carbon.
- Tertiary amine: C-NH_2 C is connected to 3 C.

Rule:

(1) Replace the 'e' of alkane with suffix 'amine'

→ CH_3-NH_3
methanamine (Methylamine)

→ $CH_3-CH_2-NH_3$
ethanamine (ethylamine)

→ $CH_3-CH_2-CH_2-NH_2$
propan-1-amine (n-propyl amine)

→ $CH_3-\underset{NH_3}{CH}-CH_3$
propane-2-amine (isopropyl amine)

→ $CH_3-\underset{CH_3}{CH}-CH_2-NH_2$
2-Methylpropan-1-amine (isobutyl amine)

(2) If there is secondary or tertiary amine, we will add the word N & will locate substituents with it

→

$$CH_3-CH_2-CH_2-\underset{CH_3}{\overset{|}{N}}-CH_2-CH_3$$

3 branches = tertiary N

N-Ethyl-N-Methyl propan-1-amine

Date

Nomenclature of Nitriles

$C_nH_{2n+1}CN$ Nitrile group: $C \equiv N$ → cyanide group.

1. 'e' from the 'alkane' is NOT ommited
2. 'nitrile' suffix is added after the alkane.

→ $CH_3 - C \equiv N$ = ethanenitrile [Acetonitrile]

~~methanenitrile~~

3. Count the carbon of nitrile in the main chain

→ $CH_3 - CH_2 - CN$

IUPAC name: propanenitrile [propionitrile]

Concept Assessment 15.7

Q1

i) $CH_3OCH_2CH_3$.

$CH_3 - O - CH_2 - CH_3$

Ans: methoxyethane

ii) $(C_2H_5)_2CHNH_2$

$CH_3 - CH_2 - CH - NH_2$

Ans: ~~2-Ethylbutanamine~~ pentan-3-amine

iii) $(CH_3)_3N$

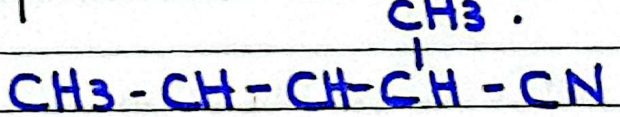
$CH_3 - N - CH_3$ (CH3)

Ans = Trimethylamine.

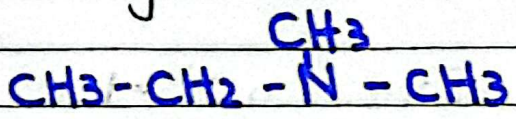
Date _____

Q12:

i) 2-methylpentanenitrile

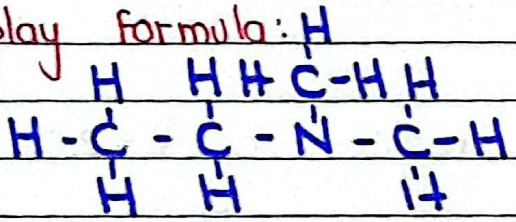


ii) N,N-dimethylethanamine

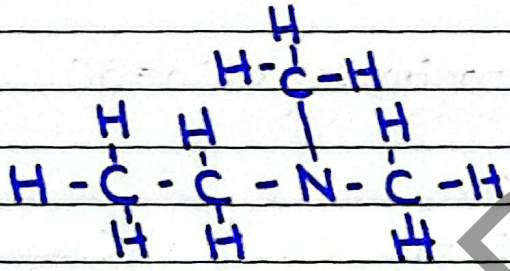


2D display formula:

i)



ii)



Formic acid = Formica = compound present in ant bite

Date

Nomenclature of Carboxylic Acids:

1. The 'e' of alkane will be replaced by sufix 'oic Acid'
2. Carboxylic group will be terminal numbering starts from the carbon of carboxylic acid.

1) $H-\overset{\overset{O}{\|}}{C}-OH$
Methanoic acid
Formic acid = 1C
•Formica = ant bite.

