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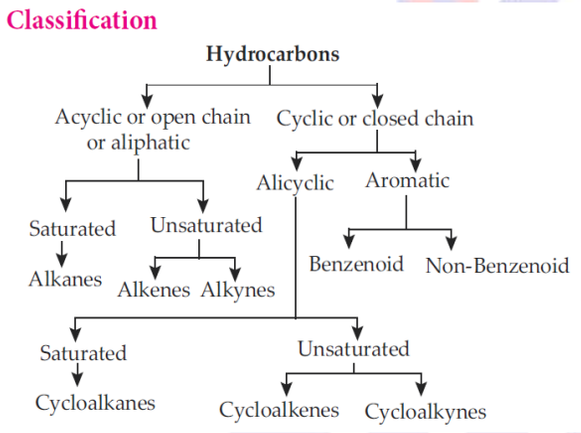
NOMENCLATURE AND GENERAL PRINCIPLES

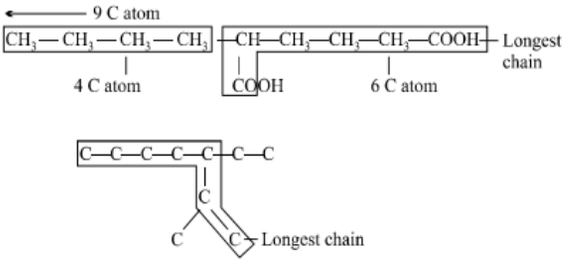
- The branch of chemistry which deals with ***hydrocarbons*** and their derivatives is called ***organic chemistry***.
- The basic organic compounds are hydrocarbons (compounds of carbon and hydrogen) which can be converted to different types of organic compounds by performing different reactions.
- Carbon forms large number of organic compound because of its properties of ***catention*** and ***tetravalency.***

CLASSIFICATION OF HYDROCARBONS



IUPAC Nomenclature of Acyclic Hydrocarbons

- **IUPAC Nomenclature of Organic Compounds:** Following rules are used to write the IUPAC name of an organic compound.
- **Rule 1. Longest chain rule:** The chain containing the principal functional group,λ secondary functional group and multiple bonds as many as possible is the longest possible chain. In the absence of functional group, secondary group and multiple bonds, the chain Containing the maximum number of C-atoms will be the longest possible chain **e.g.,**



- Choose the word root from the table given below for the longest possible chain.

Word Root for Carbon Chain

Chain length	Word root	Chain length	Word root
C_1	Meth-	C_7	Hept
C_2	Eth-	C_8	Oct
C_3	Prop-	C_9	Non
C_4	But-	C_{10}	Dec
C_5	Pent-	C_{11}	Undec
C_6	Hex-	C_{12}	Dodec

- **Rule 2 Lowest number rule :** Numbering is done in such a way so that :

(1) Branching if present gets the lowest number.

(2) The sum of numbers of side chain is lowest.

(3) Principal functional group gets the lowest number. Select the principal functional group from the preference series:

$$-COOH > -SO_3H > -COOR > -COX > -CONH_2 > -CN > -NC > -CHO > C=O > -OH > -SH > -NH_2 > -OR > = > \equiv$$

- Functional group other than the principal functional group is called substituents.
- **Rule 3. Naming the prefixes and suffixes**: Prefix represents the substituent and suffix is used for principal functional

group. Primary prefixes are cyclo, bicyclo, di, tri, tetra, tetrakis etc.

Secondary prefixes are tabulated below:

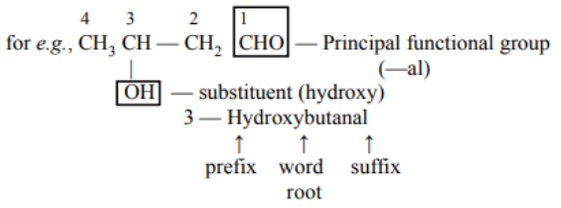
Substituent	Prefix	Substituent	Prefix
—F	Fluoro	—N=N—	diazo
—Cl	Chloro	—N=O	nitroso
—Br	Bromo	$—NO_2$	nitro

- Primary suffix are ene, ane or yne used for double, singe and triple bonds respectively.

