Nomenclature

ISHITA KANODIA

1. Wohler discovered first organic compounds. He found urea.
2. Rules for nomenclature -

① Longest C chain = parent chain.
If two chains have same no. of C ⇒ chain with most branches = parent chain.

② priority - multiple bond > no. of C ⇒ for selection of parent chain.

③ numbering must be done from that side where sum of position of substituents is minimum.

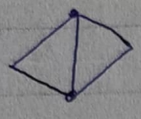
④ If sum from both sides is same, then numbering must be according to alphabetical preference.

No.	FG	Formula	2° suffix	IUPAC name	prefix
1.	Carboxylic acid	R-C(=O)-OH	oic acid	alkanoic acid	carboxy
2.	Sulphonic acid	$R-SO_3H$	sulphonic acid	alkane sulphonic acid	sulpho
3.	Acid anhydride	R-C(=O)-O-C(=O)-R'	oic anhydride	alkanoic anhydride	—
4.	Ester	R-C(=O)-OR'	oate	alkyl (R') (R) alkanoate	alkoxy carbonyl
5.	Acid Halide	R-C(=O)-X	oyl halide	alkanoyl halide	halo carbonyl
6.	Amide	R-C(=O)-NH_2	amide	alkamide	carbamoyl
7.	Cyanide	R-CN	nitrile	alkane nitrile	cyano
8.	Isocyanide	R-NC	isonitrile	alkane isonitrile	isocyano
9.	Aldehyde	R-CHO	al	alkanal	If C is in parent chain - oxo If not - formyl
10.	Ketone	R-COR'	one	alkanone	oxo / keto
11.	alcohol	R-OH	ol	alkanol	hydroxy
12.	Thioalcohol	R-SH	thiol	alkane thiol	mercapto
13.	amine	$R-NH_2$	amine	alkanamine	amino

14. alkyl halide	R–X	–	alkyl halide	halo
nitro alkane	$R-NO_2$	–	nitro alkane	nitro
ether	R–O–R'	–	alkoxy alkane	alkoxy

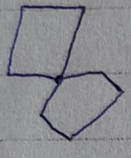
⑤ While naming cyclic compounds, parent chain could be the ring or a branch, whichever has more no. of C. But if both have equal no. of C, then cyclic is preferred.

⑥ Bicyclo



bicyclo [1.1.0] butane

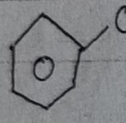
numbers written in descending order.

⑦ Spiro 

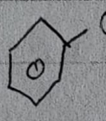
Spiro [3.4] octane

numbers written in ascending order.

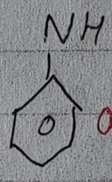
3. Benzene Derivatives



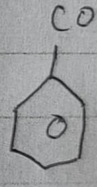
toluene



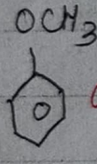
phenol



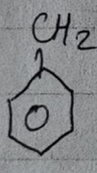
aniline



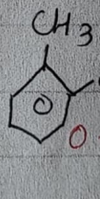
aceto-phenone



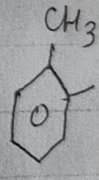
anisole



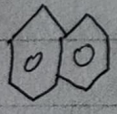
styrene



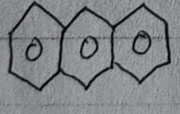
o-xylene



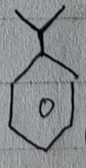
o-cresol



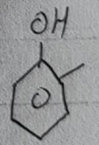
napthalene



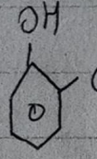
anthracene



cumene (isopropyl benzene).



salicaldehyde



salicylic acid

Isomerism

1. **Chain Isomerism** - longest chains are different in 2 compounds with same FG.

2. **Position Isomerism** - position of branch/multiple bond/FG are different. (but parent chain and FG remain same).
In alkanes - methyl can't come on 1st C, ethyl can't come on 2nd C, propyl can't come on 3rd C.

3. **Ring Chain Isomerism** - shown by π-bond(s) containing compounds, open chain compounds show ring chain isomerism with ring chain/cyclic compounds.

4. **Functional Group Isomerism** - when FG are diff. in 2 compounds (parent chain, substituents, multiple bonds may/may not be same)

Case I = alkane + O = $C_nH_{2n+2}O$ = alcohol / ether
Case-II = alkene + O = $C_nH_{2n}O$ = aldehyde/ketone/enol
Case-III = alkene + 2O = $C_nH_{2n}O_2$ = carboxylic acid / ester.