2) CH_3-COOH
ethanoic acid
acetic acid = 2C
acetum = vineger

3) CH_3-CH_2-COOH
propanoic acid
propanoic acid = 3C
prōtos = fats

4) $CH_3-CH_2-CH_2-COOH$
Butanoic acid
Butyric acid = 4C
Butyrum = butter

5) $CH_3-CH_2-CH_2-CH_2-COOH$
pentanoic acid
Valeric acid = 5C

6) $OH-\overset{\overset{O}{\|}}{C}-\overset{\overset{O}{\|}}{C}-OH$
ethanedioic acid
ethane-1,2-Dioic acid
oxalic acid = 2COOH

7) $CH_3-\underset{\underset{OH}{|}}{CH}-COOH$
2-Hydroxypropanoic acid
lactic acid.

Date _____

8) $COOH - CH_2 - CH_2 - COOH$

Butane-1,4-dioic acid Succinite acid

9) $COOH - CH_2 - COOH$

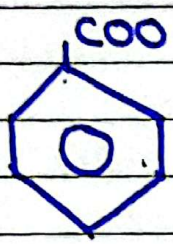
propane-1,3-Dioic acid Malanoic acid

10) $COOH - CH = CH - COOH$

~~Butane-3-ene~~ Malic acid

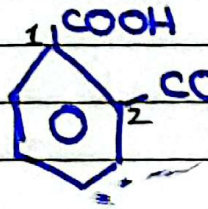
2-Butene-1,4-dioic acid

11)



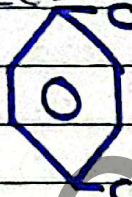
Benzoic acid Benzoic acid

12)



Benze1-1,2-dioicacid pthalic acid

12)



~~Ben-ene-1,4-Dioic acid~~

Benzene-1,4-Diloic acid Terephthalic acid

13) $COOH - CH_2 - CH_2 - CH_2 - CH_2 - COOH$

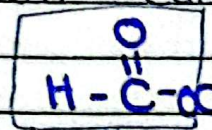
hexan-1,6-Dioicacid adipic acid

Date

Nomenclature of esters:

Ester = R-COOC-R COOC R-C(=O)-OR'C

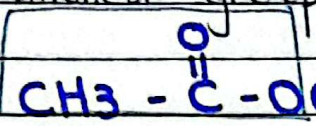
1. 'e' of alkane will be replaced by 'oate'
2. both carbon will be a part of patent chain



→ H-C(=O)-OCH3

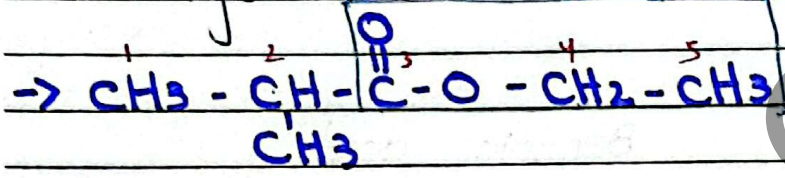
methyl methanoate Methyl formate

3. Smallest group gets the suffix 'oate'



→ CH3-C(=O)-OCH3

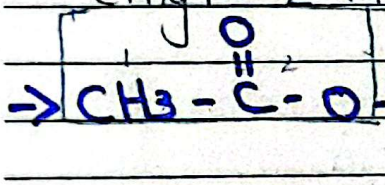
Methyl ethanoate methyl acetate



→ CH3-CH(CH3)-C(=O)-O-CH2-CH3

~~2-Methyl~~ ~~2-1~~

ethyl-2-Methylpropanoate



→ CH3-C(=O)-O-CH(CH3)-CH3

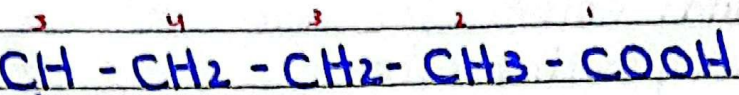
ethyl-1-Methylethanoate

Date

• Concept Assessment 15.8

Q1. i: $(CH_3)_2CH(CH_2)_3COOH$

Structure:

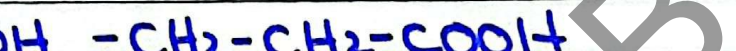


Type of compound: carboxylic acid

IUPAC name: 5-Methylhexanoic acid

ii) $(CH_2COOH)_2$

Structure:



