1) Organic chemistry - basic ✓
2) Nomenclature ✓
3) Isomerism ✓
4) G.O.C ✓

Organic chemistry (Basic)

Date ____
Page ____

* vital force theory → Berzelius

* 1st organic compound → urea, which is obtained by wohler (1828) from Inorganic compound.

* 1st organic compound Acetic acid (CH_3COOH) by element is made by kolbe.

* Catenation depends upon value of bond dissociation energy which is more in carbon

* Bond strength ↓

C–C > Si–Si > S–S > P–P > N–N > O–O
१२
भाग रही → कसीन पीसनओ

* Old definition of organic ~~compound~~ chemistry → substance which are obtained directly or indirectly from living org organisms (life) are known as organic compound,

Branch of chemistry which reads organic compound is known as organic chemistry

* Advanced definition of organic chemistry → All organic compounds contain carbon as a major elements so organic chemistry is chemistry of carbon, All organic compounds generally contains 10 types of elements as

C, H, O, N, P, S, Cl, Br, I and F

→ Hydrocarbon and its derivatives is known as Organic Substance.

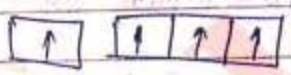
3, 4, 5

→ Kekule's principle:

• Quadrivalency of carbon ⇒ valency ⇒ 4

G. state : $2s^2 2p^2$

Excited state :

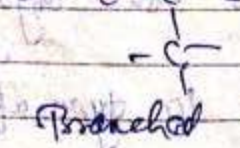


◉ Catenation → Tendency of element to form chain of similar atom known as catenation.

eg →

C–C–C–C

unbranched

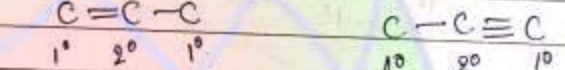


Branched

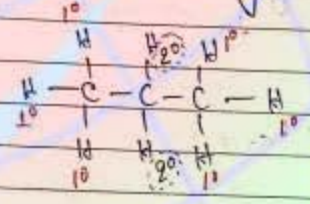
✱ Carbon of methane is super 1°

very important

→ Degree does not affected by multiple bond or in cyclic



→ Degree of hydrogen will be decided by hydrogen which is directly bonded with specific carbon.



→ By sharing of electrons carbon forms single, double and triple co-valent bond.

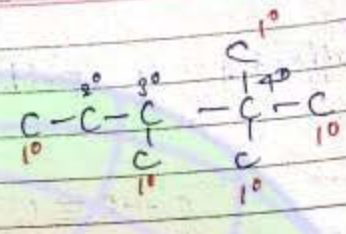
C-C , C=C , C≡C

(*) Type of carbon (classification)

(1) On the basis of Degree: Degree will be decided of any organic compound by total no. of carbons directly bonded by specific carbon.

1° → Primary (P) ; 2° → Secondary (S)

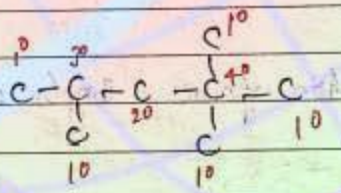
3° → Tertiary (T) ; 4° → Quaternary (Q)



Q.) $CH_3 - CH_2 - CH_3$

	0°	1°	2°	3°	4°
C	2	1	0	0	
H	6	2	1	0	

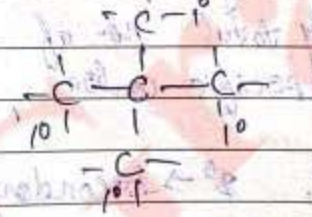
Q.) Do octane (exceptional case)



C	5	1	1	1
H	12	2	1	0

Q.) A structure of hydrogen which contain 12, 1° hydrogen only.

Sol^{n}

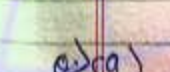


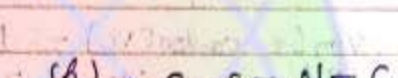
Q.)

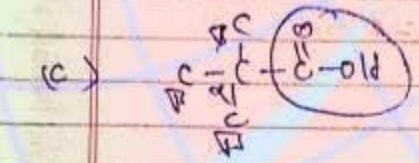
★ On the basis of position

(a) With respect of functional group :-

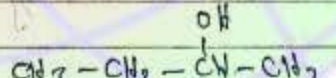
F.G. – C – C – C – C
α β γ δ

Q. (a) 

(b) 

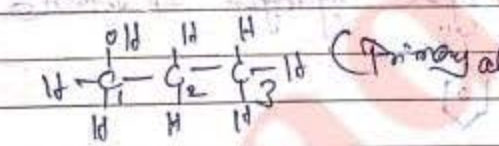
(c) 

Q. Identify carbon and hydrogen type :-

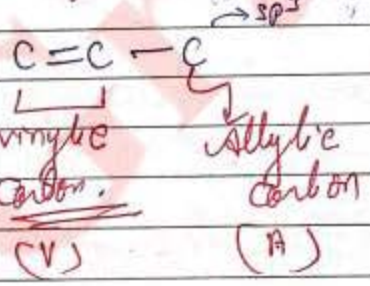


No. of α-C → 1 ; α-H → 1
No. of β-C → 2 ; α-H → 2
No. of γ-C → 1 ; α-H → 3

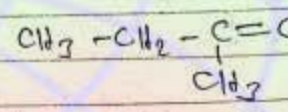
Q. Draw the structure of alcohol and its degree which contains two α-hydrogen, 2β-hydrogen, and 3rd hydrogen.


(Primary alcohol)

★ With respect of double bond



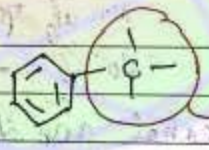
eg :- No. of vinyle carbon (VC), AC, VH and AH in following comp.



Sol^{n} No. of vinyle carbon (VC) = 1
" " allyle " (AC) = 3
" " vinyle hydrogen (VH) = 1
" " allyle " (AH) = 8

☆ Benzyle carbon

In benzene ring all carbons are vinyle type bonded sp^2 carbon is known as benzyle carbon



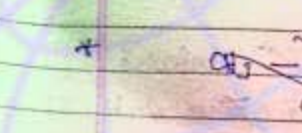
eg :- No. of benzylic hydrogen in toluene

Sol^{n} Benzylic hydrogen = 2

* Concept of α

$C_\alpha - \overset{O}{\overset{\|}{C}} - OH$, $C_\alpha - O - C_\alpha$, $C_\alpha - N - C_\alpha$

*

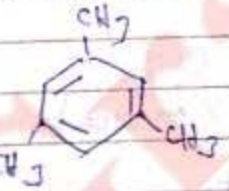


नोट = functional group के बाद वाला carbon α-carbon है।

(3) On the basis of Hybridization :-

	Structure	No. of σ	No. of π	Hybridization	Geometry	Bond angle	No. of bond angle
(I)	$\overset{\sigma}{\underset{\sigma}{\overset{|}{\underset{|}{C}}}}$	4	0	sp^3	tetrahedral	109°28'	6
(II)	$\overset{\sigma}{\underset{\sigma}{\overset{|}{\underset{|}{C}}}}=\overset{\pi}{\sigma}$	3	1	sp^2	Horizontal trigonal C–	120°, 120°	3
(III)	$-C\equiv$	2	2	sp	linear/diagonal	180	1
(IV)	$=C=$	2	2	sp	linear/diagonal	180	1

Q.) which one contains all three types of hybridized carbon

(a)  → mecetylene

(c) Propyn → $CH_3-C\equiv CH$

(d) $CH_3-CH_2-CH_3$ → propan

(e)  → Benzene

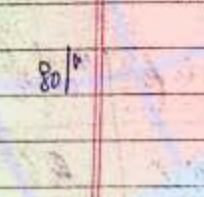
Ans. No, one contain sp, sp^2, and sp^3

Note → This contain all three

$CH_3 - CH = C = CH_2$
$sp^3 \quad sp^2 \quad sp \quad sp^2$

Q.) Identify structure of alcohol which contains same type of hybridised carbon with zero α-H and 9 H

Sol.)



☆ Representation of organic compounds ↓

↳ objects for knowledge of structure

① By molecular formula (m.f)

(a) $CH_3 - CH_2 - CH_2 - CH_3$ → structural formula

↓

C_4H_{10} → molecular formula

(b) $CH_3 - CH = CH_2$ → C_3H_6
(structural) (molecular)

(c) $CH_3 - C \equiv CH$ → C_3H_4
(structural) (molecular)

(1) By expanded and condensed formula :-

(a) $CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_2-CH_2-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_3$

(expanded / structural formula)

$\downarrow$

$(CH_3)_2CH(CH_2)_3C(CH_3)_3$

(condensed formula)

$\Downarrow$

(b) $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{CH_3}{|}}{CH}-CH_3 \longrightarrow CH_3CH_2CH(CH_3)CH(CH_3)_2$

(expanded/structural) (condensed formula)

(c) $CH_3-CH=\overset{\overset{CH_3}{|}}{C}-CH_2-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_3$

$\downarrow$

$CH_3-CH\,C(CH_3)(CH_2)_2\,CH(CH_3)_2$

(condensed formula)

(d) $CH\,C(CH_2)_2\,C(CH_3)\,CH_2 \rightarrow H-C\equiv C-CH_2-CH_2-\overset{\overset{CH_3}{|}}{C}=CH_2$

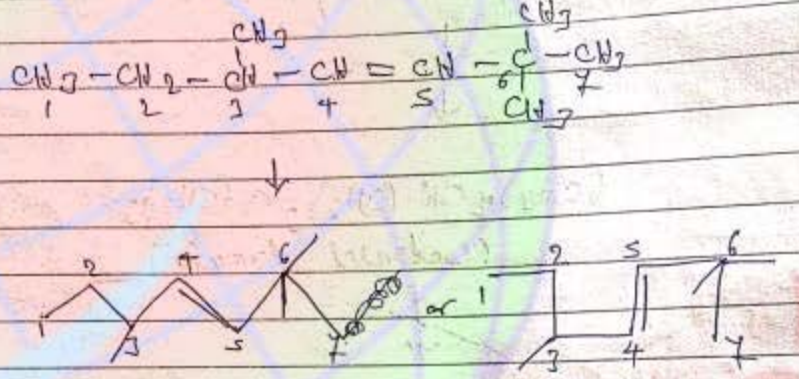
③ By Bond line notation :-

C–C → —

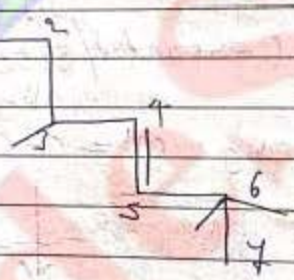
C=C → =

C≡C → ≡

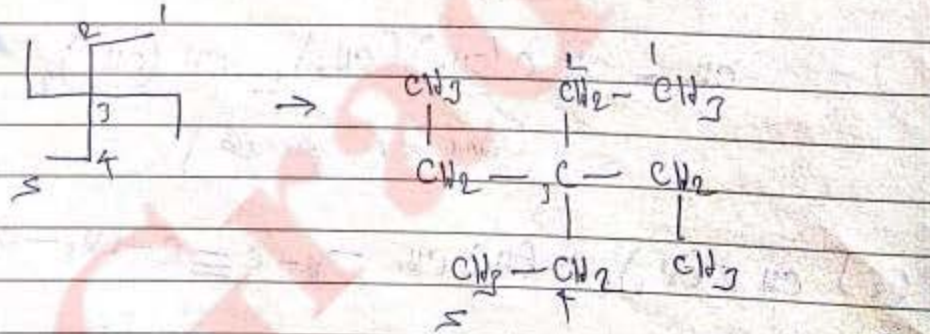
Q1



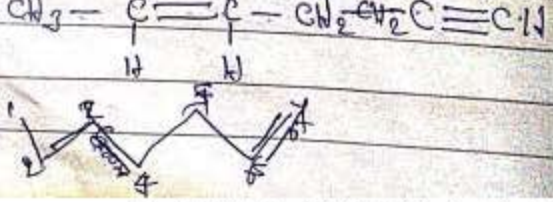
or



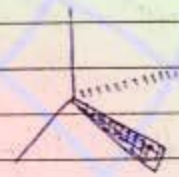
Q10



Q2 $CH_3CH(CH_3)(CH_2)_2C{\equiv}N \rightarrow$



④ By 3D-formula (Dash-wedge) or (wedge-Dash formula)



—— (on the Plane)

(wedge) (above the Plane)

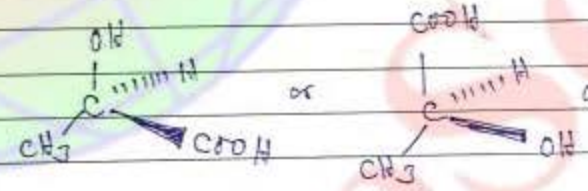
(dash) (below the Plane)

Eg) $CH_3-\underset{OH}{\underset{|}{CH}}-\overset{O}{\overset{||}{C}}-OH$ (lactic acid)

↓

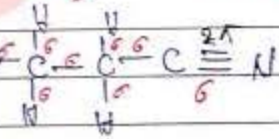
3D figure

↓



★ Extra point

Determination of possible number of σ-bonds

$CH_3-CH_2-C\equiv N \rightarrow$ 

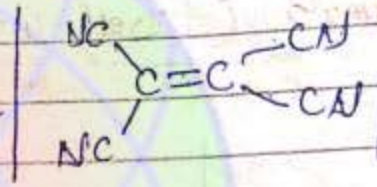
↳ 8 σ bonds

↳ 2 π bonds

Trick ⇒ (total no. of atoms − 1) = No. of bonds (only for non-cyclic compound)

class
Date
Page

Example

Q → $(CN)_2CC(CN)_2$ |  | tetra cyano ethylene

Sol^n

No. of σ bonds → 10 − 1 ⇒ 9

No. of π-bonds → 9

Classification of organic compounds

Acyclic comp.
or
Non-cyclic comp.
or
open chain compound
or
Aliphatic compound
(Aliphas = fat)

Hydrocarbon
(made up of C & H)

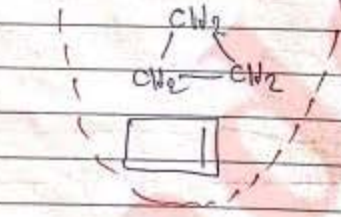
① Saturated
→ Alkane
② Unsaturated
→ Alkene
→ Alkyne

Derivatives
(C, H, O, N, S etc)

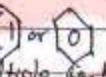
Cyclic comp.
or
closed chain comp.

Homocyclic or Carbo-cyclic
(all atoms are similar in type)

Alicyclic
(eg: cyclohexane, cyclononane, cyclodecyne)



Aromatic
(C = 6 atoms alternatively)

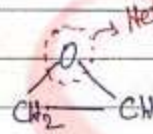


(multiple bond present alternately)

Hetero-cyclic
(different atoms)

Alicyclic

Aromatic



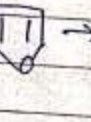
Hetero-atom → Oxygen

→ Thiophene ;

→ Pyridine

Hetero atom

→ Pyrolle ;



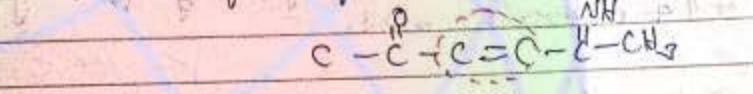
→ furanone

Extra point 7

① determination of No. of "σ" bond in organic comp

② olefinic → Double bond वाले "C" (C=C)

Eg: No. of olefinic bonds in



Soln "1" ✓

नोट: olefins - वो है C=C के लिए = कहा जाता है।

② Paraffins → Saturated alkanes.

★ Homologus Series

A list or a series of organic compounds which contains (i) same functional group and (ii) structurally similar are arranged in increasing molecular weight, known as homologas series.