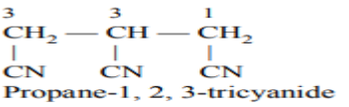
Secondary suffixes are tabulated below:

S.No.	Class	Formula	Prefix	Suffix
1.	Acid halides	$—\overset{\overset{O}{\|\|}}{C}—X$	halocarbonyl	—oyl halide
2.	Alcohols	—OH	hydroxy	—ol
3.	Aldehydes	—CHO	formyl —carbaldehyde	—al
4.	Ketones	C = O	oxo	—one
5.	Amides	$—CONH_2$	carbamoyl	—amide
6.	Amine	$—NH_2$	amino	—amine
7.	Carboxylic acid	—COOH	carboxy	—carboxylic acid
8.	Ester	—COOR	alkoxy carbonyl	—alkyl alkan**oate**
9.	Nitriles	—CN	cyano	—nitrile
10.	Sulphonic acid	$—SO_2—OH$	sulpho	—sulphonic acid

- Here according to the rules, given above, the IUPAC name of a compound can be written as Prefixes + Word root + Suffixes.⇒
- **Primary prefix + secondary prefix + Word root + primary suffix + secondary suffix**

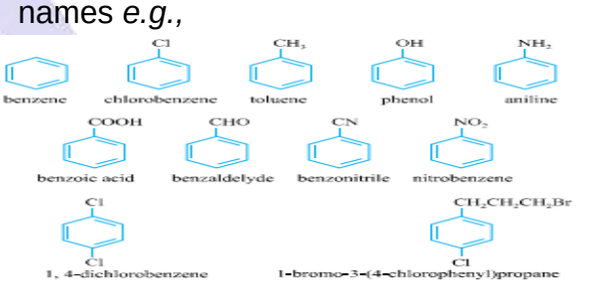


- If more than two similar functional groups are present, all the groups are considered as substituent, for *e.g.,*



Nomenclature of Cyclic Hydrocarbons

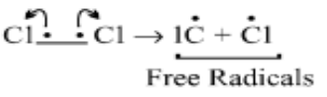
- A cyclic (ring) hydrocarbon is designated by the prefix cyclo- which appears directly in front of the base name. In summary, the name of the compound is written out with the substituents in alphabetical order followed by the base name (derived from the number of carbons in the parent chain).
- IUPAC accepted their common trivial names *e.g.,*



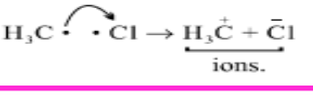
TYPES OF REACTIONS IN ORGANIC COMPOUNDS

Breaking of a Covalent Bond - Types of Bond Fission

(a) Homolytic cleavage: In this cleavage, one of the electrons of the shared pair in a covalent bond goes with each of the bonded atoms.

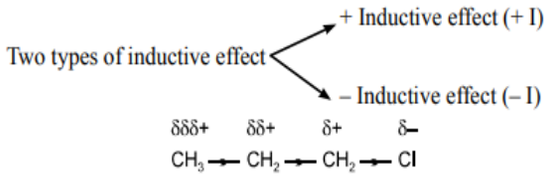


(b) Heterolytic cleavage: In heterolytic cleavage the bond breaks in such a fashion that the shared pair of electrons remains with one of the fragment.



Electron Displacements in a Covalent Bond

- **Inductive effect (I):** Polarisation of a bond caused by the polarisation of adjacent bond is referred to as the inductive effect.

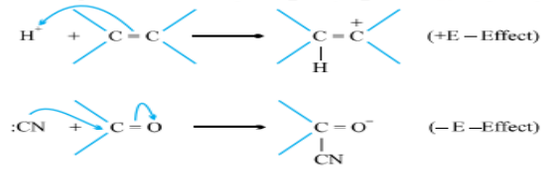


- It is a permanent effect and decrease with the increase in distance.