Type of compound: carboxylic acid

IUPAC name: Butanedi-1,4-Dioic acid (Succinate)

iii) $(COOH)_2$

Structure:

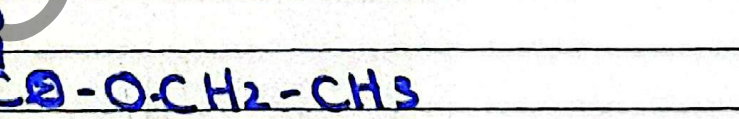
Type of compound: carboxylic acid

IUPAC compound: ~~ethanoic acid~~

ethanedioic acid (oxalic acid)

iv) $CH_3COOCH_2CH_3$

Structure:



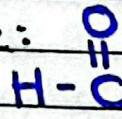
Type of compound: ~~ethe~~ esters

~~Struct~~ IUPAC name: ethylethanoate.

Date

v. $HCOOCH_3$

structure:

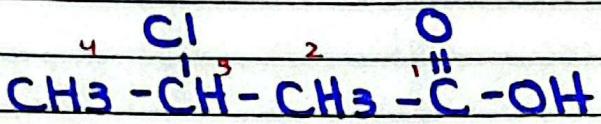


Type of compound: ester.

IUPAC name: methylmethanoate

vi) $CH_3CH(Cl)CH_2COOH$.

Structure:



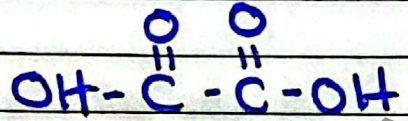
Type of compound: carboxylic acid

IUPAC name: 3-Chloro-Butan-1-oic acid

Q12.

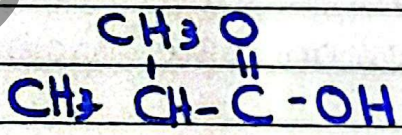
i) oxalic acid:

$(COOH)_2$



ii) 2-methylpropanoic acid

$(CH_3)_2CHCOOH$



Date _____

Nomenclature of Acid Chlorides:

Acid halides are derivates of carboxylic acids.

(1) 'e' in alkane is replaced by 'oyl' & followed by the name of ~~the~~ chloride.

-> $CH_3-\overset{\overset{O}{\|}}{C}-Cl$

ethanoyl chloride

-> $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-Cl$

propanoyl chloride

-> $CH_3-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-Cl$

butanoyl chloride

Nomenclature of Amides:-

Amides are derivates of carboxylic acid.

$\overset{\overset{O}{\|}}{C}-NH_2$ = Amide group.

(1) Replace the 'ioc acid' from carboxylic acid to suffix 'amide'

-> $H-\overset{\overset{O}{\|}}{C}-NH_2$

Methanamide

-> $CH_3-\overset{\overset{O}{\|}}{C}-NH_2$

ethanamide

-> $CH_3-CH_2-CONH_2$

propanamide

-> $CH_3-\overset{\overset{O}{\|}}{C}-N(H)-CH_3$

N-methylethanamide.

Date

Terminology of Organic reactions:

Types of reagents used in chemical rxns:

*Reagent= compound or a mixture added to the system to start a chemical rxn

-> Free Redical : (·)

Free redical is a atom or group of atom with unpaired electron, bears no electric changerge. This is quiet unstable specie so it reacts with any substance it comes across, It starts a chain of reaction.

Formed: A Free Redical is formed by homolytic fission of molecules. e.g. Cl· (Clorine redical)
$CH_3^{\cdot}$ (methyl redical)
H· (Hydrogen redical

Homolytic fission:

$$Cl-Cl \xrightarrow{\text{sunlight}} 2Cl^{\cdot}$$

-> Electrophile. $E^{\oplus}$

An atom or group of atom which is electron defiecent It is either positive (H^+) or ~~an~~ neutral (empthy orbital) which can easily recieve electron. (BF_3)

-> Nucleophile:

An atom or group of atom which is rich in electron. Either it carries a lone pair of electron (neutral) or a neg charge so it can be easily donate electron

e.g: OH^-, CN^-, Cl^-, H_2O, NH_3, $C=C$.