Each member of series said to be homologs

* Salient features of homologous series

① In each homologous series two successive members (succeeding and preceding) differ by CH_2 or 14 molecular mass.

eg → Alkane series (C_nH_{2n+2})

$n=1$	CH_4 → lower homolog	$CH_2/14$
$n=2$	C_2H_6	
$n=3$	C_3H_8 → higher homolog	$CH_2/14$
$n=4$	C_4H_{10}	

② Each homolog of homologous series are similar in
* General formula
* Chemical properties and
* General methods of preparation (GNP)

③ Gradual physical changes occur in homologous series

Gas → liquid → solid

(पहले) (बीच वाले) (last)

(smaller groups) (higher groups)

(1) Next homolog of propane will be $CH_3-CH_2-CH_3$

(a) $CH_3-CH(CH_3)-CH_3$

(b) CH_3-CH_3

(c) $CH_3-CH_2-CH_2-CH_3$

(d) $CH_3-CH_2-CH_2-CH_2-CH_3$

Sol^n c (Note: Structurally similar होना चाहिए)

(2) Homolog of two Propanol is

$CH_3-CH(OH)-CH_3$

(a) $CH_3-CH_2-CH_2-CH_2(OH)$

(b) $CH_3-C(OH)(CH_3)-CH_3$ (3°)

(c) $CH_3-CH_2(OH)$

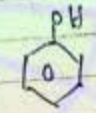
(d) $CH_3-CH_2-CH(OH)-CH_3$

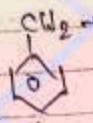
Sol^n "d"

Note: Homologous series पता करने के लिए, हर बात को step by step satisfy करवाना है।

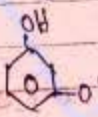
Note → 1st see → same functional group
2nd see → Same structure
3rd see → see preceding and succeeding compound differ by CH_2 / 14

(8) Homolog of phenol will be



a) 

(c) 

(d) 

(d) 

Ans (a) "C"

{ "OH" जो है वह directly benzene ring से जुड़ा होना चाहिए।

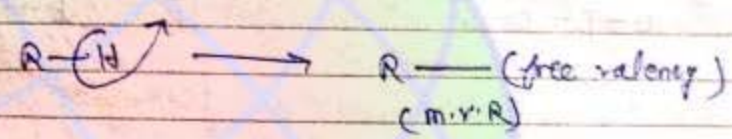
☆ Radicals of hydrocarbon:-

* Radicals → A reactive species of atom's or group of atom's.
* Radicals of hydrocarbons
The reactive species of hydrocarbon which obtain after removal of one or more Hydrogens said to be radicals of hydrocarbon.

on the basic of no. of hydrogens it will be
(i) monovalent radicals (MVR)
(ii) Bivalent " (BVR)
(iii) Trivalent " (TVR)

(1) Monovalent Radicals (m.v.R)

Alkane →



नोट → या तो free valency देखें या no. of H-atom देखें।

Step No 2

Determination of possible number of m.v.R

Compound	possible no. of mvR
(1) CH_3-CH_3	1
(2) $CH_3-CH_2-CH_3$	2
(3) CH_4	1
(4) $CH_3-CH_2-CH_2-CH_3$	2
(5) $CH_3-CH(CH_3)-CH_3$	2

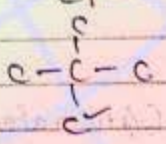
नोट → किसी भी comp. में जितना प्रकार का Carbon होगा उतना प्रकार का m.v.R होगा।

(6) $C-C(-C)(-C)-C$ 3

T

Important

(1) 

(2) 

☆ For Statical Purpose]

m.F	Possible no. of mVR
C_1	1
C_2	1
C_3	2
C_4	4

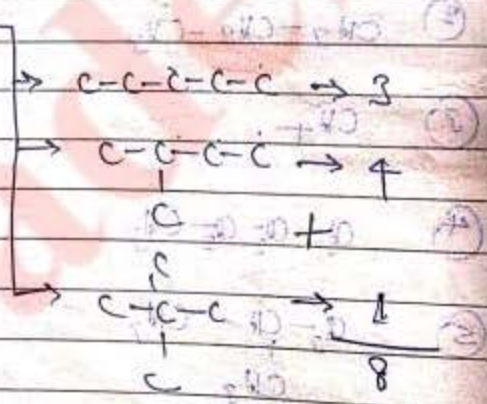
very-very Important

→ 

$2^C \Rightarrow 4$

C_5 8

16



10 to 11:00 am

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Date
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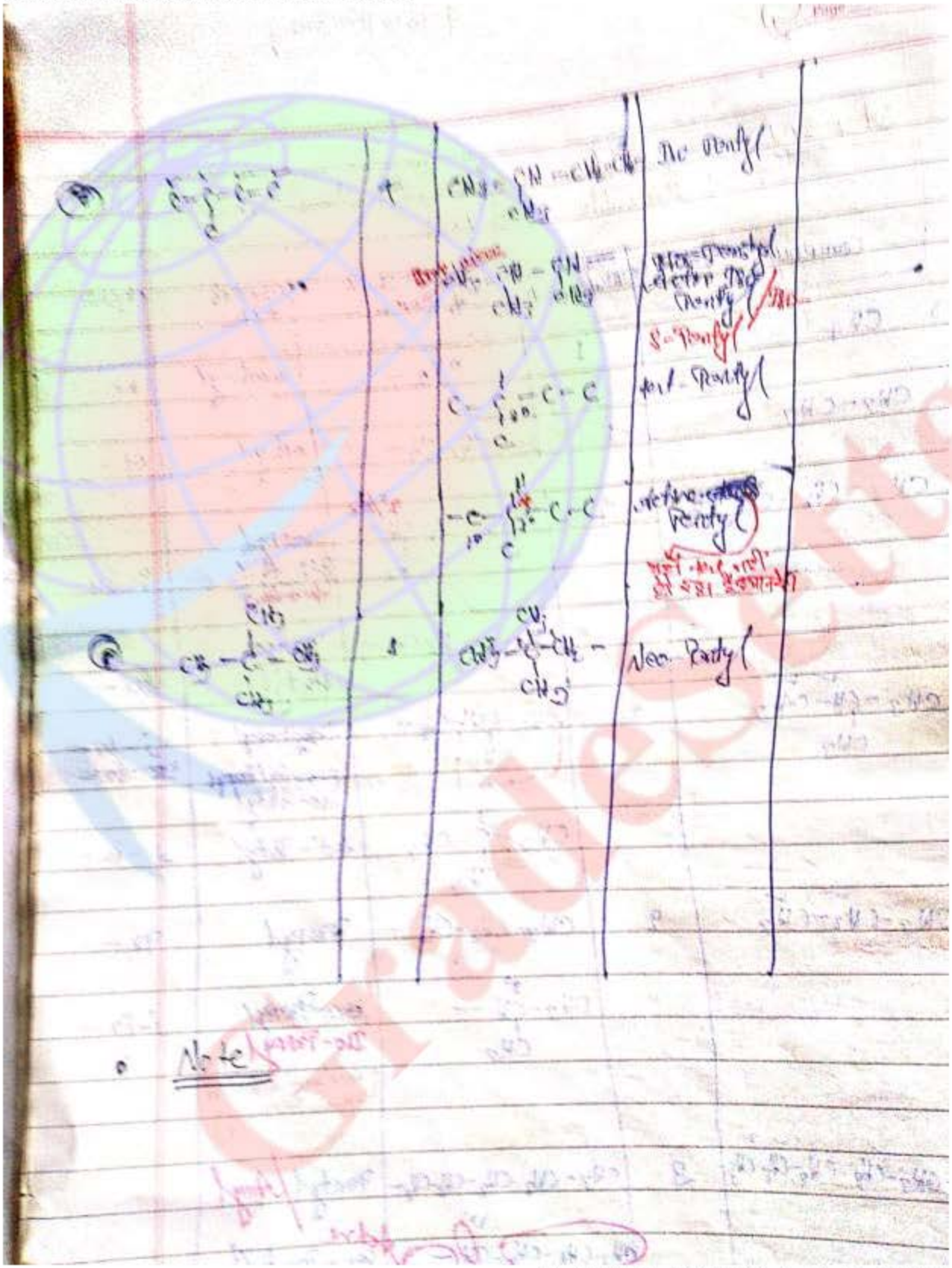
Step 2nd → formation of structure and name of possible m.v.R

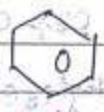
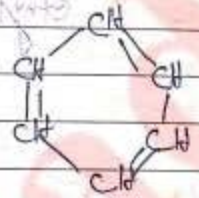
	Compound	Possible no. of m.v.R	Possible structure of m.v.R	Name of m.v.R	Symbol
C_1	(1) CH_4	1	CH_3-	meth-yl	me –
C_2	(2) CH_3-CH_3	1	CH_3-CH_2-	ethyl	et –
C_4	(3) $CH_3-CH_2-CH_2-CH_3$	2	$CH_3-\underset{CH_3}{\overset{2^\circ}{CH}}-CH_2-$	sec-Butyl / 1-methyl-propyl	s-bu –
			$CH_3-CH_2-CH_2-CH_2-$	Butyl	bu –
	(4) $CH_3-\underset{CH_3}{CH}-CH_3$	2	$CH_3-\underset{CH_3}{CH}-CH_2-$	Iso-Butyl	i-bu –
			$CH_3-\underset{CH_3}{\overset{CH_3}{\overset{|}{C}}}-CH_3$	tert-Butyl	t-Bu –
C_3	(5) $CH_3-CH_2-CH_3$	2	$CH_3-CH_2-CH_2-$	Propyl	Pr –
			$CH_3-\underset{CH_3}{\overset{2^\circ}{CH}}-$	Iso-Propyl (here "Iso" is common when Secondary)	i-Pr –
	(6) $CH_3-CH_2-CH_2-CH_2-CH_3$	3	$CH_3-CH_2-CH_2-CH_2-CH_2-$	Pentyl / Amyl	
			$CH_3-CH_2-CH_2-\underset{CH_3}{\overset{2^\circ}{CH}}-$	Active Sec-Pentyl / Active-Sec-Amyl	
			$CH_3-CH_2-\underset{CH_2\,CH_3}{\overset{|}{CH}}-$	Sec-Pentyl / 3-Amyl	



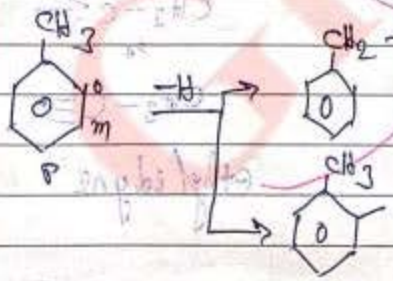
Some Important unsaturated hydrocarbons and M.V.R

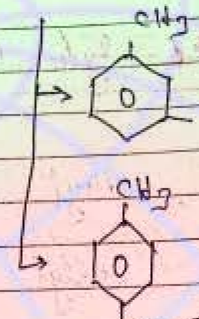
1. $CH_2=CH-$ — vinyl
2. $CH_2=CH-CH_2-$ — Allyl
3. $CH_3-CH=CH-CH_2-$ — Crotyl
4. $C_6H_5-CH=CH-CH_2-$ — Cinnemyl
5. $CH\equiv C-CH_2-$ — Propargyl

M.V.R of Aromatic Compounds :- (Aryl radicals)

1.  or  or $C_6H_6 \xrightarrow{-H}$  or C_6H_5- or $Ph-$ or ϕ

   Benzene/phene — Phenyl/Benzenyl

2.  — Benzyl; o-tolyl



m-tollyl

p-tollyl

शब्द दो Gem का अर्थात विद्यमान एक ही कार्बन जुड़े रहते हैं।

Gem [Geminale → Twins] radicals

The removal of more than one Hydrogens from same-carbon or two or more than two free valencies present at same carbon.

eg →

$CH_3-CH_3 \xrightarrow{-H} CH_3-CH_2$ (ethyl) [MVR] $\xrightarrow{-H} CH_3-CH<$ or $CH_3-CH=$ [DVR]

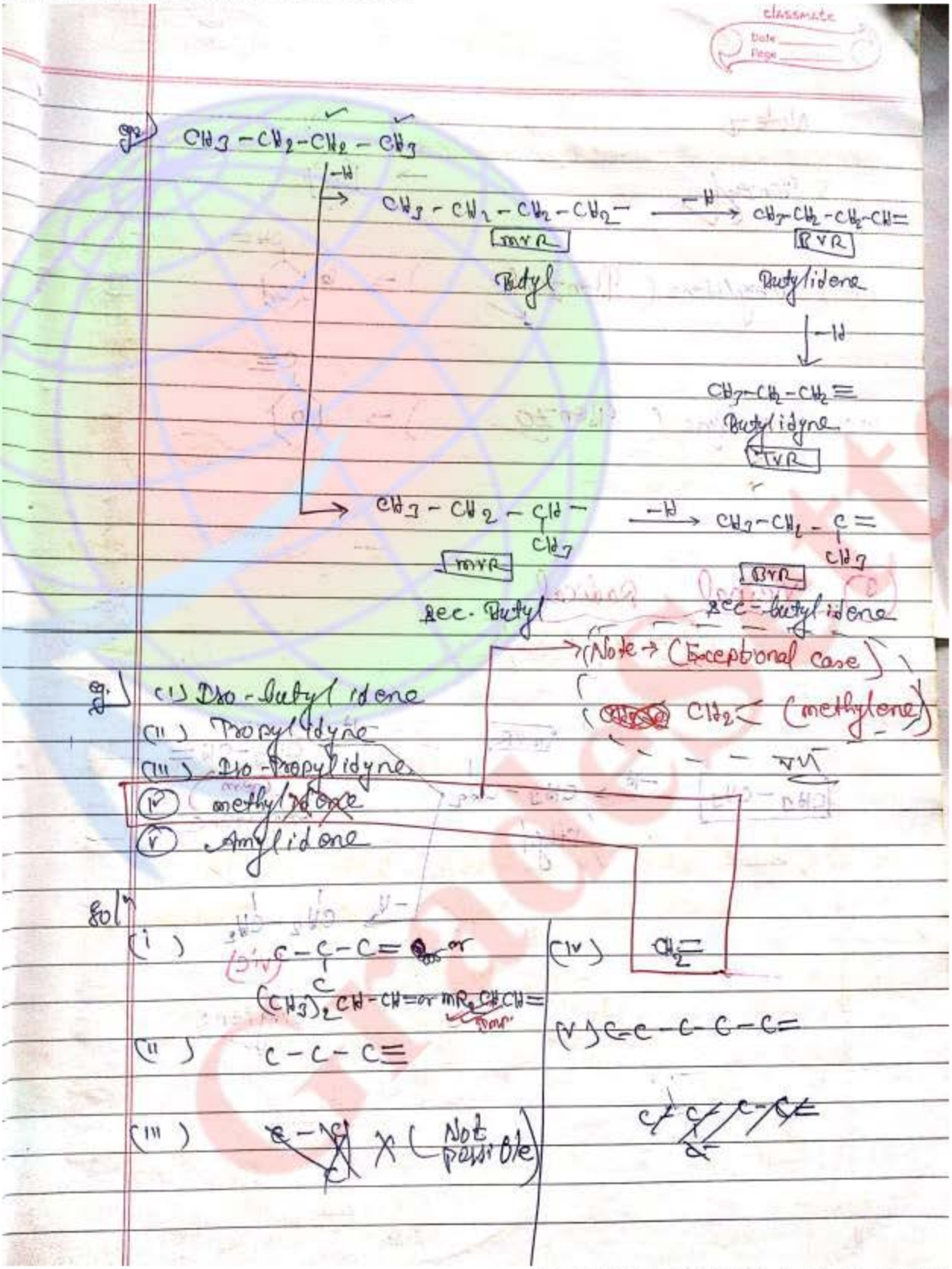
ethylidene
(→ this indicate Gem)

↓ −H

[TVR]
$CH_3-C\leqslant$ or $CH_3-C\equiv$

ethylidyne

must learn this name one time.