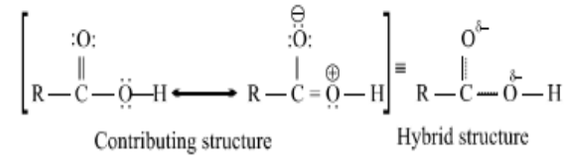
$-I$ effect : $-NO_2 > -F > -Cl > -Br > -I > -OCH_3 > -C_6H_5$

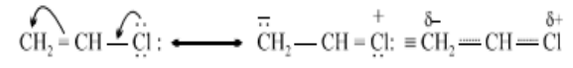
$+I$ effect : $-C(CH_3)_3 > -CH(CH_3)_2 > -C_2H_5 > -CH_3$

- **Electromeric effect:** The complete transfer of the shared pair of π electrons of a multiple bound to one of the atoms in the presence of the attacking reagent is called electromeric effect.
- If the transference of e^- towards attacking reagent + E effect.
- If the transference of e^- takes place away from attacking reagent ñ E effect.



- **Resonance effect (+R effect):** The polarity produced in the molecule -bond and lone pair of electrons present on an π by the interaction of two adjacent atom.

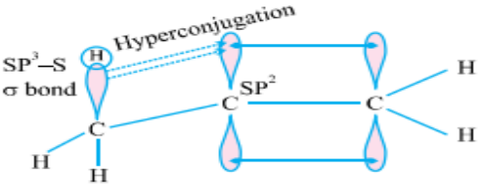




+ R Effect : $-\ddot{O}H$, $-\ddot{O}R$, $-\ddot{N}H_2$, $-\ddot{N}HR$ etc

– R Effect : $-NO_2$, $-COOH$, $-CHO$, $>C=O$, $-CN$

- **Hyperconjugation:** It is special kind of resonance in which delocalization of e^- takes place through overlap between. σ bond orbital and π- orbital. It is also called no bond resonance.

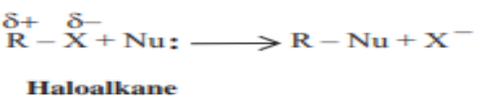


Steric Hinderance

- **Steric hindrance** is when the large size of groups within a molecule prevents chemical reactions which can take place in related molecules with smaller groups.

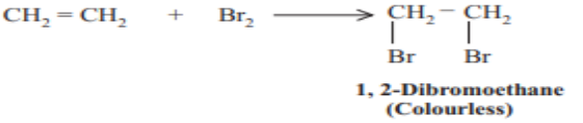
Substitution Reactions

- A substitution reaction involves the displacement of one atom or group in a molecule by another atom or group. Aliphatic compounds undergo nucleophilic substitution reactions. For example:



Addition Reactions

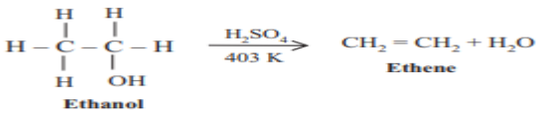
- Unsaturated hydrogen combines with another substance to form a single product. This **reaction** takes place only in unsaturated compounds where there are double or triple bonds. **Example**: ethane + bromine → 1,2-dibromoethane.



Elimination Reactions

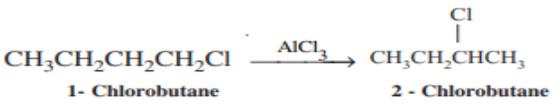
- An elimination reaction is characterized by the removal of a small molecule from

adjacent carbon atoms and the formation of a double bond. For example:



Molecular Rearrangements

- A molecular rearrangement proceeds with a fundamental change in the hydrocarbon skeleton of the molecule. During this reaction, an atom or group migrates from one position to another.