$\S - CH_3$ = (1) $\S - C_2H_5$ = (1) $\S - C_3H_7$ = (2)
$\S - C_4H_9$ = (4) $\S - C_5H_{11}$ = (8).

Case IV = nitroalkane ($R-NO_2$) and alkyl nitrite ($R-ONO$)
Case V = cyanide ($R-CN$) and isocyanide ($R-NC$)
(except, HNC and HCN show tautomerism).
Case VI = 1°/2°/3° amine
Case VII = alcohol ($\bigcirc CH_2OH$) and phenol ($\bigcirc OH$).
Case VIII = alkynes, alkadienes, cycloalkenes [C_nH_{2n-2}].

Halo alkane will never show FG I.

5. **Metamerism** - shown only by polyvalent FG, diff. set of C with respect to FG.

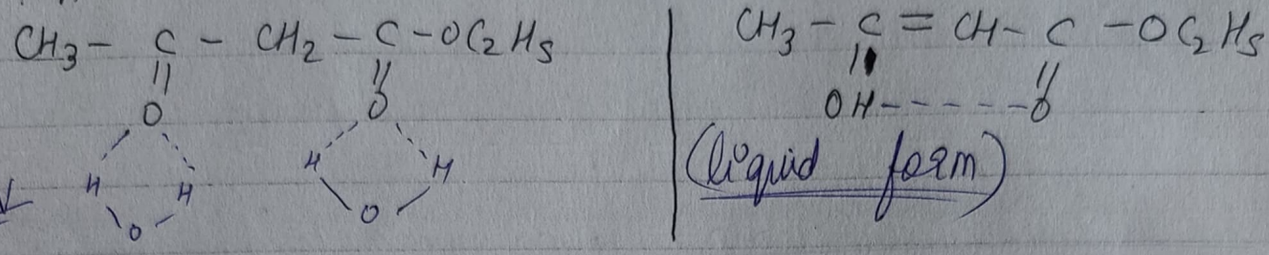
Eg - $C_4H_{10}O$ = $CH_3-O-CH_2-CH_3$ and $C_2H_5-O-C_2H_5$. metamers.

6. Tautomerism / Desmotropism / Keto - Enol Isomerism

Shifting of π-bond and α-H from their original position.

Conditions - (i) α-H must be present.
(ii) α-C must not be sp or sp^2 hybridised.

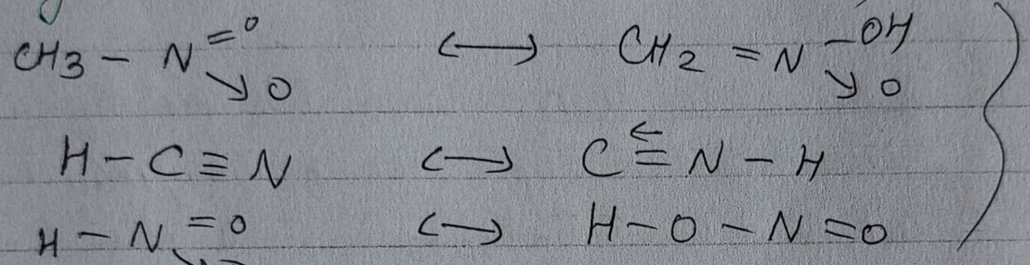
Eg :- AAE (Aceto Acetic Ester)



aqv

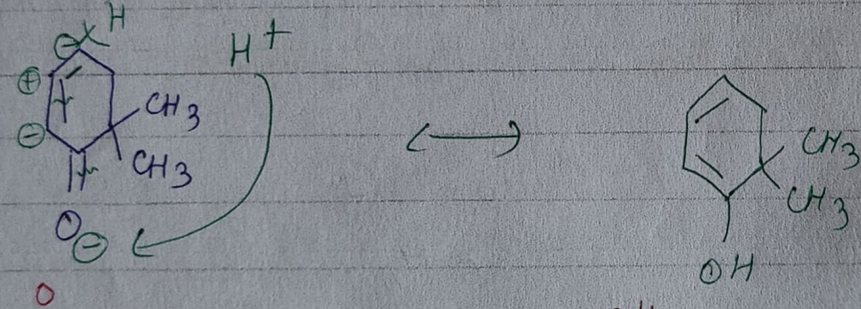
(liquid form)

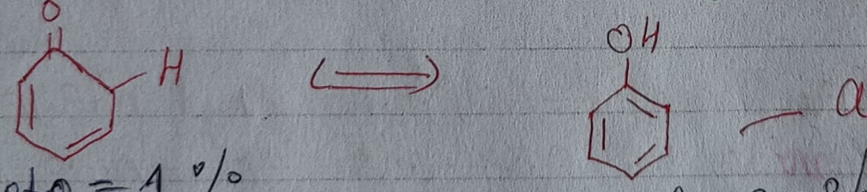
→ nitro compounds also show tautomerism (αH must be present). (solubility ↑ in NaOH, with ↑ in α-H).



diads.