Note :-

(I) Benzyl → $C_6H_5-CH_2-$

(II) Benzylidene (Benzal) → $C_6H_5-CH=$

(III) Benzylidyne (Benzo) → $C_6H_5-C\equiv$

(3) Vicinal Radical

↳ पड़ोसी / neighbour

CH_3-CH_3 $\xrightarrow{-H}$ CH_3-CH_2 (Ethyl)

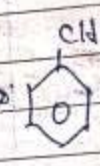
CH_3-CH_2 $\xrightarrow{-H}$ $CH_3-CH=$ (Gem ethylidene)

CH_3-CH_2 $\xrightarrow{-H}$ CH_2-CH_2 (vic ethylene)

Note :-

(I) Benzyl

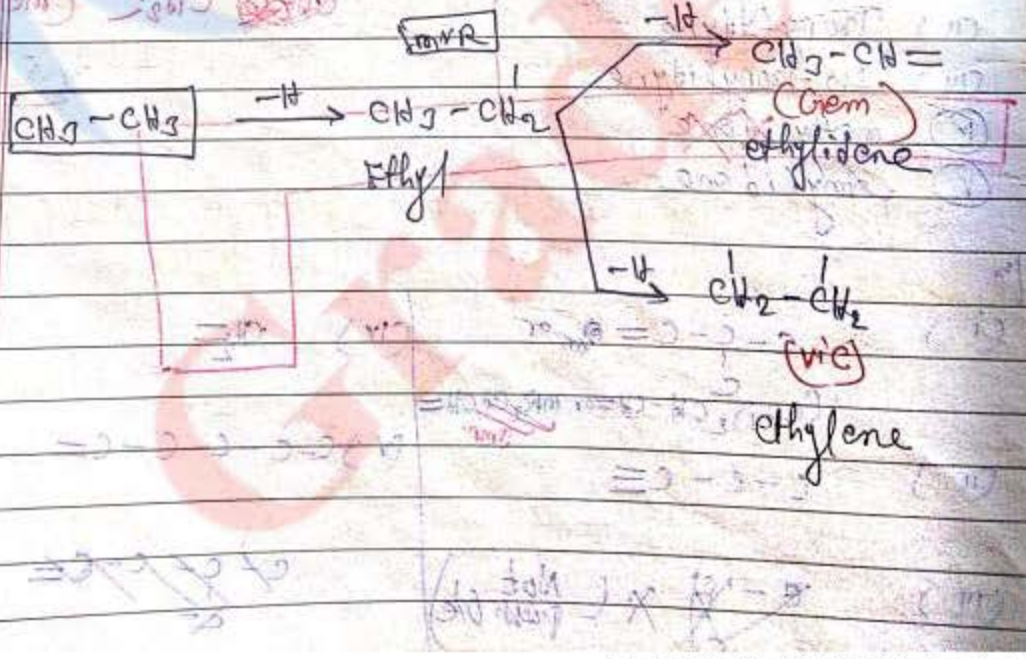
(II) Benzylidene (Benzal) →



(III) Benzylidyne (Benzo) →

(3) Vicinal Radical

↳ पड़ोसी / neighbour



Q.1 (i) Propylidene
(ii) Propylene
(iii) Propyl
(iv) Propylidyne

Sol:

Gem (I) $CH_3-CH_2-CH=$

Vic (II) $CH_3-\overset{|}{C}H-\overset{|}{C}H_2$

Mono (III) $CH_3-CH_2-CH_2-$

Gem (IV) $CH_3-CH_2-C\equiv$

Important points

Number and name of vicinal radicals are based upon type of "σ" bonds.

Example →

$CH_3 \overset{\alpha}{-} CH_2 \overset{\beta}{-} CH_2 \overset{\alpha}{-} CH_3$

→ $CH_3-CH_2-\overset{|}{C}H \overset{\alpha}{-} \overset{|}{C}H_2$

α-Butylene ✓

→ $CH_3-\overset{|}{C}H \overset{\beta}{-} \overset{|}{C}H-CH_3$

β-butylene ✓

Note: याद रखें ! जितना युक्त [illegible] अलग-अलग Carbon होगा उसी में α, β [illegible] का प्रयोग [illegible] ही और [illegible] करें

Q1) $CH_3 \overset{\alpha}{-} CH_2 \overset{\alpha}{-} CH_3 \rightarrow CH_3 - CH = CH_2$

Propylene

Note → किसी भी compound में जितना प्रकार का σ-bond होता उतना प्रकार का normal structure

Q2) β-Amylene

$C-C-C \overset{\beta}{=} C-C$

Sol^n

$CH_3 - CH = CH - CH_2 - CH_3$

or

$CH_3 - CH_2 - CH = CH - CH_3$

Applications of Radicals →

① Common name (C/N) formation of organic compounds

R — F.G.

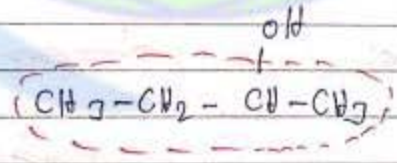
R → Radical

F.G. R

–OH	alcohol
–SH	Thio alcohol
–O–	ether
$-NH_2$	P-Amine
–NN–	2-amine
–N–	T-amine
–C(=O)–	ketone
–X	halo

(X → Cl/Br/I/F)

eg:

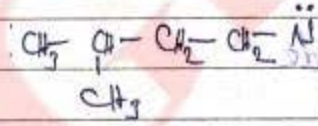


Common name → sec-butyl alcohol

m.v.R functional group

g. Iso-pentyl Amine

m.v.R functional group



Topic – Radical, and alkyl group before

Examples of Radical

Common name (Nomenclature)

Q(8) Propyl alcohol

$CH_3-CH_2-CH_2-OH$

Q(9) ethyl methyl ketone

ethyl — m.v.R, methyl — m.v.R, ketone — functional group

$CH_3-\underset{\|O}{C}-CH_2-CH_3$ (m.v.R … m.v.R)

Q(5) Iso-Propyl amine

C–C(–C)–NH_2

(2) T-butyl methyl ketone

CH_3–C(=O)–C(–C)(–C)–C

(3) ethyl methyl propyl amine

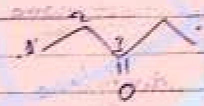
C–C–N(–C)–C–C–C

(4) Active S-amyl chloride

C–C–C(–C)–C(H)(Cl)–C

(5)  → N,N,N triethyl amine

(6)  → ~~sec~~ 2-butyl alcohol

(7)  → Ethyl ethyl ketone

(2.) Derivative name formation :-

In derivative nomenclature system 1st stable member of series will be designated as a parent compound and all other remaining member's said to be derivative of parent compound.

eg:- Alkyne series → 1st stable member

[C≡C]

Root compound Acetylene

Note → derivative name में Root compound को ढूंढना पड़ता है क्योंकि derivative name से naming होता है

m.v.r   m.v.r

$CH_3-CH_2-C\equiv C-CH_3$

Derivative name:- Ethyl-methyl Acetylene.

1.) Dimethyl Acetylene ~~...~~

C –C≡C– C

Acetylene.

(5)  → N,N,N Diethyl amine

(6)  → ~~Butan-2-ol~~ sec-butyl alcohol

(7)  → Ethyl ethyl ketone

(2.) Derivative name formation :-

In derivative nomenclature system 1st stable member of series will be designated as a parent compound and all other remaining members said to be derivative of parent compound.

eg :- alkyne series → 1st stable member

$C \equiv C$

Root compound Acetylene

Note → Derivative name of Root compound को हटना पड़ेगा क्योंकि उसकी derivative name से naming होता है

$\overbrace{CH_3-CH_2}^{m.v.r}-C\equiv C-\overbrace{CH_3}^{m.v.r}$

Derivative name = Ethyl-methyl Acetylene.

1.) Dimethyl Acetylene ~~Dimethyl Acetylene~~

$C-C\equiv C-C$

Acetylene.

11:00 to 1:00

8:05 – AB
9:50 to 10:50 – BP

Room 2409

classmate
Date
Page

Imp ⑥ Vinyl Acetylene or But en yne

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

	Series	Root comp.	Root name
Imp 1.)	Alkyl	$-C\equiv C-$	Acetylene
2.)	Alkane	~~$-\overset{|}{C}-$~~ (more branched)	methane
(3)	Alkene	~~$>C=C<$~~	ethene
Imp	Alcohol	~~$-CH_2-OH$~~	carbinol
(5)	Aldehyde	$-\overset{||}{C}-C-H$	Acetaldehyde ~~ethanaldehyde~~
(6)	Acid	~~$-\overset{||}{C}-COOH$~~	~~methanoic acid~~ Acetic acid
(7)	Ketone	$-\overset{||}{C}-C-$	~~methyl methyl ketone~~ Acetone

eg.) $CH_3-CH_2-\overset{OH}{\overset{|}{C}}-CH_3$

Derivative name → D/N → ethyl methyl carbinol

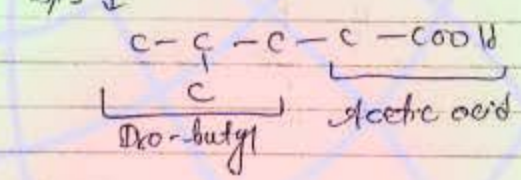
Common name → C/N → 2-butyl alcohol

Trivial nomenclature → IUPAC → Buten-2-ol

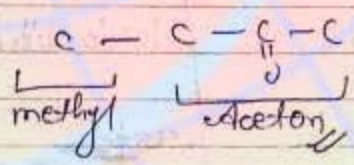
Q2:

① Iso-butyl Acetic acid

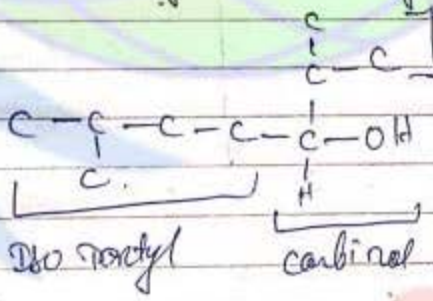
D/S I



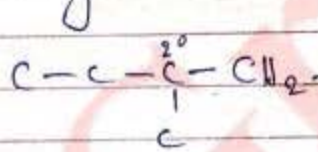
② methyl aceton



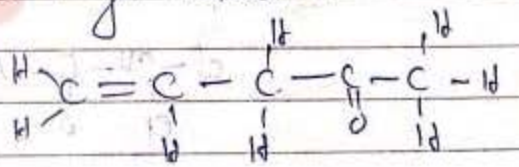
③ Iso-propyl - Iso-pentyl carbinol



④ s-butyl carbinol



⑤ vinyl aceton



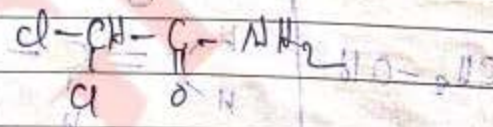
Date
Page

Note

(1) methyl Aceto Nitrile (C≡N)

	Series		
(1)	Cyanide	$-\overset{|}{C}-CN$	Aceto Nitrile
(2)	Acetamide	$-\overset{|}{C}-\underset{O}{\overset{||}{C}}-NH_2$	Acetamide

(2) di-chloro Acetamide



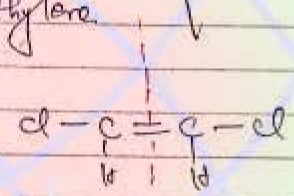
Rag

Rag ☆ Extra point :-

नोट → याद रखें → ethylene के case में symmetric and antisymmetric का case आता है ।

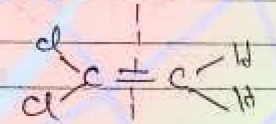
Dichloro ethylene

(a)



Symmetric - dichloro ethylene

(b)



Unsymmetric - dichloro ethylene

Own visualisation in field of Derivative name System :-

Step 1st → सबसे पहले functional group और m.v.r को पकड़े ।

Step 2nd → Right (दाहिने तरफ) side में सबसे पहले functional group का naming करें इसके बाद बाएँ तरफ m.v.r का naming करें

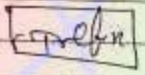
Step 3rd → इस बात का जरूर ख्याल रखें की functional group का carbon और m.v.r का carbon दोनों अलग - अलग consider किया जाएगा ।

Common-names of organic compound in which functional groups contains carbon;

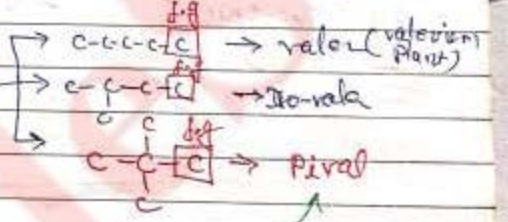
Above type of organic compounds can get common names by two systematic steps.

Step 1st ↓

Prefix will be given by total number of carbon including carbon of functional group



1 C → form
2 C → Acet
3 C → Propion
4 C → Unbranched → Butyr
Branched → Dio-butyr
5 C → Valer
6 C → Capr



Ring

Step 2nd ↓

To determine suffix of functional group

Series	functional group	Suffix
(i) Acid	-C(=O)-OH	-oic-acid
(ii) aldehyde	-C(=O)-H	~~-al dehyde~~ -alkehyde ~~aldehyde~~

(3)	Acid anhydride	$-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-$ $\left(-\overset{O}{\overset{\|}{C}}\right)_2O$	-ic acid anhydride
(4)	Ester	$-\overset{O}{\overset{\|}{C}}-O-R$ (R = alkyl / aryl)	Alkyl ... -ate
(5)	Acid amide	$-\overset{O}{\overset{\|}{C}}-NH_2$	-oic acid / -amyl amide
(6)	Acid chloride	$-\overset{O}{\overset{\|}{C}}-Cl$	-yl chloride
(7)	Cyanide	$-C\equiv N$	-Onitrile
(8)	Iso-cyanide	$-N\equiv C$	-O isonitrile

(1) $CH_3-\overset{O}{\overset{\|}{C}}-OH$ → Acetic acid ($2C$)

(2) $CH_3-\overset{O}{\overset{\|}{C}}-H$ ⇒ Acetaldehyde

(3) $CH_3-\overset{O}{\overset{\|}{C}}-Cl$ ⇒ Acetyl chloride

(4) $CH_3-\overset{O}{\overset{\|}{C}}-NH_2$ → ~~Acetyl~~ Acetamide

(5) $CH_3-\overset{O}{\overset{\|}{C}}-O-CH_3$ → ~~Propanol~~ methyl-acetate, Acetyl methanoate, Acetyl formate

(6) $(CH_3-\overset{O}{\overset{\|}{C}})_2O$ or $CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3$