Date

Types of Bond breakage:

There are different ways a covalent bond be broken during chemical reaction

1. Homolytic Fission:

Homolytic fission involves equal splitting of covalent bond between 2 atoms in a molecule.
Each atom takes its own electron in the form of unpaired electron.
This equal splitting takes place because the electroneg diff between the two atoms is zero or near to zero **(same atom)**

$\longrightarrow 2\dot{Cl}$ $\Delta E.N \leq 0$

2. Hetrolytic fission:

Hetrolytic fission is unequal breakage of covalent bond between atoms in organic molecules
As a result we get posiv and neg ions
Such splitting takes place in between molecules having enough electronegative difference

$CH_3Cl \longrightarrow CH_3^+ + Cl^-$

Date _____

Types of Organic Chemical Reactions :-

i. Free Redical substitution reaction of alkanes:

A halogen Free redical replaces the hydrogen from alkane successively and form a mixture of halogenoalka-nes. This takes place in three steps.

$$CH_4 + Cl_2 \xrightarrow{h\nu} CH_3Cl + HCl$$

$$CH_3Cl + Cl_2 \xrightarrow{h\nu} CH_2Cl_2 + HCl$$

$$CH_2Cl_2 + Cl_2 \xrightarrow{h\nu} CHCl_3 + HCl$$

$$CHCl_3 + Cl_2 \xrightarrow{h\nu} CCl_4 + HCl$$

ii. Electrophilic addition reaction:

The type of reaction in which electrophile attacks double bond or triple bond and adds itself in the molecule.

(Rule = neg part will be added to the C with less hydrogen)

$$CH_3CH=CH_2 + \overset{H=\delta\varepsilon+}{H}Br \longrightarrow CH_3CH(Br)CH_3$$

-> Multiple bond is converted into single bond.

iii. Elimination reaction :

Removal of atom from adjacent carbon atom in form of small molecule like H_2O, HCl.

-> Elimination of water from alcohol or hydrogen cloride from haloalkanes gives us the corresponding alkenes

$$CH_3CH_2OH \longrightarrow CH_2=CH_2 + H_2O$$

dehydration of alcohol gives us alkane.

Date _____

iv. Nucleophilic substitution reaction:

In this reaction, a nucleophile replaces an atom or a group of atom in an molecule

$$CH_3CH_2Br + \overset{+S\ -S}{NaOH} \longrightarrow CH_3CH_2OH + NaBr$$

$$CH_3CH_2Cl + \overset{+S\ -S}{NaOH} \longrightarrow CH_3CH_2OH + NaCl$$

v. Nucleophilic addition reaction:

In these reaction a nucleophile (electron rich) is added to the molecule, usually aldehyde or ketone = the double bond in between C and O is converted into single covalent bond.

$$CH_3C\overset{+S\ -S}{\oplus}HO + HCN \longrightarrow CH_3CH(CN)OH$$

$$CH_3-\underset{\underset{O}{\|}}{C}-H + HCN \longrightarrow CH_3-\underset{\underset{OH}{|}}{CH}-CN$$

vi. Hydrolysis:-

chemical rxn in which water molecule attacks the organic compounds and breaks it into diff substances, catalyst = acids or alkalis.

$$CH_3COOCH_2CH_3 + H_2O \xrightarrow{H_2SO_4} CH_3COOH + CH_2CH_3OH$$

vii. Condensation:

Condensation reaction involve the combination of two organic compounds to form larger compounds with or without the elimination of smaller compound like H_2O or HCl

$$CH_3COOH + CH_3CH_2OH \xrightarrow{H_2SO_4} CH_3COOCH_3CH_2 + H_2O$$

viii. Oxidation reaction:

In this reaction organic molecules either gain oxygen or lose hydrogen.

They involve increase in the no of bonds blw C and O.