Eg -





aromatic (SBR)

keto = 1%

enol = 99%.

Isomerism:

(1) Chain Isomerism

Longest chains are different in two compounds with same functional group.

(2) Position Isomerism

position of branch, multiple bond, functional group are different (but parent chain and functional group remain same).
in alkanes - methyl can't come on 1st C, ethyl can't come on 2nd C, propyl can't come on 3rd C.

(3) Ring chain Isomerism -

(shown by π-bond containing compounds)
Open chain compounds show ring chain isomerism with ring chain/cyclic compounds.

(4) Functional Group Isomerism

F/ FG are different in two compounds. (parent chain, position of substituent, multiple bonds may or may not be same)

Case - I = alkane + O = $C_nH_{2n+2}O$ = alcohol / ether
Case - II = alkene + O = $C_nH_{2n}O$ = aldehyde / ketone / enol
Case - III = alkene + 2O = $C_nH_{2n}O_2$ = carboxylic acid / ester.

$\{-CH_3$ = (1) $\{-C_2H_5$ = (1) $\{-C_3H_7$ = (2)
$\{-C_4H_9$ = (4) $\{-C_5H_{11}$ = (8)

Case - IV = nitro alkane ($R-NO_2$) and alkyl nitrite ($R-ONO$)
Case - V = cyanide ($R-CN$) and isocyanide ($R-NC$)
(except HNC and HCN show tautomerism)
Case - VI = 1°/2°/3° amine
Case - VII = alcohol ($C_6H_5-CH_2OH$) and phenol (C_6H_5-OH).
Case - VIII = alkynes, alkadienes and cycloalkenes [C_nH_{2n-2}].

Halo alkane will never show FG isomerism.

(5) Metamerism

(shown only by polyvalent FG)

different set of C with respect to the FG.

Eg - $C_4H_{10}O$ = $CH_3-O-C_3H_7$ and $C_2H_5-O-C_2H_5$

metamers

(6) Tautomerism/Desmotropism/Keto-Enol Isomerism -

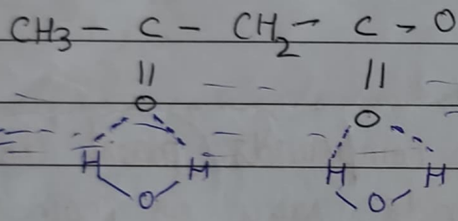
(shown by carbonyl compounds that must have α-H)

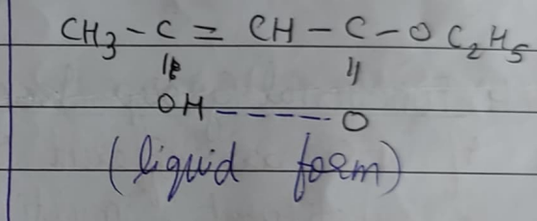
shifting of π-bond and α-H from their original position.

conditions - (i) α-H must be present

(ii) α-C must not be sp or sp^2 hybridised.

Eg- AAE (Aceto acetic ester)

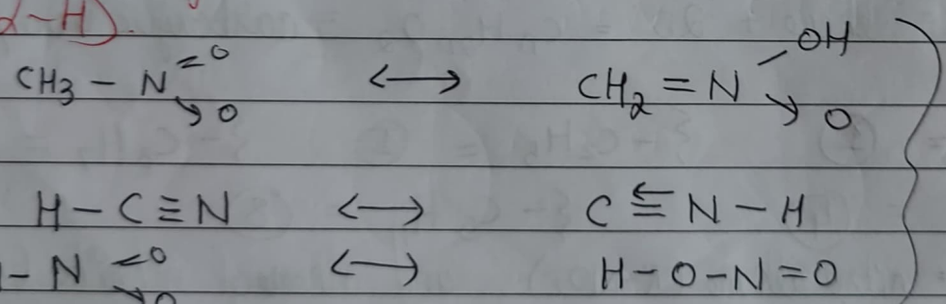




(liquid form)