Acetic ~~butyric~~ Anhydride

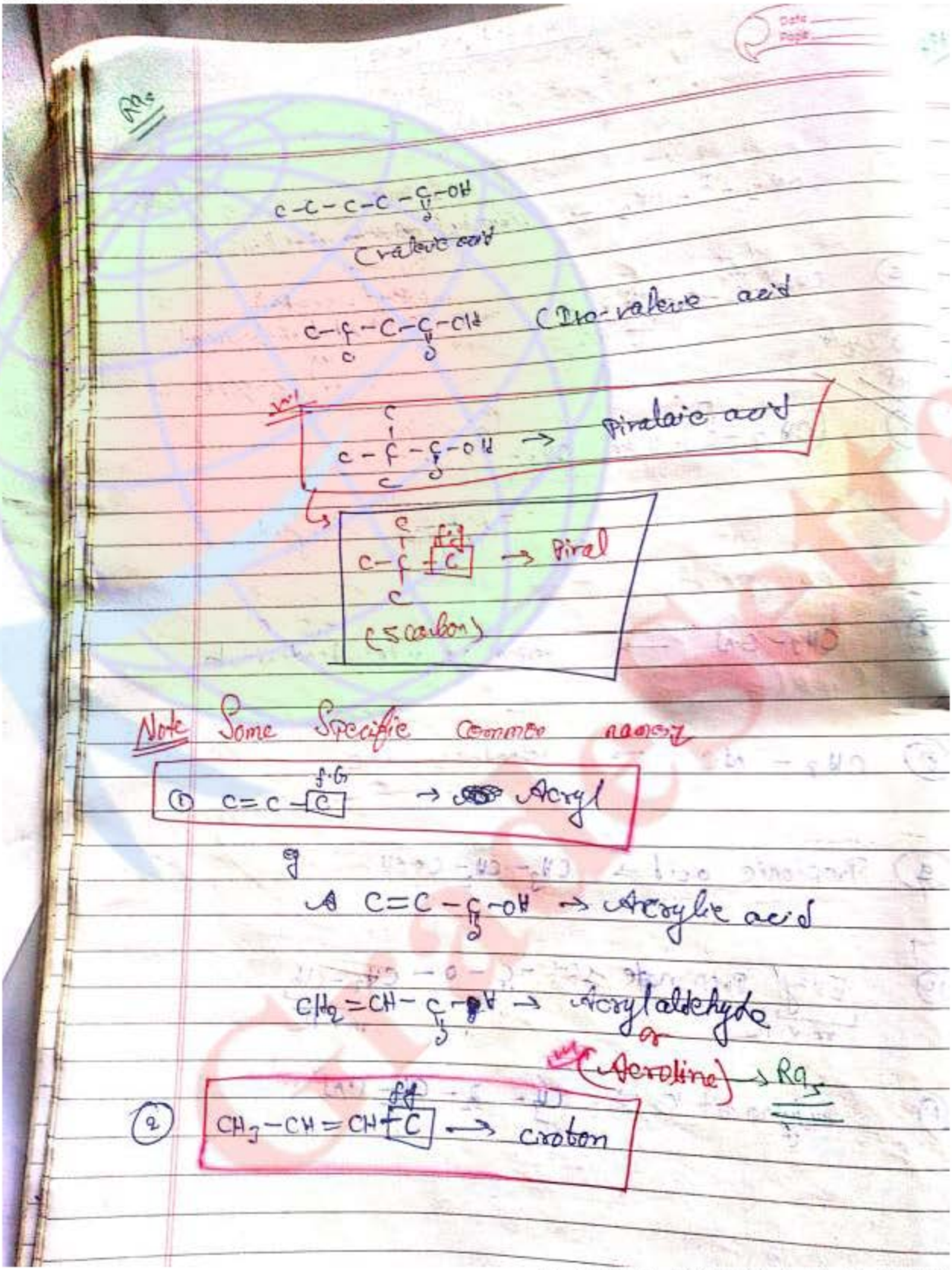
(7) CH_3-CN → ~~formal~~ Acetonitrile

(8) CH_3-NC → Acetoisonitrile.

(9) Propionic acid → CH_3-CH_2-COOH

(10) Ethyl Propionate → $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-O-CH_2-CH_3$

(11) Butyronitrile → $CH_3-CH_2-CH_2-CN$



(i) $CH_3-CH=CH-\overset{O}{\overset{\|}{C}}-OH$ → crotonic acid

(ii) $CH_3-CH=CH-\overset{O}{\overset{\|}{C}}-H$ → ~~crotonyl aldehyde~~ crotonaldehyde

(iii) $CH_3-CH=CH-\overset{O}{\overset{\|}{C}}-NH_2$ → croton amide

(iv) $CH_3-C=C-\overset{O}{\overset{\|}{C}}-O-CH_3$ → methyl crotonate

(v) $C-C=C-CN$ → Crotononitrile

(vi) $C-\overset{O}{\overset{\|}{C}}-\boxed{C}$ → Pyru

RAG

Q 2

$CH_3-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-OH$ → pyruvic acid

Q4 // Common Name of compound containing Carbon as functional group.

(1) Iso Butyr aldehyde
(2) Iso Butyronitrile
(3) Sodium formate
(4) Butyryl chloride
(5) Acrylonitrile

Sol:-

(1) $C-\underset{C}{\underset{|}{C}}-\underset{O}{\overset{||}{C}}-H$

(2) $C-\underset{C}{\underset{|}{C}}-C\equiv N$

(3) $\underset{O}{\overset{||}{C}}-O-Na$

(4) $C-C-C-\underset{O}{\overset{||}{C}}-Cl$

(5) $C=C-C\equiv N$

Note: Special point :-

(1) cyanide and Iso cyanide contains both type of common name system

eg/ CH_3-CN

$CN-(Alk)$ → Methyl cyanide

$CN-(Acyl)$ → Acetonitrile

Q4 → Methyl cyanide और Isocyanide को दो प्रकार से common name लिखा जायेगा

Ques ☆ Common Name of compound containing carbon as functional group.

① Iso Butyr aldehyde
② Iso Butyronitrile
③ Sodium formate
④ Butyryl chloride
⑤ Acrylo nitrile

Sol:

(1) $C-\underset{C}{\overset{}{C}}-\overset{O}{\overset{\|}{C}}-H$

(2) $C-\underset{C}{\overset{}{C}}-\overset{\bullet}{\underset{\bullet}{O}}-C\equiv N$

(3) $\overset{O}{\overset{\|}{C}}-O-Na$

④ $C-C-C-\overset{O}{\overset{\|}{C}}-Cl$

⑤ $C=C-\overset{\bullet}{\underset{\bullet}{O}}-C\equiv N$

Note Special point :

① cyanide and Iso cyanide contains both type of common name system

eg

CH_3-CN (methyl)

$CN-(Alk)$ → methyl cyanide

$CN-(Acyl)$ → Acetonitrile

Ques → किसी cyanide और Isocyanide को दो प्रकार से common name लिखा जाता है

g. most Polar

CH_3-NC / $CH_3-N\equiv C$

c/N ⇒ methyl Isocyanide

c/N ⇒ Acetonitrile

most Polar

Ist

(1) Propiononitrile → $C-C-CN$

(2) Propyl butylate → $C-C-C(=O)-O-C-C-C$

(3) → Do-decanoic

4/6/2018

Nomenclature of Organic compound

Raj

(*) Three type of nomenclature system occurs

(1) Trivial or common name system
(2) derivative system
(3) IUPAC system
or
Systematic system

(1) Trivial or common name system:
This type of nomenclature system is based upon origin/source of organic compound.

(i) CH_4 → Marsh gas → marsyn land ✓
or
Fire damp → Inflamable gas ✓
or
mine gas → mine Host ✓

(ii) $H-\overset{O}{\overset{\|}{C}}-OH$ → Formic acid → formica / formicus = Red Ants

(3) $CH_3-\overset{OH}{CH}-CH_3$ → Rubbing alcohol (मलहम) ⇒ It useful in lowering the body temperature in infants by rubbing on forehead.

Raj

(2) Derivative system:

IUPAC system ↓

Note → यह alphabetic letter की सहायता से बने होते

I/N [A - O, P, Q, R, S ... Z]

2° Prefix + 1° Prefix + [WR] + 1° suffix + 2° suffix

- 2° Prefix → For substituent/alkyl branch /side chains (Only applicable)
- 1° Prefix → cyclo (only for cyclic) (which contain cycle structure as a root)
- WR → शब्द (word root) (Total Number of carbons)
- 1° suffix → (Nature of bond b/w carbon-carbon (C–C))
- 2° suffix → For main functional group.

(a) word root → Total number of carbon's present in selected longest chain.

No. of carbon	Alkyl group
1C	meth
2C	eth
3C	Prop
4C	But
5C	Pent
6C	Hex
7C	Hepta

8C	oct
9C	non
10C	dec

(2) 1° Prefix → "cyclo" only applicable when parent compound contains ring structure.

(3) 1° Suffix → Nature of bond present in selected chain

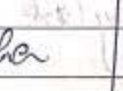
Bond	1° suffix
C–C	-ane
C=C	-ene
C≡C	-yne
2 x C=C or more	adiene
2 x C≡C or more	adiyne
C=C and C≡C both	-enyne

(4) 2° Prefix → will be used for substituents or branch chain occurs at selected parent chain.

(5) 2° Suffix → 2° suffix for principle functional group present at selected parent chain.

	Series	functional group	1° Pl (6) → As a substituent
(1)	carboxylic acid	$-\overset{O}{\overset{\|}{C}}-OH$	carboxy
(2)	sulphonic acid	$-SO_3H$	sulpho
(3)	Acid Anhydride	$-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R$	—
(4)	Acid Ester	$-O-\overset{O}{\overset{\|}{C}}-R$ $-\overset{O}{\overset{\|}{C}}-O-R$	
(5)	Acid chloride	$-\overset{O}{\overset{\|}{C}}-Cl$	chloro formyl

2° S	special suffix
-oic acid	carboxylic acid
-sulphonic acid	
-oic anhydride	
-[m.v.R]----oate	carboxylate
-oyl chloride	carbonyl chloride

(6)	Acid amide	$-\overset{O}{\overset{\|}{C}}-NH_2$	carbamoyl
(7)	cyanide or Nitrile	$-C\equiv N$	cyano
(8)	Iso-cyanide or Iso Nitrile	$-NC$	Isocyano
(9)	Aldehyde	$-\overset{O}{\overset{\|}{C}}-H$	formyl / oxo / aldo
(10)	keton	$-\overset{O}{\overset{\|}{C}}-$	oxo / keto
(11)	Alcohol	$-OH$	hydroxy
(12)	Thio alcohol	$-SH$	mercapto
(13)	Amine	$-NH_2$ / $-NH-$ / $-N<$	amino
(14)	Ether	$-O-R$	Alkoxy
(15)	cyclic ether		Epoxy (up) → for oxygen
(16)	Nitro	$-NO_2$ or $-N\overset{O}{\underset{O}{}}$	Nitro
(19)	Nitroso	$-N=O$	Nitroso
(18)	Halide	$-X$ ($-Cl$ / $-Br$ / $-I$ / $-F$)	halo

Amide	Carboxamide
– nitrile	Carbonitrile
– Diazonitrile / carbyl amine	
– al	Carbaldehyde
– one	
– ol	
– thiol	
– amine	

Rules of IUPAC naming system :-

Rule 1st - selection of longest Parent chain in which —

- maximum number of carbons
- maximum number of functional groups
- maximum number of multiple bonds
- maximum number of substituents.

But

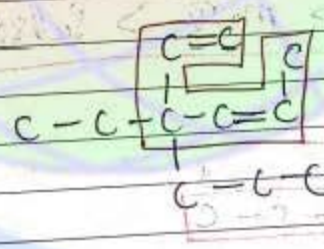
According to Priority order

F.G > M.B > Substituent

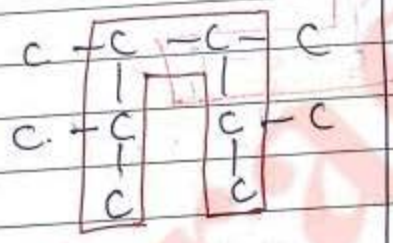
↳ functional group ↳ multiple bond ↳ substituent की सबसे कम Priority होती है

Note :
Always ~~*~~ tick take two Priorities
selection of chain on the basis of maximum
number of ticks

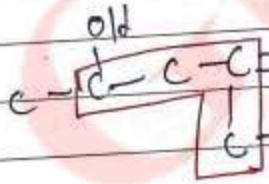
eg ①



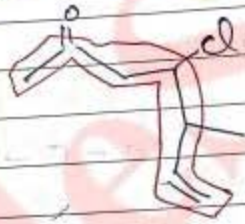
②



③



④



* Important point
In cyclo compound Alt Rule is not applicable

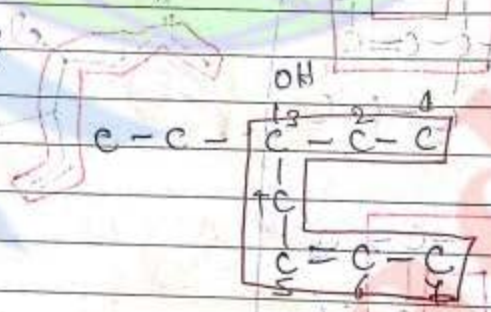
eg

Rule 2nd ⇒ Numbering Rule

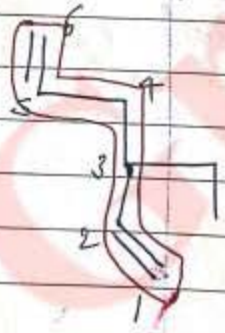
Numbering always minimum from any terminal of selected chain
but according to Priority order

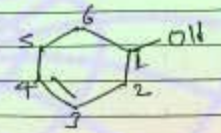
F.Gr > M.B. > Substituent

eg



eg 2

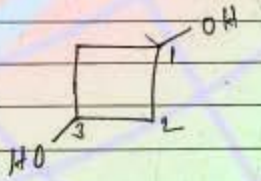


(3) 

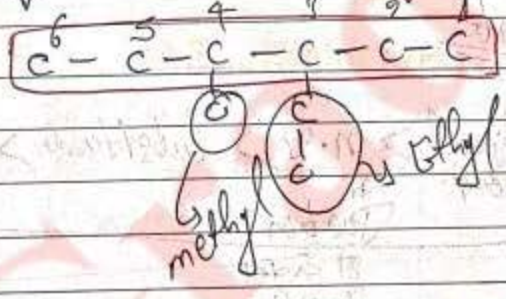
Sub Rules :-

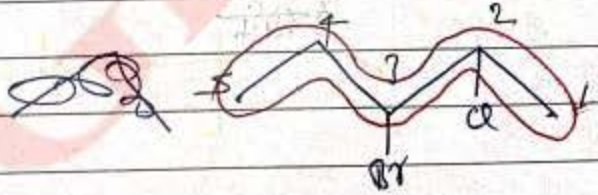
1st rule :- If same substituents occurs at same position than numbering from anywhere