→ Alcohols may oxidize to corresponding ketones, Aldehyd or carboxylic acid

$$2CH_3OH + 3[O] \xrightarrow{H_2SO_4} 2HCOOH$$

methanoic acid

ix. Reduction:

A reduction reaction involves loss of H, Oxygen or gain of H.

They involve decrease in the no of bonds in blt C and O

$$CH_3CHO + 2H \rightarrow CH_3CH_2OH$$

Ethanal → ethanol

Elimination Reaction :-

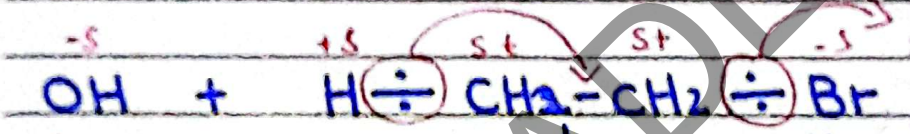
Elimination reaction involve removal of atom or group of atoms in the form of molecule from two consecutive carbon atom. Consequently we get :

* an unsaturated molecule (alkene)
* a small molecule (HCl or H_2O)

Consider a molecule **Bromoethane** having partial positive H and partial neg Br

1) A base (OH^-) attacks acidic H making water
2) Bromine atom due to its higher electroneg takes away the bonding e⁻ and leaves the molecule as Bromide ion

Result = elimination of Hydrogen Bromide takes place & giving ethene molecule.



base

Bromoethane

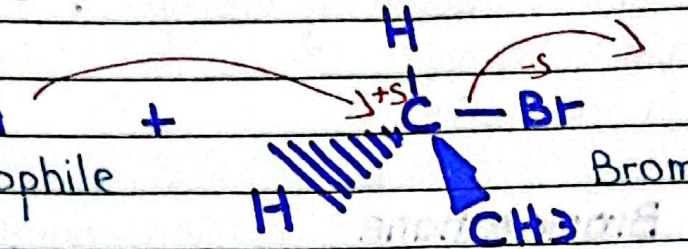
$H_2O + Br^- + CH_2 = CH_2$

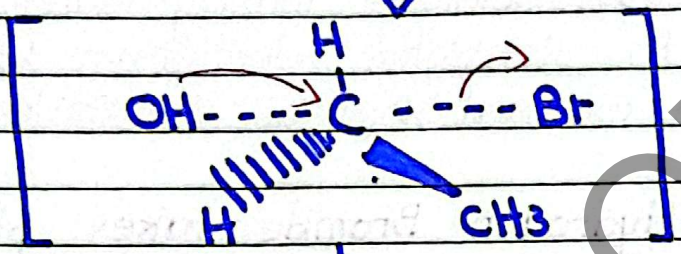
ethene

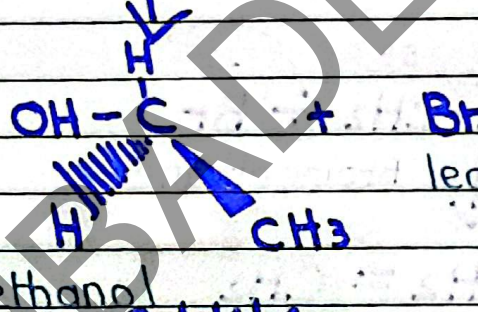
Date

Nucleophilic Substitution :-

Nucleophile attacks on the electrophile of Carbon of halogenoalkane substituting the halogen atom





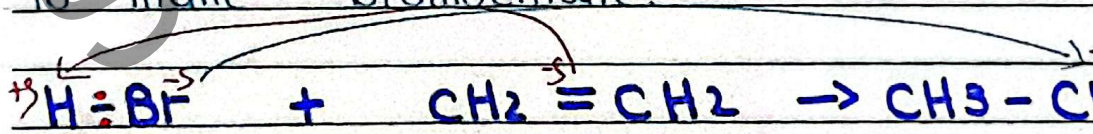


Electrophilic Addition :

~~the~~ arrow = neg to posiv

such reaction involves the attack of electrophile on multiple bond (π) and converts it into single covalent bond.

Attack of hydrogen bromide on ethene molecule to make Bromoethane.



→ CH_3-CH_2Br.