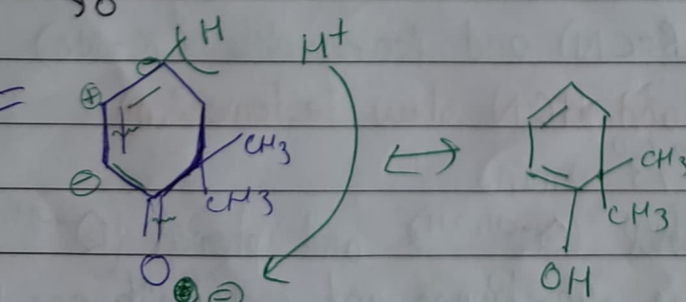
Nitro compounds also show tautomerism (αH must be present).

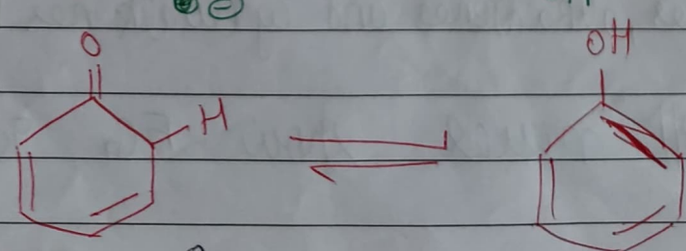
(Solubility increases in NaOH, with increase in α-H).



diads.

Eg=





-aromatic (SBR).

keto = 1%

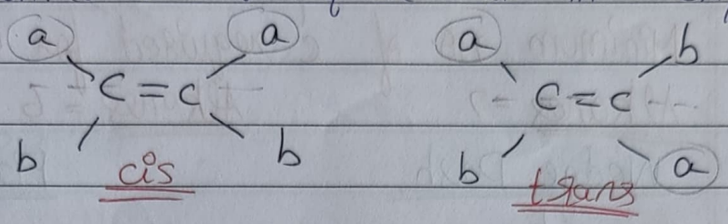
enol = 99%.

Oxime - only those oximes show G.I, whose sp^2 C have two different groups.

(1) Geometrical Isomerism (due to restricted motion about multiple bond)
two compounds are non-interconvertible
(shown by - alkene, oxime ($\dot{C}=N-$), azo ($-N=N-$), cycloalkane).

condition - two same groups should not be present on one C atom (on same side of one C atom in a compound).

Nomenclature ⇒



E = entgegen = trans
Z = zussamen = cis.

Priority rule - (priority is given on the basis of atomic number) (CCP rule)
if both high priority = in same direction ⇒ Z
= in opposite direction ⇒ E

Oxime ⇒ $R-CH\boxed{O + H_2}\ddot{N}-OH \longrightarrow R-CH=\ddot{N}-OH$
(aldehyde) (hydroxyl amine) (aldoxime)

cis = H and OH on same side
trans = H and OH on opposite sides.

Azo ⇒ $-\ddot{N}=\ddot{N}-$
cis / syn = lp on same side
trans / anti = lp on opposite sides.

Cyclo alkane - free rotation about any bond is not possible.
- two different groups on C atoms.