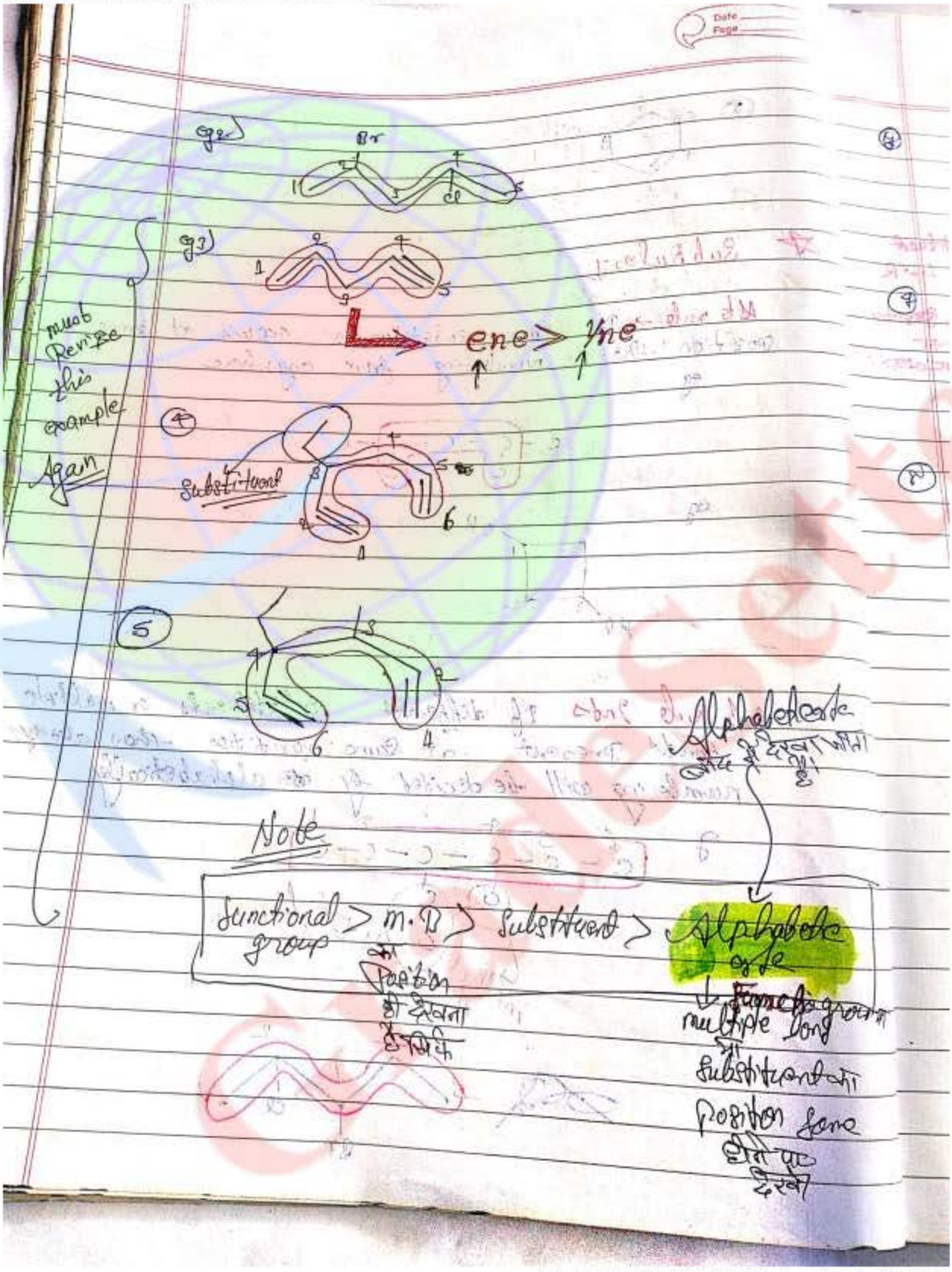
eg 

eg 

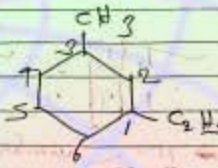
2nd Rule :- If different substituents or multiple bonds present at same position than always numbering will be decided by alphabetically

eg 

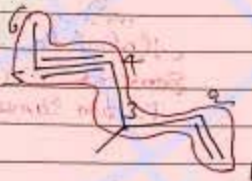
eg 



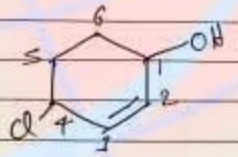
(P)



(q)



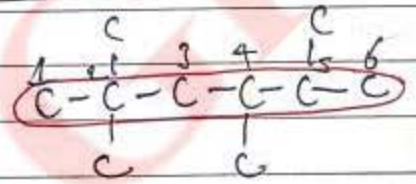
(R)



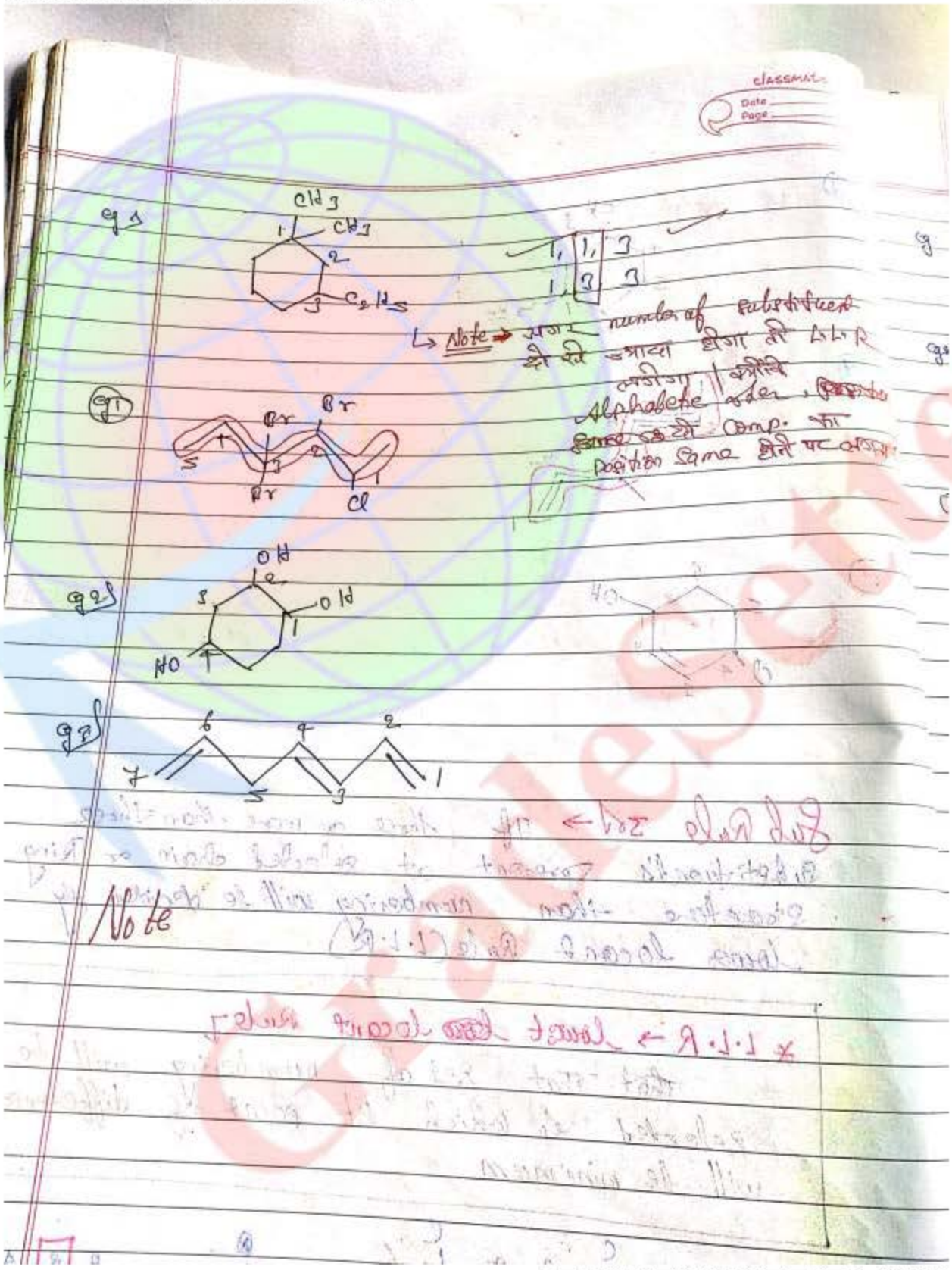
Sub Rule 3 → If three or more than three substituents present at selected chain or Ring structure then numbering will be started by lowest locant Rule (L.L.R)

* L.L.R → lowest locant Rule
That set of numbering will be selected in which 1st point of difference will be minimum

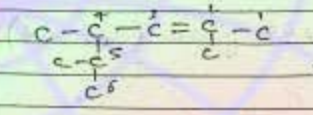
q →

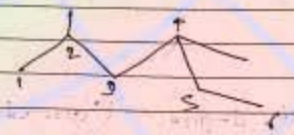


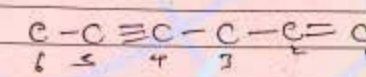
L to R → 2, 4, 4, 5 ✓
R to L → 2, 3, 5, 5 (X)
↳ 1st point of difference.

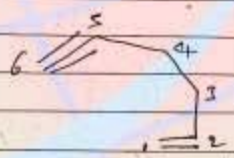


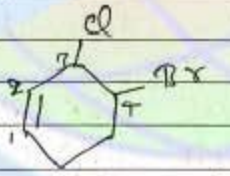
Iupac naming of Hydrocarbon: I

(2)  → 2,4,5 trimethyl Hex-2-ene

(3)  → 2,4 dimeth Heptane

(3)  Hex-1-en-4-yne

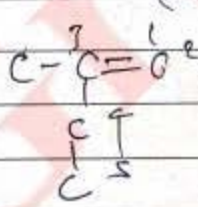
(4)  Hex-1-en-5-yne

(5)  4-Bromo 3-chloro ~~Hexa~~ cyclo hex-1-en

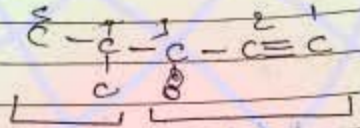
Wrong to Right Structural formation/ IUPAC name formation.

Q1.

2-ethyl-3-methyl Prop-2-ene (wrong name)

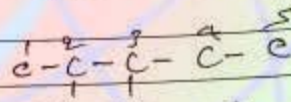
 → 3-methyl Pent-2-en (correct name)

(2.) ~~2-Dio prop~~ 1- Dio prop prop-2-yne (Incorrect)



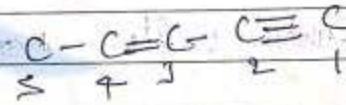
3 4-methyl Pent-1-yne (correct)

(3) 2, 3, dimethyl Pentane



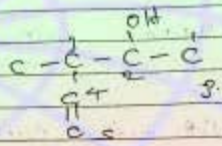
2, 3, dimethyl Pentane

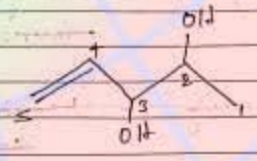
(4) Pent-2-en-4-yne (Incorrect)

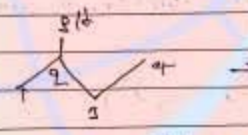


Pent-3-ene-1-yne (correct)

Reg — Alcohol / thio alcohol / and Amines

Qn)  3-methyl Pent-4-en-2-ol

Qn)  → Pent-4-ene-2,3 diol

Qn)  → Buten-2-thial

Qn)  → 4-methyl Pent-1-en-3-amine

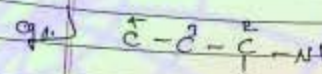
Note — Old IUPAC Naming of amines

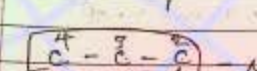
Reg — According to old naming system amine functional group treated as a substituent

New I/N → Buten-2-amine (2°S)

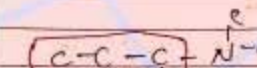
old I/N → 2-Amino Butene (2° P)

Comparative study of primary, secondary and tertiary amines:-

(1)  → Butan-2-amine

(2)  → N-methyl Butan-2-amine

N-methyl N-(2-methyl Propan) amine

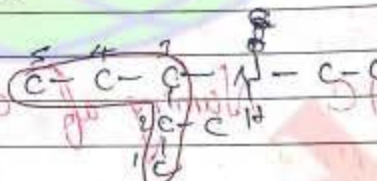
(3)  →

~~N-ethyl N-methyl N-(1-methyl Propan) amine.~~

N-ethyl N-methyl Butan-2-amine.

Note सबसे बड़ी longest chain लेंगे।

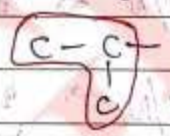
(4) N-Propyl-2-methyl Pentan-3-amine (~~Incorrect~~)



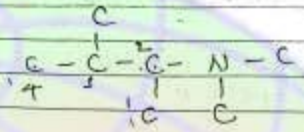
~~N-Propyl-N-methyl~~

~~N-methyl-N-Propyl Pentan-3-amine (Correct)~~

(5) N,N-Di methyl Propan-2-amine



Exam point



I/N (neo) → N-N dimethyl ~~Butan~~ 3-methyl Buton-2-amine

~~I/N (neo) → 3-methyl N-N dimethyl Buton-2-amine~~

I/N (neo) → 3, N, N-trimethyl Buton-2-amine.

~~I/N (old) → 2-amine N-N dimethyl 3-methyl Buton~~

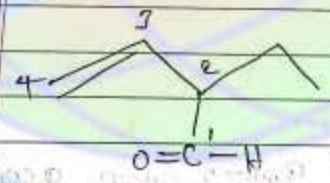
2-(Dimethyl amine)-3-methyl Buton

or

2-(N-N dimethyl amine)-3-methyl Buton

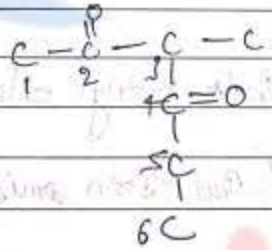
☆ Aldehyde/ketone

(1)



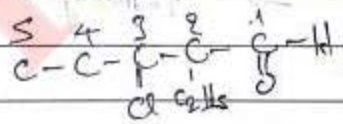
2-ethyl Butanal ~~3-one~~

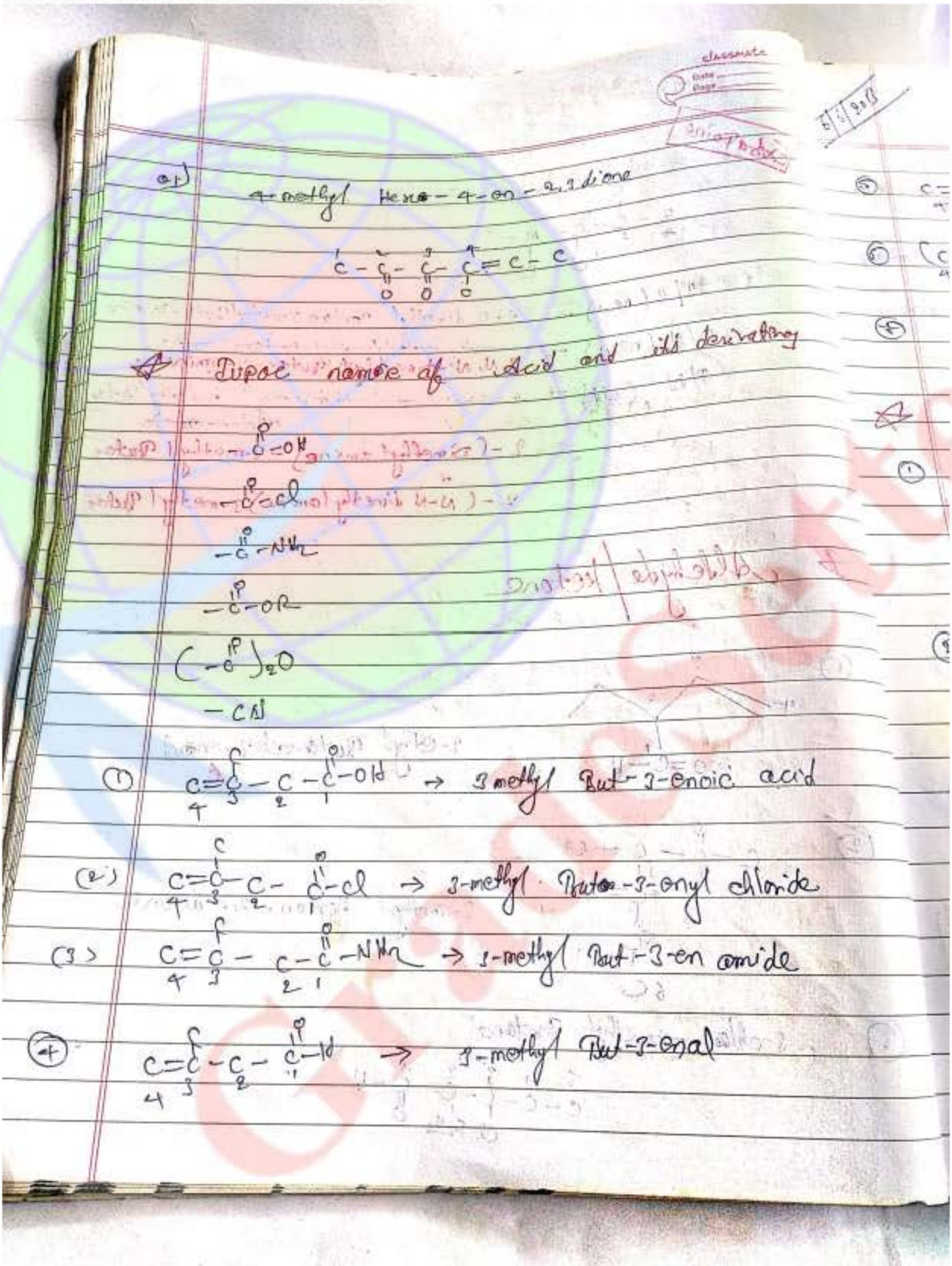
(2)