Date

Free Redical Substitution of Alkane

$CH_4 + Cl_2 \xrightarrow{hv} CH_3Cl + HCl$ chloromethane
$CH_3Cl + Cl_2 \longrightarrow CH_2Cl_2 + HCl$ dichloromethane
$CH_2Cl_2 + Cl_2 \longrightarrow CHCl_3 + HCl$ trichloromethane
$CHCl_3 + Cl_2 \longrightarrow CCl_4 + HCl$ tetrachloromethane

In such reaction, a free redical is formed which replaced hydrogen in alkanes successively. takes place with halogens in the presence of sunligh.

Mechanism:

* Iniation:

In this step a halogen molecule splits homolytically in the presence of sunlight to give **free redicals**. Energy comes from ultraviolet region of sunlight

$Cl\!:\!Cl \xrightarrow{hv} Cl^{\bullet} + Cl^{\bullet}$

chlorine — free redical of Chlorine

$2Cl \xrightarrow{hv} 2Cl^{\bullet}$

* Propagation:

Attatk of free redical on methane to generate methyl free redical.

$H_2C\!:\!H + Cl^{\bullet} \longrightarrow H\text{-}\underset{H}{\overset{H}{C}}{}^{\bullet} + HCl$ (unpaired e^-)

methyl redical

Cl free red = takes H
~~no~~ Cl stable molecule = forms free red & attaches to methyl red

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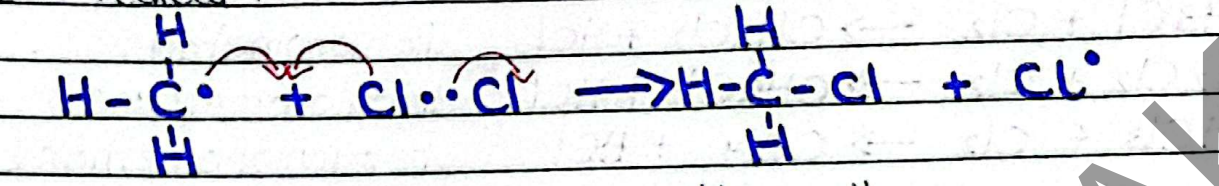
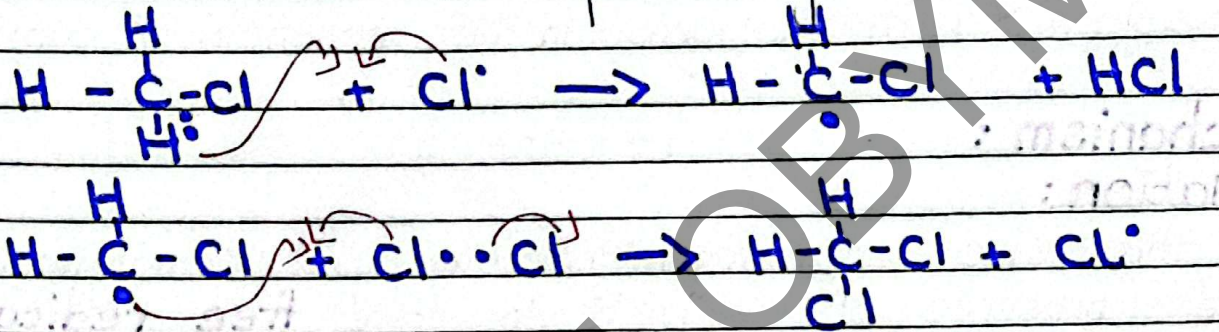
The methyl radical may attack on the stable chlorine to form chloromethane & chlorine free radical.