Number of G.I ⇒ $R_1-(CH=CH)_n-R_2$

if $R_1 \neq R_2$
$G.I = 2^n$

if $R_1 = R_2$
$G.I = 2^{n-1} + 2^{p-1}$

if n is even: $p = \frac{n}{2}$
if n is odd: $p = \frac{n+1}{2}$

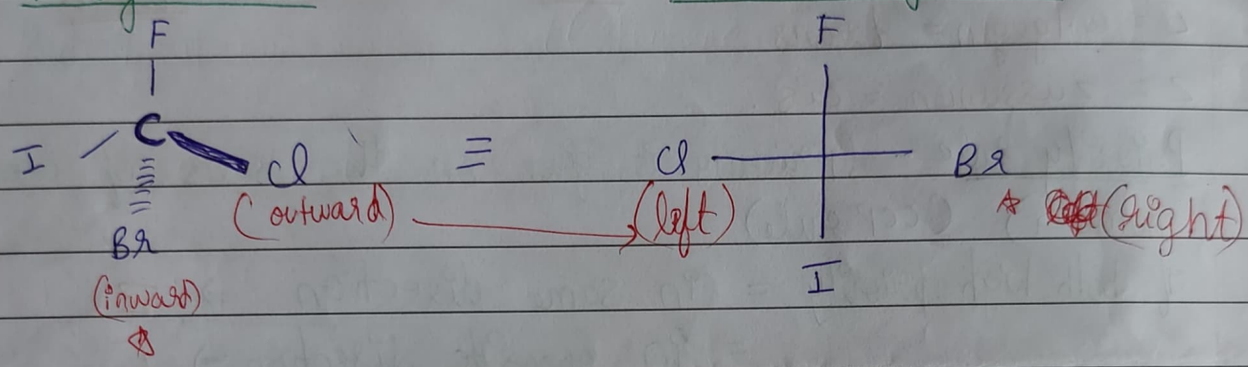
(2) Optical Isomerism

PPL - clockwise = dextrorotatory (d)
anticlockwise = laevorotatory (l).

chirality - ✱ C should have all different substituents. (Assymetrical/chiral c) (mirror image is ~~super~~ non-superimposable)

Minimum no. of C required for OI/chirality -
Alkanes = 7 Alkenes = 6 Alkynes = 6.

Wedge Dash **Fischer Projection**



Nomenclature - numbering according to CCP rule.
odd no. of shuffling = mirror image
even no. of shuffling = same compound.

Fischer - Least priority should be at the ~~bottom~~ vertical.
R = CW S = ACW. ← (opp. for horizontal)

Wedge Dash - Least priority on dash, most priority on top. R = CW S = ACW.

for 2 *C in a compound

Enantiomer - two compounds are mirror image of each other.
Diastereomer - two compounds are not mirror image of each other.
Meso compound - when a compound becomes optically inactive due to presence of plane of symmetry
Racemic mixture - equal conc. of R and S solution.

When a C is connected to 2 same chiral C groups, it is ~~a~~ a pseudo chiral C.
When there is only one *C in a compound, all its optical isomers are enantiomers.

Number of OI (n = number of chiral C)

	optically active	Meso compounds	Total O.I
$R_1 \neq R_2$	2^n	0	2^n
$R_1 = R_2$ (n = even)	2^{n-1}	2^{p-1} ($p = n/2$)	$2^{n-1} + 2^{p-1}$
$R_1 = R_2$ (n = odd)	$2^{n-1} - 2^{p-1}$	2^{p-1} ($p = \frac{n+1}{2}$)	2^{n-1}

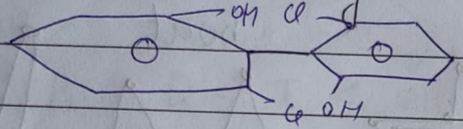
3° amine / 3° carbanion – no OI due to rapid umbrella inversion

Allene derivative – C=C=C=C.....

even no. of (C=C) continuously = OI ✓ (non-planar)

odd no. of (C=C) continuously = OI ✗ (planar)

Biphenyl



ortho derivative of biphenyl

↓

non-planar

↓

optically active ✓

Confirmation (3 continuous single bonds must be present)

No. of confirmational isomers (CI) = ∞

Anti/staggered = most stable, maximum distance.

Eclipsed = least stable, least distance.

skew = all possible structures between staggered and eclipsed.

Stability -

Anti > Gauche > Partially eclipsed > eclipsed.

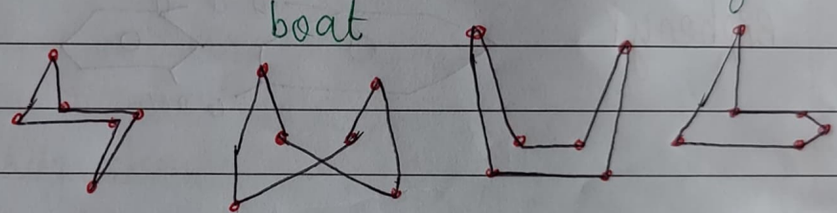
But if H-bonding present (ethylene glycol $\overset{OH}{\overset{|}{CH_2}}-\overset{OH}{\overset{|}{CH_2}}$)