3-methyl Hexan-2,4-dione

(3) 3-chloro-2-ethyl Pentanal





a) 4-methyl Hexa-4-en-2,3-dione

Dupoc names of Acid and its derivatives

- $-C(=O)-OH$
- $-C(=O)-Cl$
- $-C(=O)-NH_2$
- $-C(=O)-OR$
- $(-C(=O)-)_2O$
- $-CN$

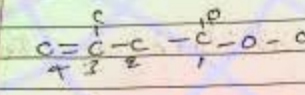
(1) $C=C(C)-C-C(=O)-OH$ → 3-methyl But-3-enoic acid

(2) $C=C(C)-C-C(=O)-Cl$ → 3-methyl But-3-enyl chloride

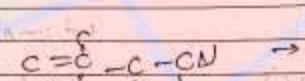
(3) $C=C(C)-C-C(=O)-NH_2$ → 3-methyl But-3-en amide

(4) $C=C(C)-C-C(=O)-H$ → 3-methyl But-3-enal

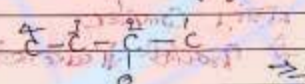
6/6/2018

(5)  → ethyl 3-methyl but-2-enoate

(6)  → 3-methyl but-3-enoic ethanoic anhydride

(7)  → 3-methyl but-3-en nitrile

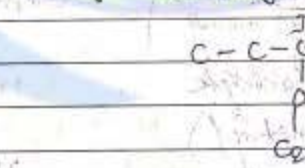
Dupe naming of ethers

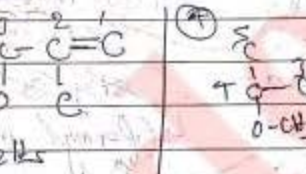
(1) 

→ 2-methoxy but-1-ene

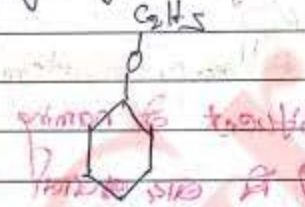
→ 2-methoxy butene

(2) 3-ethoxy 2-methyl pent-1-ene

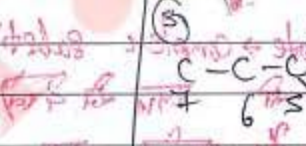


(4) 

(3) Ethoxy cyclohexene



2 ethoxy 4 methoxy Pentane

(5) 

2-Bromo 3,5 epoxy Heptane

Rao// Ra11

Complex substituent (or substituent on substituent)

Substance	IUPAC	Complex or not compl.
(1) $-CH_3$	methyl	not complex
(2) $-CH_2Cl$	(chloro methyl)	complex

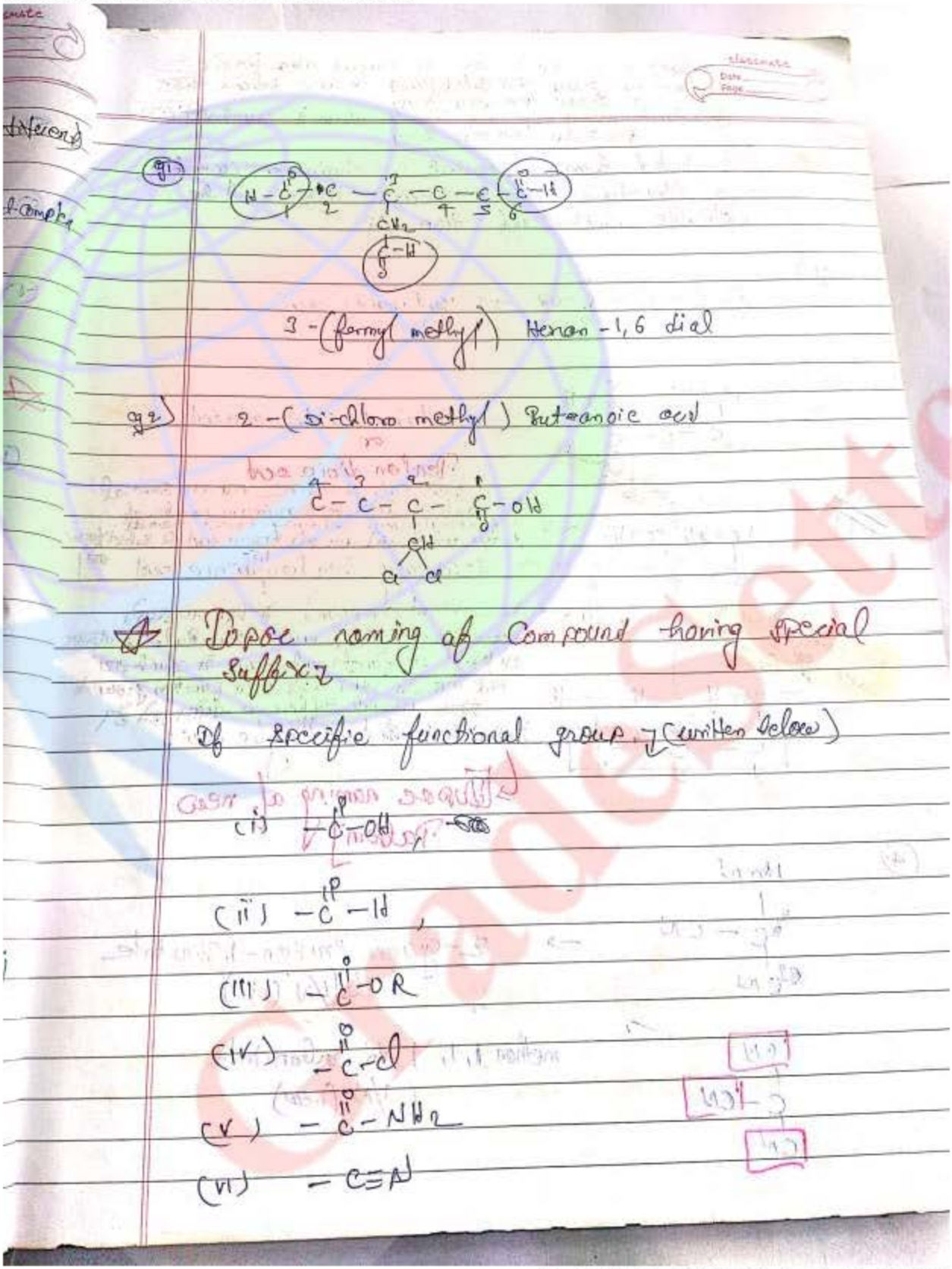
Note → ऐसे ही सीधा bracket में कर देते अर्थात complex substituent को bracket में लिखते है।

Substance	IUPAC	Complex or not compl.
(3) $-CHCl_2$	(dichloro methyl)	complex
(4) $-CH_2-NH_2$	(amino methyl)	complex
(5) $-NH-CH_3$	(methyl amino)	complex
(6) $-CH_2-CHO$	(formyl methyl)	"
(7) $-CH_2-COOH$	(carboxy methyl)	"

Ra11

↓ इसमें कार्बन की carbon-atom count हुआ है

Note → complex substituent की naming के pattern को ध्यान से देखो कि बाद वाला पहले आ रहा है अर्थात जो longest chain या parent chain में count



Q1)

3-(formyl methyl) Hexan-1,6 dial

Q2) 2-(di-chloro methyl) Butanoic acid

Proper naming of Compound having special suffixes

Of specific functional group (written below)

(i) $-\overset{O}{\overset{\|}{C}}-OH$

(ii) $-\overset{O}{\overset{\|}{C}}-H$

(iii) $-\overset{O}{\overset{\|}{C}}-OR$

(iv) $-\overset{O}{\overset{\|}{C}}-Cl$

(v) $-\overset{O}{\overset{\|}{C}}-NH_2$

(vi) $-C\equiv N$

Note:

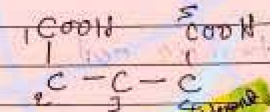
Given below page की पहली से वाक्य को concept clear करेंगे (Reference) (below पढ़ो)
① functional group जब substituent की तरह count नहीं होगा तब उसका क्या नाम होगा
② functional group जब parent chain में count होगा तब उसका क्या नाम होगा

excluded from parent chain or parent ring structure then special suffix will be applicable instead of ~~too~~ 2°S

eg.)

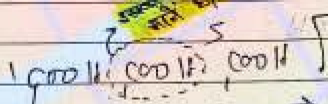
$\overset{4}{C}-\overset{3}{C}-\overset{2}{C}-\overset{1}{C}(=O)-OH$ → Butanoic acid

②



→ Pentan 1, 5 di oic acid
or
Pentan di oic acid

Imp. ③

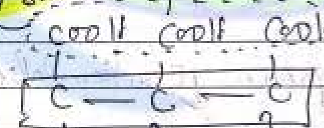


substituent माने है

→ इसमें Rule के अनुसार तथा General Rule — maximum number of functional group containing Parent chain को substituent ...

→ 3-Carboxy Pentan 1,5 di oic acid

parent chain में count नहीं हो रहे हैं

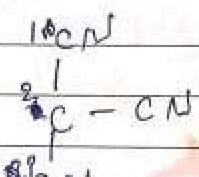


→ Note → अगर किसी compound में तीन या अधिक functional group हों तो New Rule के अनुसार हम किसी भी functional group को count नहीं करते तथा हम इसके बदले इन function group के लिए special suffix का प्रयोग करते हैं।

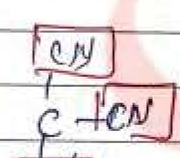
→ Propane 2, 3 tri carboxylic acid

↳ [IUPAC naming of new Pattern]

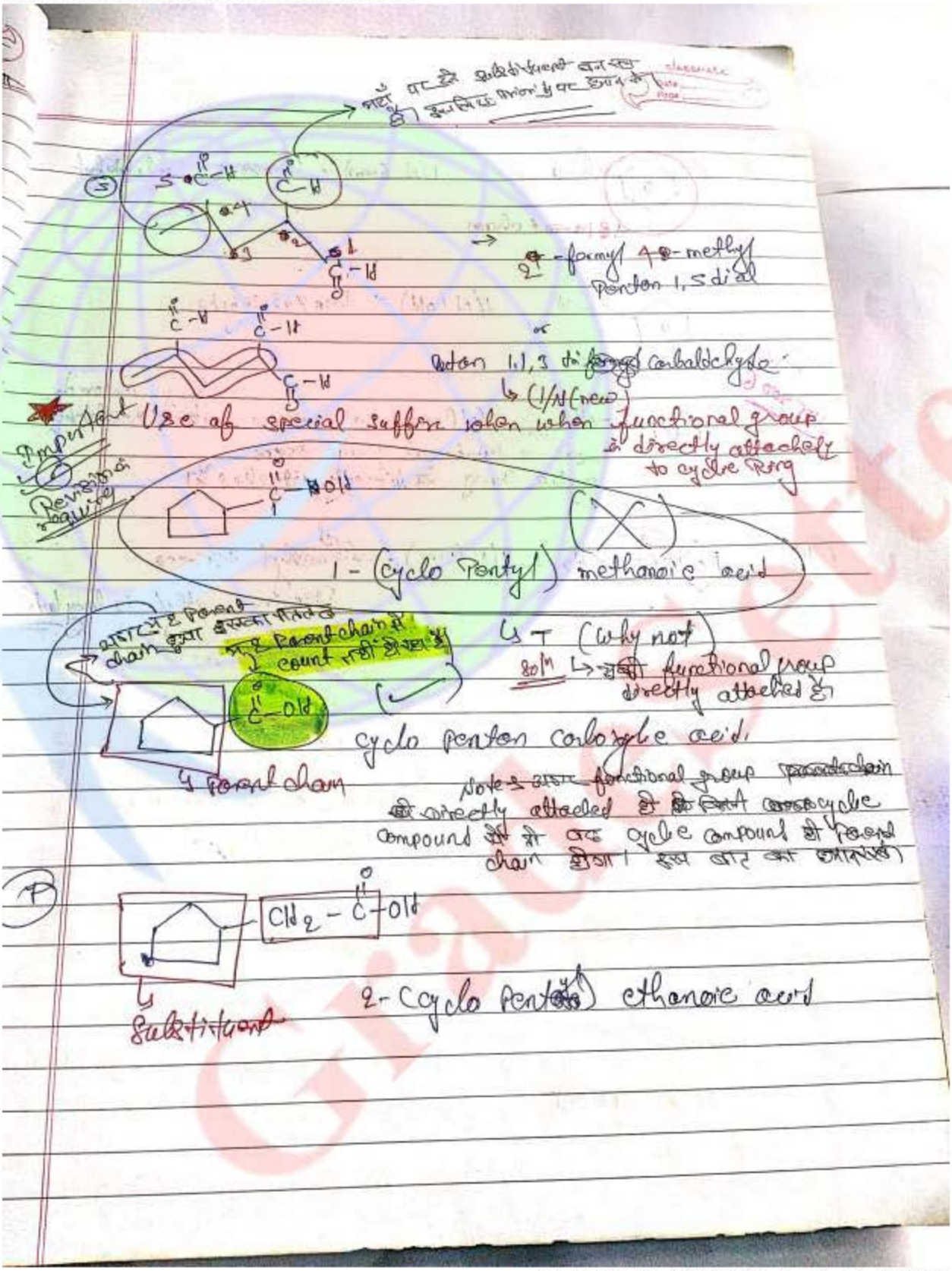
④



→ 2-cyano Propan-1,3 dinitrile
↳ [I/N (old)]

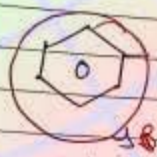


methane 1, 1, 1 tri carbonitrile
(I/N (new))



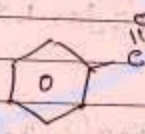
Roll) Roll

Roll 8



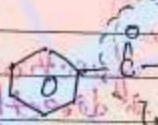
I/N (new) → Benzene Carbaldehyde

Parent chain



I/N (old) → Benzaldehyde

Roll 9 Free



I/N (new) → Benzene carbonyl chloride

functional group

cyclic Ring directly attached

(10)

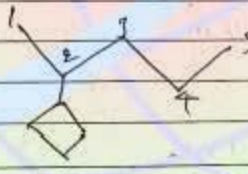
I/N (new) → Benzene methyl carboxylate

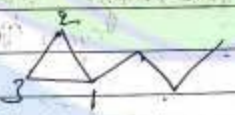
L-1 (Discussion) + Learn list of Prefixes

IUPAC naming of Alicyclic hydrocarbon

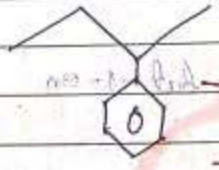
Parent will be decided by maximum number of carbon either in chain or cycle. but in case of similar number of carbon parent will be always cycle.

eg 1)  → (1-methyl) cyclo propan

eg 2)  → 2-(cyclo but) Pentane

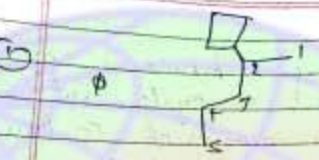
eg 3)  → 1-(2-Propyl) cyclo propan.

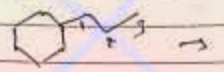
For example

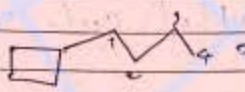
(1)  This is always substituent

2-Benzyl Butan

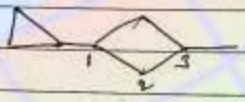
2-Phenyl Butan

(9)  2-cyclo butyl Pentane.