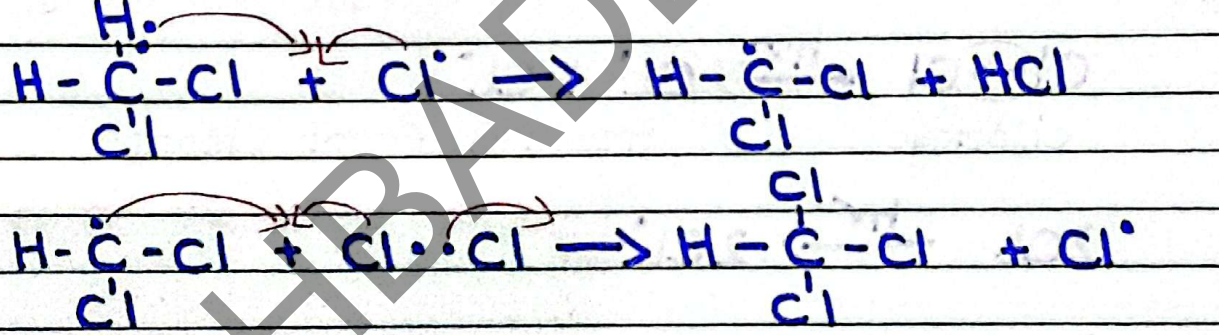


chloromethane

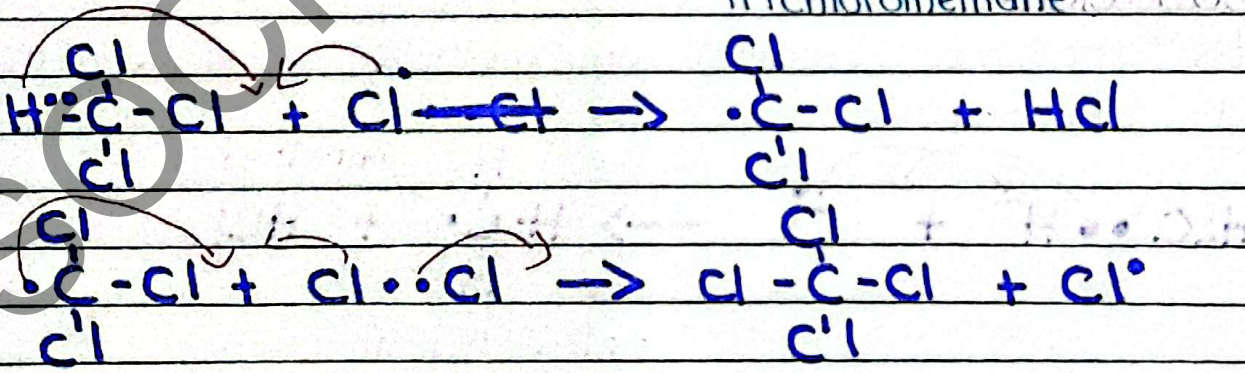
If excessive chlorine is used, then all hydrogen atoms of methane are replaced by Cl atoms



dichloromethane



trichloromethane



tetrachloromethane

Date

Termination:

this will be the end point of the reaction, when two free redical reacts with each other to give a neutral molecule this will be the death of all the free redical

$Cl^{\cdot} + Cl^{\cdot} \longrightarrow Cl_2$

$CH_3^{\cdot} + CH_3 \longrightarrow CH_3CH_3$ ethane

$CH_3^{\cdot} + Cl^{\cdot} \longrightarrow CH_3Cl$ chloromethane

Isomerism :- → geometrical → structural

Phenomenon in which two or more compounds have the same molecular formula but different structural formula.

→Organic compounds show isomerism because of the directional characteristics of covalent bond.

no of isomers increase with an inc of C atom

↳Butane = 2
↳Pentane = 3
↳decane = 75

} isomers

Structural isomerism: same molecular formula but different arrangement of atom, it has 5 types:

1. Chain isomerism:

Compounds having same ~~structural~~ molecular formula but different structural formula with respect to carbon chain (length)

Branch will change the length

$CH_3 - CH_2 - CH_2 - CH_3$
n-butane

$CH_3 - CH(CH_3) - CH_3$
iso-butane.

Date

ii. Position Isomerism:

Compounds have the same molecular formula but are different in different location of functional group in the parent chain.

Different position of the same functional group

$CH_3-CH_2-CH_2-OH$ — pran-1-ol

$CH_3-\underset{OH}{CH}-CH_3$ — propan-2-ol

iii. Functional group isomerism:

molecules have the same molecular formula but different functional group.