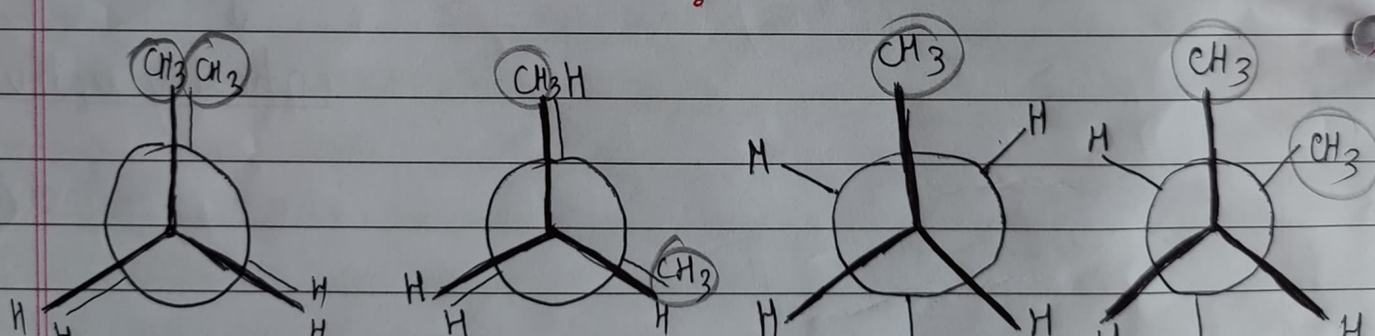
Gauche > Anti > Partially eclipsed > eclipsed.

↓

has H-bonding.

Cyclohexane - Chair > twisted > boat > half chair





eclipsed | partially eclipsed | anti | gauche

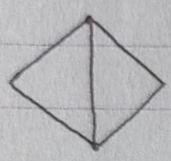
1. Modified IUPAC Rule -

$CH_2(OH)-CH(OH)-CH_2(OH)$ — Propane-1,2,3-triol

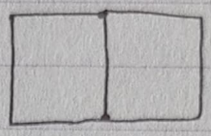
If same FG in all C, then FG's C is not counted in parent chain.

$CH_2(CN)-CH(CN)-CH_2(CN)$ — Propane-1,2,3-tricarbonitrile

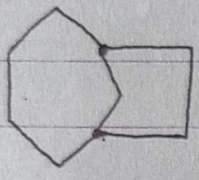
2. Bicyclo And Spiro Compound (C_nH_{2n-2}) -



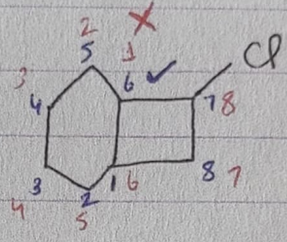
Bicyclo [1,1,0] butane



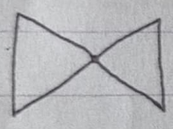
Bicyclo [2,2,0] hexane



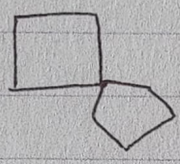
Bicyclo [4,2,1] nonane.



7 chloro bicyclo [4,2,0] octane.

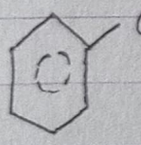


Spiro [2,2] pentane

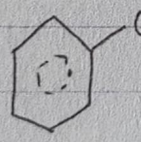


Spiro [4,3] octane.

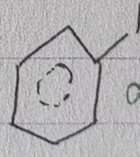
3. Benzene Derivatives -



toluene

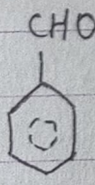


phenol

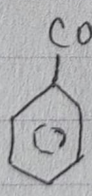


aniline

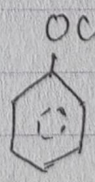
benzoic acid



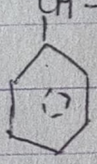
benzaldehyde



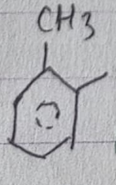
acetophenone



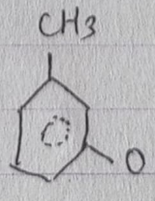
anisole



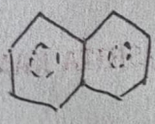
styrene



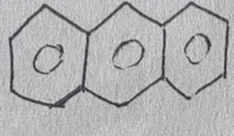
o-xylene



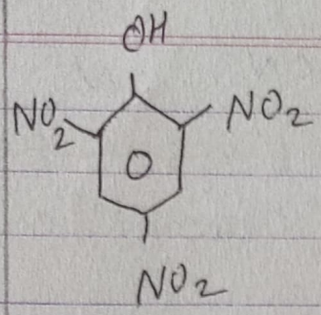
m-cresol



naphthalene



anthracene



picric acid.