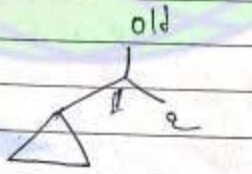
(10)  → Propyl cyclo Hexane

(11)  Butyl cyclo Buten.

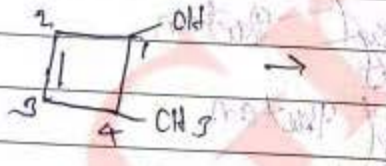
(12) 

 → 1-cyclo Propyl 2-methyl cyclo Buten

Comp containing functional group :-

(1)  1 cyclo Propyl ethanol

(2)  → 2-methyl cyclo-but-1-en

(3)  → 4-methyl cyclo but-2-en-1-ol

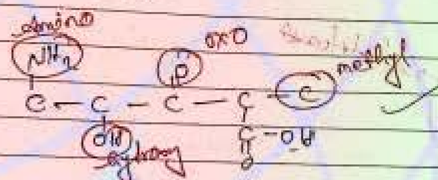
7/6/2017

IUPAC naming of multiple functional group Compounds:-

If any cyclic or non-cyclic compound contains two or more than two different functional group then rule 1, 2, 3 only applicable for high priority principle functional group.

Other remaining functional group treated as a substituent (2°P)

(1)



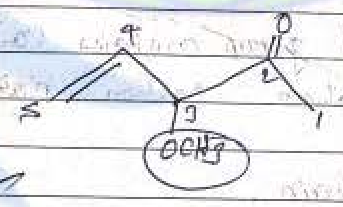
Priority → –C(=O)–OH > –C(=O)– > –OH > –NH2

2°P — Substituent (2°P) According to Alphabetic order.

जो अलग-अलग function group होते हैं तो Priority के आधार पर Parent मान कर बाकी को Substituent मानते हैं।

5-Amino-4-hydroxy-2-methyl-3-oxo pentan oic Acid
(2°P) (W.R) (2°S)

(2)

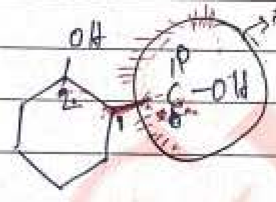


~~methyl ether~~

3-methoxy pent-4-en-2-one

Important

(3)

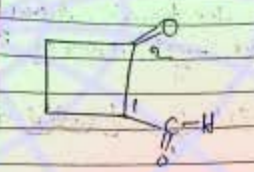


→ यह Parent chain में count नहीं होता है (क्योंकि यह cycle Ring से directly जुड़ा है)

~~1-carboxy 2-hydroxy cyclo hexane~~

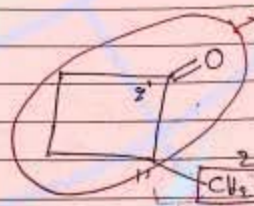
2-hydroxy cyclohexane carboxylic acid

(4)



2-oxo cyclo-butan carbaldehyde

(5)

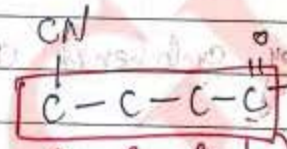


2-(2'-oxo cyclo butyl) ethanal

Note

Of substituent functional group contains carbon (–CN, –C–OH, –C–NH₂ etc) then carbon not included for in parent chain.

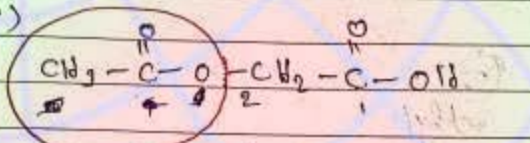
eg



4-cyano butanoic acid

Two special name

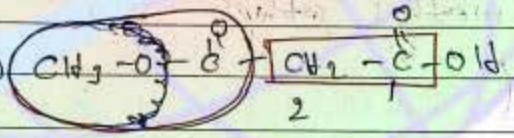
(1)



Ethanoyl oxy

2 ethanoyl oxy ethanoic acid

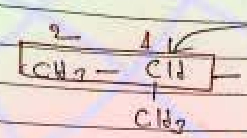
(1)



2 methoxy carbonyl ethanoic acid

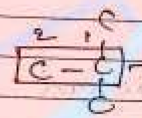
Iupac naming of m.v.R

Iupac में सबसे ... (1) ही मानना है v.v. I Refer

① 

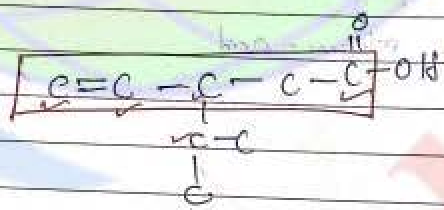
I/N → Iso-Propyl

I/N → 1-methyl ethyl

② 

I/N → 1, 1, di methyl ethyl

I/N → T-butyl

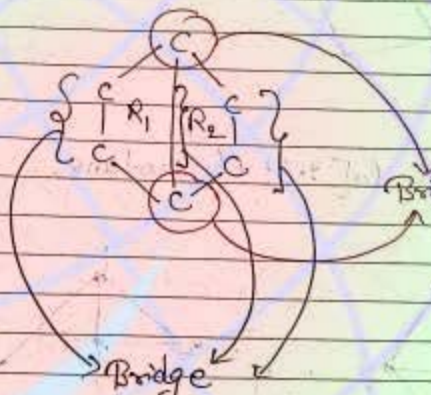
③ 

I/N → 3-(1-methyl ethyl) Pent-4-enoic acid

I/N → 3-(Iso-Propyl) Pent-4-enoic acid

Bicyclo compounds

Organic compounds in which fusion of two rings occurs

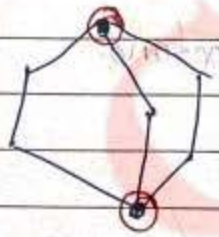


(minimum 3 bridge is must)

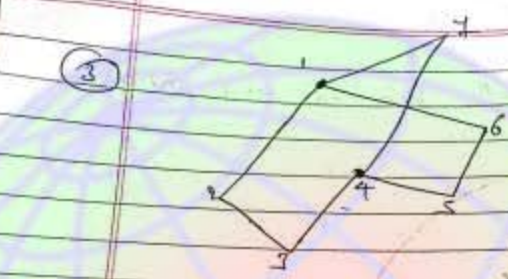
Bicyclo Identified by :-

(1) BHA → Two carbons which are said to be bridge head atoms connected to each other by 3-carbon chains.

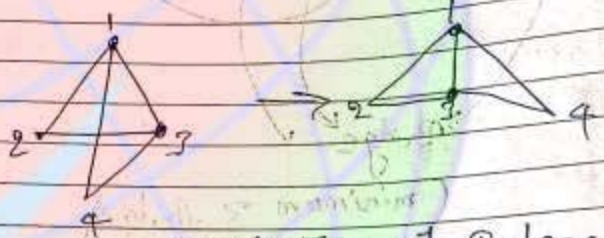
(2) Bridge → carbon chain said to be bridge present b/w two B.H.A



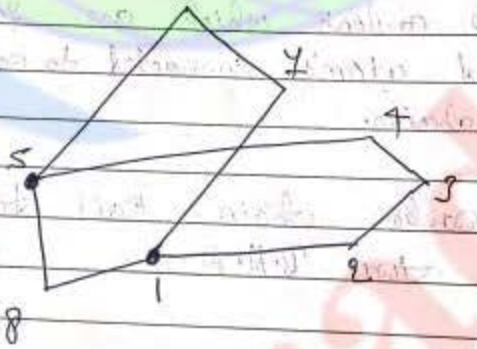
I/N → Bicyclo [2.2.1] heptane
(Prefix)



Bicyclo [2.2.1] Heptane.



Bicyclo [1.1.0] Butane.

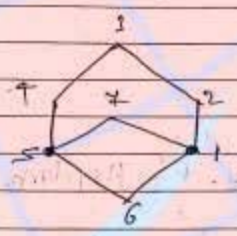


Bicyclo [3.2.1] octane.

(A)

Bicyclo [2.2.1] Heptane.

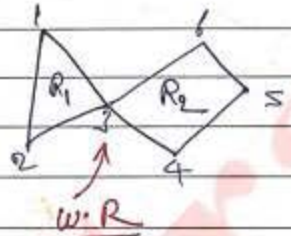
(B)



Bicyclo [2.2.2] Heptane.

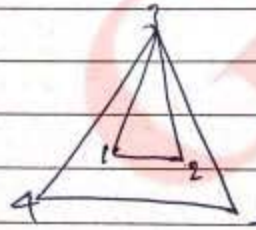
☆ Spiro Compound :-

Organic cyclic compounds in which two rings are joined to each other at 4°C (spiro carbon) known as spiro compounds.



W.R

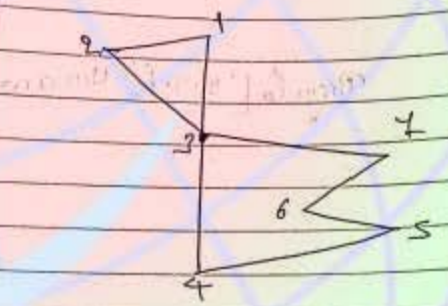
Spiro [2.3] Hexane.



Spiro [2.2] Pentane.

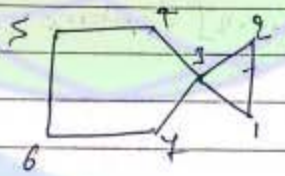
L-1, L-2 → discussion.

(3)



Spiro [2.4] Heptane

(4)



Spiro [2.4] Heptane

Date
Page

Please attention these point !

① mvr का प्रयोग common और Derivative name दोनो में होता हैं। यह point application of Derivative से पढ़े।

Isomerism

Degree of Unsaturation / Hydrogen deficiency Index

Shortcut

M.F	D.U
1.) C_xH_y	$D.U = x + 1 - \frac{y}{2}$
2.) $C_xH_yO_z$	$D.U = x + 1 - \frac{y}{2}$
(3.) $C_xH_yN_w$	$D.U = x - 1 - \frac{y - w}{2}$
4.) $C_xH_yX_m$ (X → halogen)	$D.U = x + 1 - \frac{y + m}{2}$

→ यह सभी उपरोक्त निकालने में O-atoms संख्या का कोई प्रभाव नहीं पड़ता है।

→ अर्थात् D.U निकालने में Nitrogen की case में Hydrogen atom की case में घटना चाहिए।

→ Note: यहाँ Halogen के case में N-atom की साथ जुड़ता है।

⇓

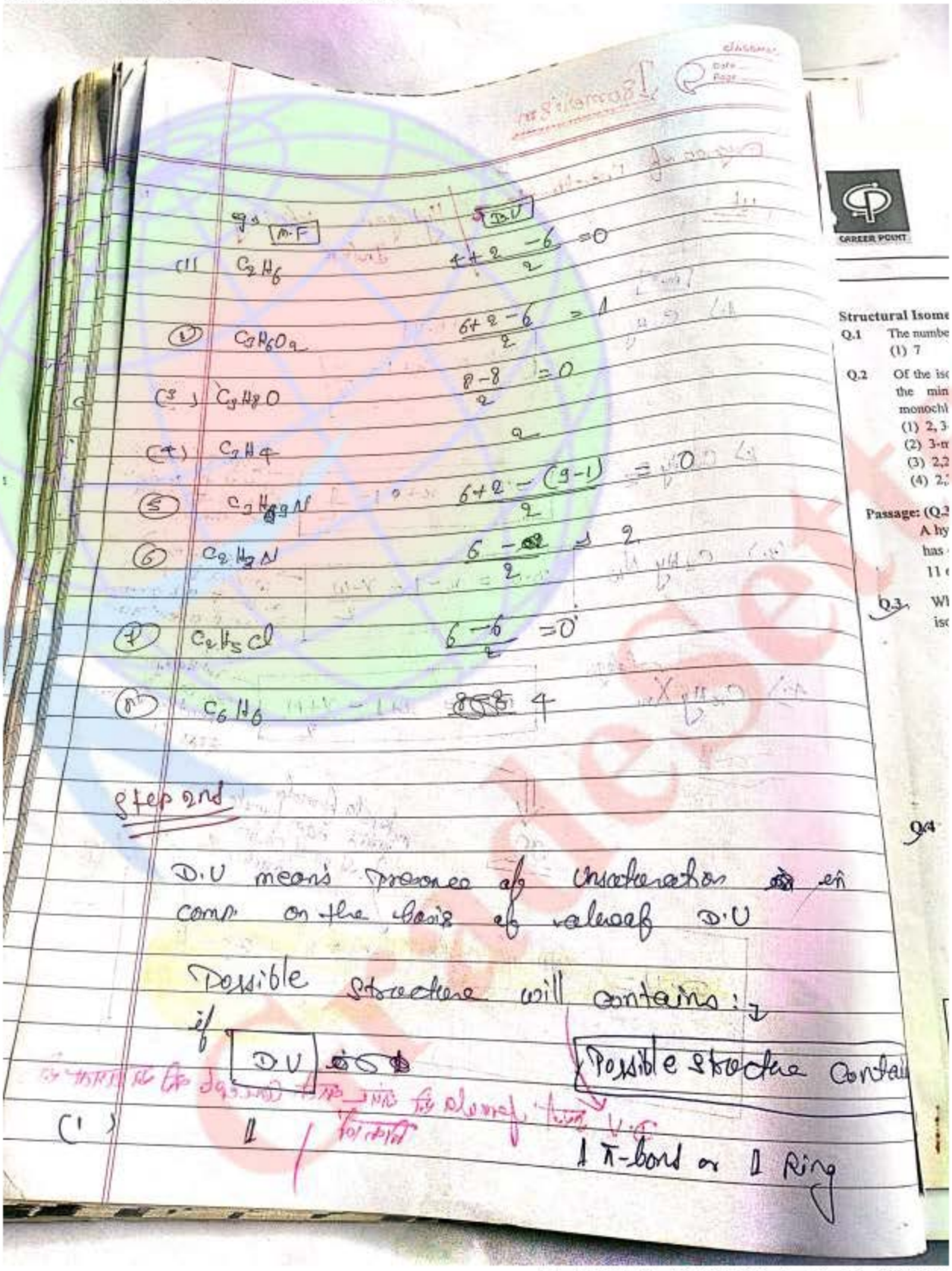
OR

$$D.U = \frac{\text{No. of Carbon (m.F)} \times 2 + 2 - H}{2}$$

molecula formula अर्थात् main formula में no. of carbon atom लेना है।

No. of Halogen atom

D.V इस formula से ऊपर वाले concept की सहायता से निकालें।



	M.F	D.U
(1)	C_2H_6	$\frac{4+2-6}{2} = 0$
(2)	$C_3H_6O_2$	$\frac{6+2-6}{2} = 1$
(3)	C_3H_8O	$\frac{8-8}{2} = 0$
(4)	C_2H_4	$\frac{4+2-4}{2} = 1$
(5)	C_3H_9N	$\frac{6+2-(9-1)}{2} = 0$
(6)	C_2H_7N	$\frac{6-8}{2} = 2$
(7)	C_2H_5Cl	$\frac{6-6}{2} = 0$
(8)	C_6H_6	$\frac{12-6+2}{2} = 4$

Step 2nd

D.U means presence of unsaturation in comp. on the basis of value of D.U

Possible structure will contains :-

if D.U = 1 → Possible structure contain 1 π-bond or 1 Ring

(1)

Structural Isome
Q.1 The numbe
(1) 7
Q.2 Of the iso
the min
monochl
(1) 2, 3
(2) 3-m
(3) 2,2
(4) 2,
Passage: (Q.2
A hy
has
11
Q.3 Wh
iso
Q.4