$CH_3-CH_2-CH_2-OH$ — propan-1-ol

$CH_3-O-CH_2-CH_3$ — methoxyethane

iv. Metamarism:

molecules have the same molecular formula but are different in chain length in both side of the functional group.

Metamers have the same functional group.

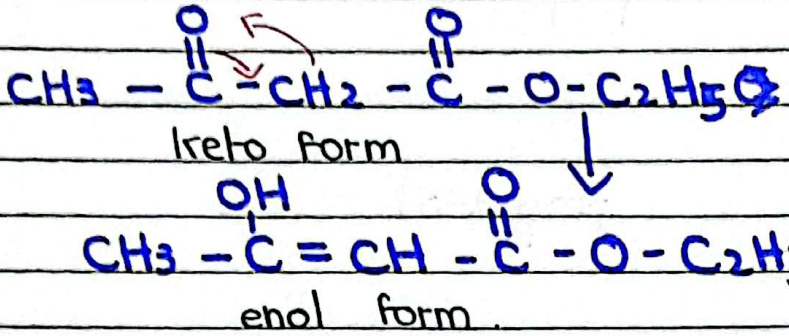
$CH_3-O-CH_2-CH_2-CH_3$ — methoxypropane

$CH_3-CH_2-O-CH_2-CH_3$ — ethoxyethane

Date

v. Tautomerism.

compounds have the same molecular formula but different in structural formula by different position of Hydrogen atom with the shifting of double bond.



→they exist in dynamic equilibrium.

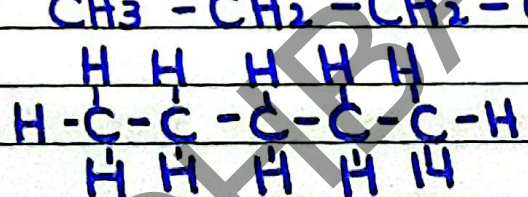
Concept Assessment 15.9:

Q11.

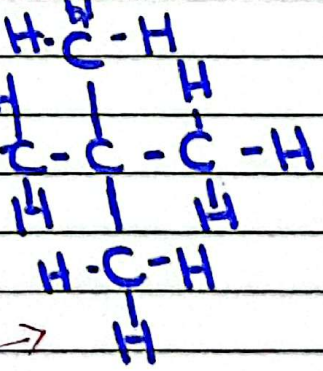
i) pentane

pentane has three isomerism.

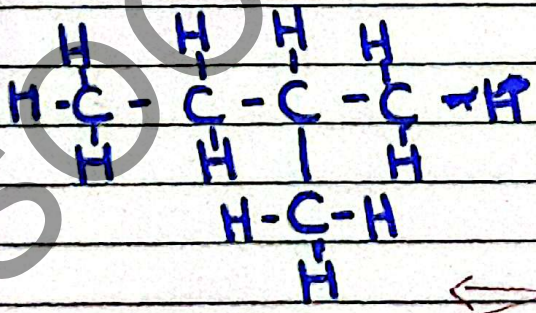
1.



pentane



2.



3.

neo-pentane

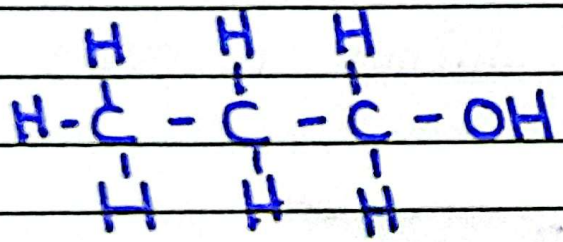
iso-pentane.

Date

iii) prop-1-ol

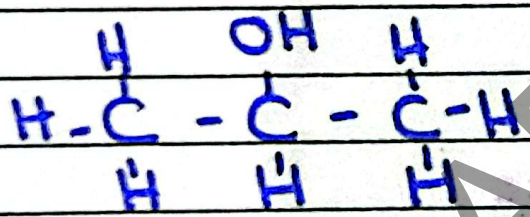
It has 2 isomers :

1



prop-1-ol

2.



prop-2-ol