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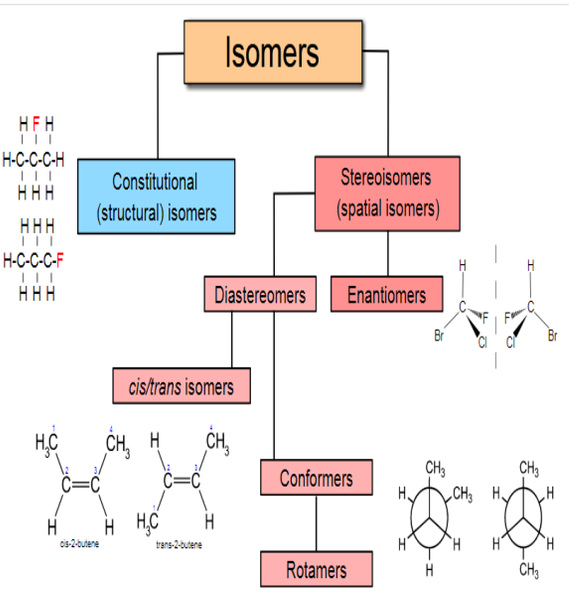


Qualitative Analysis Of Organic Compounds

Element	Sodium Extract	Procedure	Reaction
Nitrogen	Na+C+N → NaCN(S.E.)	S.E. + $FeSO_4$ + NaOH then boil and cool + $FeCl_3$ + conc.HCl → **Blue or green colour**	1)$FeSO_4 + 2NaOH \rightarrow Fe(OH)_2 + Na_2SO_4$ 2)$Fe(OH)_2 + 6NaCN \rightarrow Na_4[Fe(CN)_6] + 2NaOH$ 3)$Na_4[Fe(CN)_6] + FeCl_3 \rightarrow NaFe[Fe(CN)_6] + 3NaCl$ prussian blue or $3Na_4[Fe(CN)_6] + FeCl_3 \rightarrow Fe_4[Fe(CN)_6]_3 + 2NaCl$ prussianblue
Sulphur	2Na + S →Na_2S(S.E.)	1. S.E. + sodium nitro prusside→A **deep violet colour.** 2. S.E.+ CH_3COOH + $(CH_3COO)_2Pb$→**black ppt.**	$Na_2S + Na_2[Fe(CN)_5NO] \rightarrow Na_4[Fe(CN)_5NOS]$(deep violet) $Na_2S + (CH_3COO)_2Pb \rightarrow PbS\downarrow + 2CH_3COONa$(Black ppt)
Halogen	Na + Cl→NaCl(S.E.)	S.E. + HNO_3 + $AgNO_3$ 1.**White ppt** soluble in aq NH_3 confirms Cl 2.**Pale Yellow** ppt. partially soluble in excess aq. NH_3 confirms Br. 3.**Yellow ppt** insoluble in aq NH_3 confirms I	$NaX + AgNO_3 \rightarrow AgX\downarrow$(white ppt) $AgCI + 2NH_3(aq) \rightarrow [Ag(NH_3)_2]Cl$(soluble)
Nitrogen and Sulphur	Na+C+N+S→NaCNS (S.E.)	As in test for nitrogen; instead of green or blue colour, **blood red coloration** confirms presence of N and S both.	$NaCNS + FeCl_3 \rightarrow [Fe(CNS)]Cl_2 + NaCl$(blood red colour)

Check Yourself

1. Identify the chiral molecule among the following:

(A) Isopropyl alcohol (B) 2-pentanol

(C) 1-bromo 3-butene (D) Isobutyl alcohol

2. The displacement of electrons in a multiple bond in the presence of attacking reagent is called

(A) Inductive effect (B) Electromeric effect

(C) Resonance (D) Hyper conjugation.

3. Which of the following cannot be represented by resonance structures?

(A) Dimethyl ether (B) Nitrate anion

(C) Carboxylate anion (D) Toluene

4. An organic compound which produces a bluish green coloured flame on heating in presence of copper is

(A) Chlorobenzene (B) Benzaldehyde

(C) Aniline (D) Benzoic acid

5. Which one is strongest acid among following options?

(A) CH_2FCOOH (B) $CH_2ClCOOH$

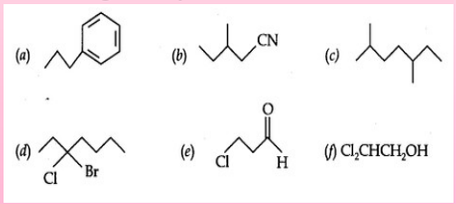
(C) $CHCl_2COOH$ (D) CHF_2COOH

Stretch Yourself

1. What are hybridisation states of each carbon atom in the following compounds?
   $CH_2=C=O$, $CH_3CH=CH_2$, $(CH_3)_2CO$, $CH_2=CHCN$, C_6H_6.
2. Indicate the σ- and π-bonds in the following molecules:

   C_6H_6, C_6H_{12}, CH_2C_{l2}, $CH=C=CH_2$, CH_3NO_2, $HCONHCH_3$

3. Write bond-line formulas for: Isopropyl alcohol, 2, 3-Dimethyl-butanal, Heptan-4-one.
4. Give the TUPAC names of the following compounds:



5. Draw formulas for the first five members of each homologous series beginning with the following compounds.

Test Yourself

Question: Will CCl_4 give white precipitate of AgCl on heating it with silver nitrate? Give reason for your answer.

Answer: No. CCl_4 is a completely non-polar covalent compound whereas $AgNO_3$ is ionic in nature. Therefore they are not expected to react and thus a white ppt. of silver chloride will not be formed.

Answers

Check Yourself

Answer: 1(B); 2(D); 3(A); 4(B); 5(D)

Stretch Yourself

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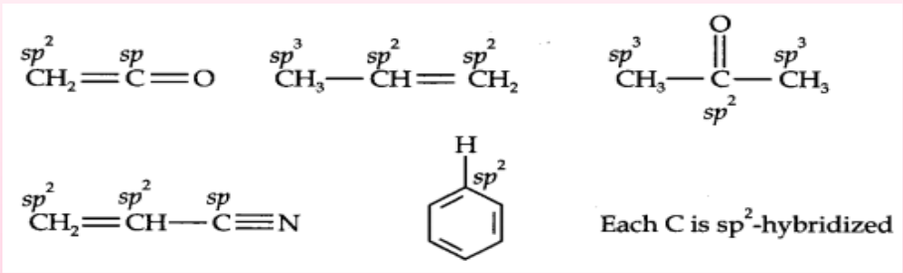

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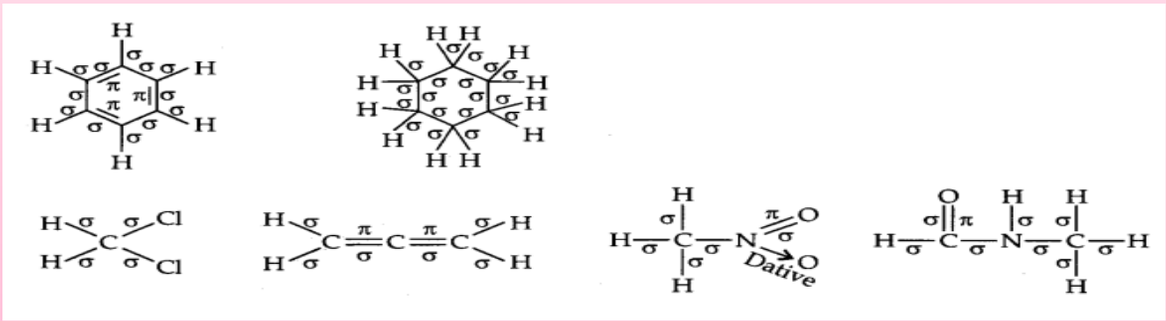

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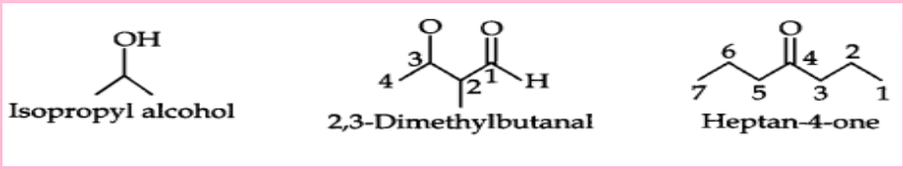

4. (a) Propylbenzene (b) 3-Methylpentanenitrite (c) 2, 5-Dimethylheptane

(d) 3-Bromo- 3-chloroheptane (e) 3-Chloropropanal (f) 2, 2-Dichloroethanol

5. Do it by yourself