पहले वहले D.U निकाले

eg. C_2H_6 D.U ⇒ 0 → C–C

(2) 2 2π-bond or 2 Ring or 1π-1 Ring

eg C_2H_4O → 1 → CH_2-CH_2 (O) or $CH_2=CH-OH$

or

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

3 3π or 3 Ring or 2π+1 Ring or 1π+2 Ring

Solved Question

Quest C_3H_4 Represents

D.U $= \frac{8-4}{2} \Rightarrow 2$

(a) $CH_3-C\equiv CH$ $\Rightarrow$ D.U = 2

(b) $CH_2=C=CH_2$ $\Rightarrow$ D.U = 2

(c) $CH_2-CH-CH_2$ (CH above the middle C)

(d) $C\equiv C$ (CH$_2$ above one C)

$\Rightarrow$ D.U $\Rightarrow$ 2

Q) C_4H_6 D.U

(a)

(b)

(c)

(d)

Isomerism

→ Isos → Same
→ meros → Parts

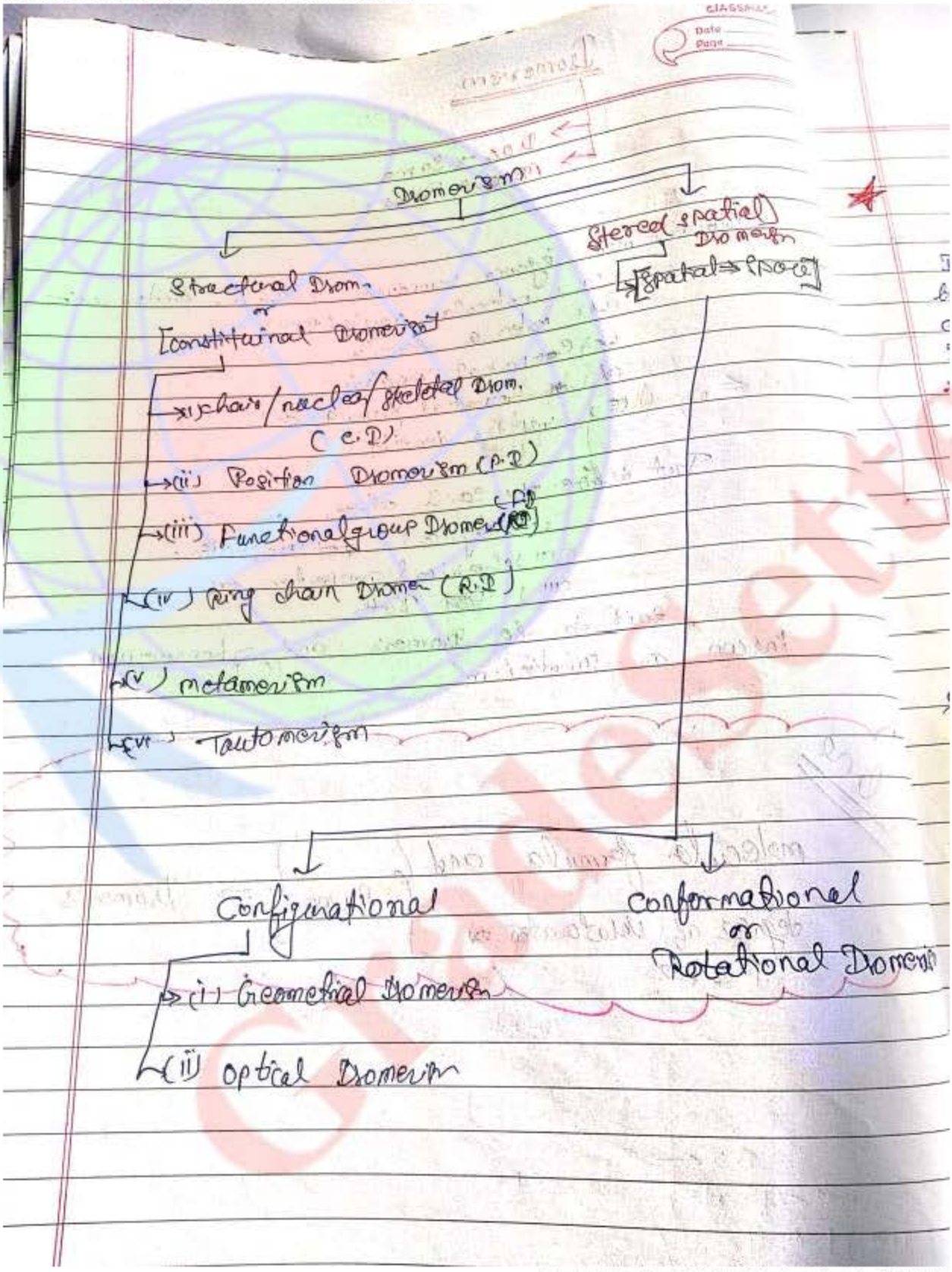
Two or more organic compounds which are similar in
(a) molecular weight (m.w)
(b) molecular formula
(c) empirical weight
(d) empirical formula and
(e) vapour density

But differ to each other in
(i) physical properties,
(ii) chemical properties or
(iii) Both

said to be Isomers and phenomenon known as Isomerism

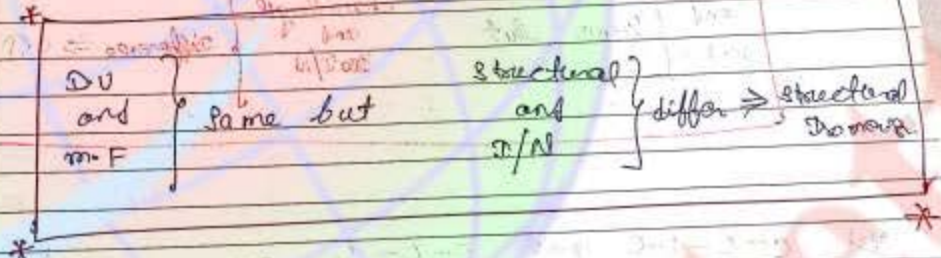
Outline

molecular formula and degree of unsaturation } same } ⇒ Isomers



Structural Isomerism

Isomers which are equal in D.U and m.F but differ to each other in structure or connectivity of atom's said to be Structural Isomers



Q) $CH_3-CH_2-CH_2-CH_3$ and $CH_3-CH(CH_3)-CH_3$ is

(a) G.I (b) optical (c) St. Isom (d) None of the

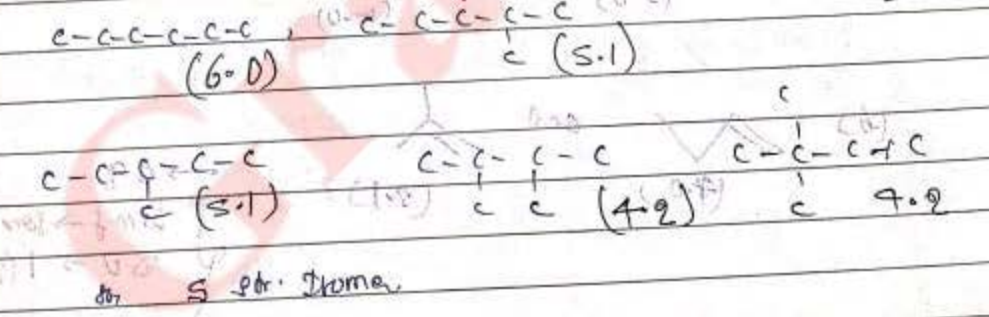
Sol (c)

Q) C_6H_{14} St. Isomers ?

Note → Alk first D.U = 0

4 → 2
5 → 3
6 → 5

Sol



So 5 St. Isomers

(1) Chain Isomerism:

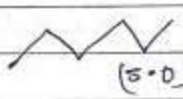
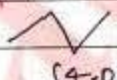
Two or more Ph Dom. which are diff. to each other in parent chain length said to be chain Isom.

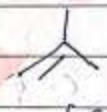
B.P and M.P } same but chain length and D/N } difference ⇒ C.I

eg. C-C-C-C and C-C-C (4-0) (3-1)
C

(i) C.I
(ii) P.I
(iii) G.I
(iv) O.I

eg. Pair of C.I is

(a)  (5-0) and  (4-0) → Not Isom

(b)  (4-0) and  (3-1)

→ C.I
{ Ism.f → Same
BP → 1 (Same) }

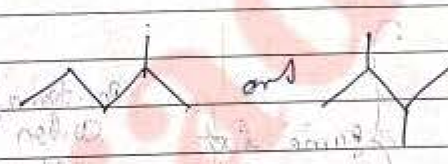
(c)  → C.I
(6.0) (5.1) [D.U + f (m.f + same)]

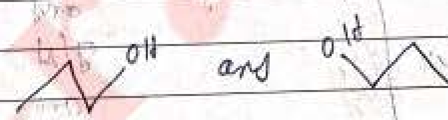
(d)  → Not Isome

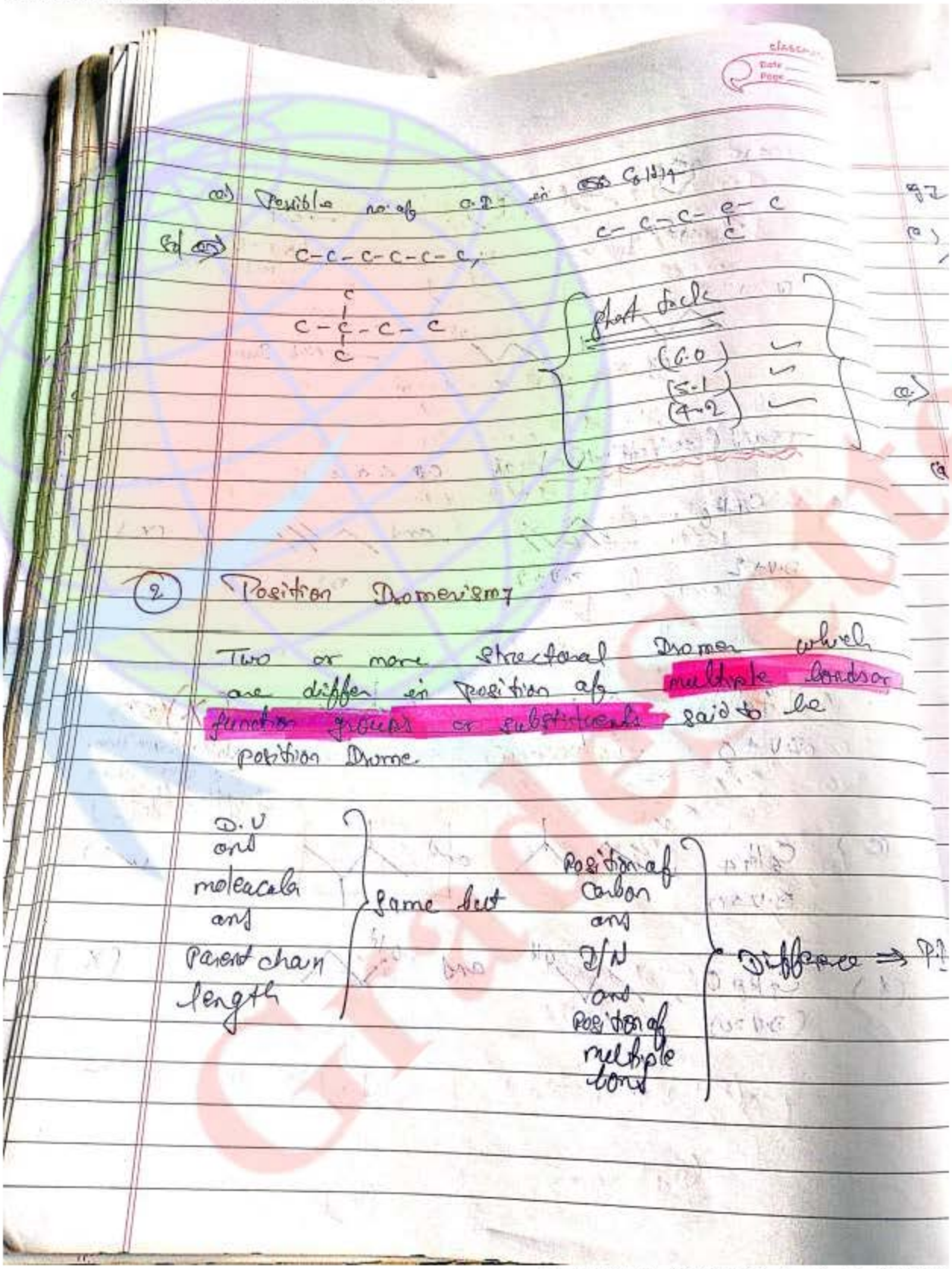
Q. Traid (set of three) of CI is are

(a) C_4H_6,  (X)
D.U → 2 D.U → 2 D.2

(b) C_6H_{14},  (X)
DU → 0
Note → chain Isom. होने के लिए chain length diff होना चाहिए

(c) C_6H_{14},  (✓)
D.U → 0

(d) C_3H_8O,  (X)
(D.U → 0)



(a) Possible no. of o.I. in C_6H_{14}

(b) C-C-C-C-C-C

C-C(C)-C-C

C-C-C(C)-C-C

Chain Isomers

(C-C-C-C-C-C)

(C-C(C)-C-C)

(C-C-C(C)-C)

(2) Position Isomerism

Two or more structural Isomers which are differ in position of multiple bonds or functional groups or substituents said to be position Isomers.

D.U and molecular and parent chain length } same but

Position of carbon and F/N and position of multiple bond } Difference ⇒ P.I

Q7

(a)  and  are P.I

Butan-2-ol (Butan-1-ol)

Q. Pair of P.I is/are

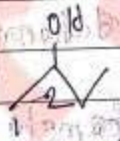
(a)  and  → Not Prone

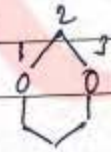
(b)  and  → Not Prone.

(c)  and  → Not P.I

(d)  and  → P.I

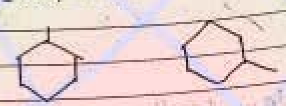
(e)  and  → P.I

(f)  and  → Not P.I

Ans (g)  and  → P.I

Note ① mono substituted cyclic or aromatic compounds does not exhibit P.I.

eg



→ Not show P.I

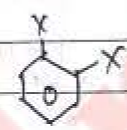
② P.I always similar in
- (i) chain length ✓
- (ii) Ring length ✓
- (iii) Series ✓
  - ↳ means alcohol है तो alcohol ही होना चाहिए। यानी family भी same होना चाहिए

★ Position Isomerism in Di-substituted aromatic compounds

Note ⇒ ortho, meta, para respective name है उनके स्थान पर अर्थात X respect से define है

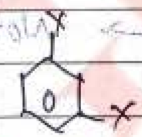
eg → $C_6H_4X_2$

(i)



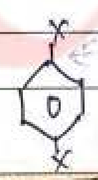
ortho (1,2)
↳ adjacent

(ii)



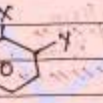
meta (1,3)

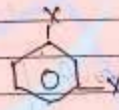
(iii)



Para (1,4)

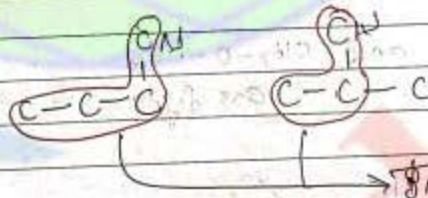
Q C_6H_4XY

(i)  — ortho

(ii)  — meta

(iii)  — ~~meta~~ para

Note



→ These two are Chain Isomers

(11) ☆ Functional group Isomers

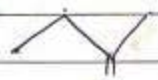
Two or more structural Isomers is said to be f.g.I if differ to each other in functional group structure or belongs from diff-diff families series.

D.U and m.f same but diff functional group or series family or D/N } different ⇒ f.g.I

eg) CH_3-CH_2-O-H and CH_3-O-CH_3 are f.g.I

Q) Select pair of f.g.I

(1)



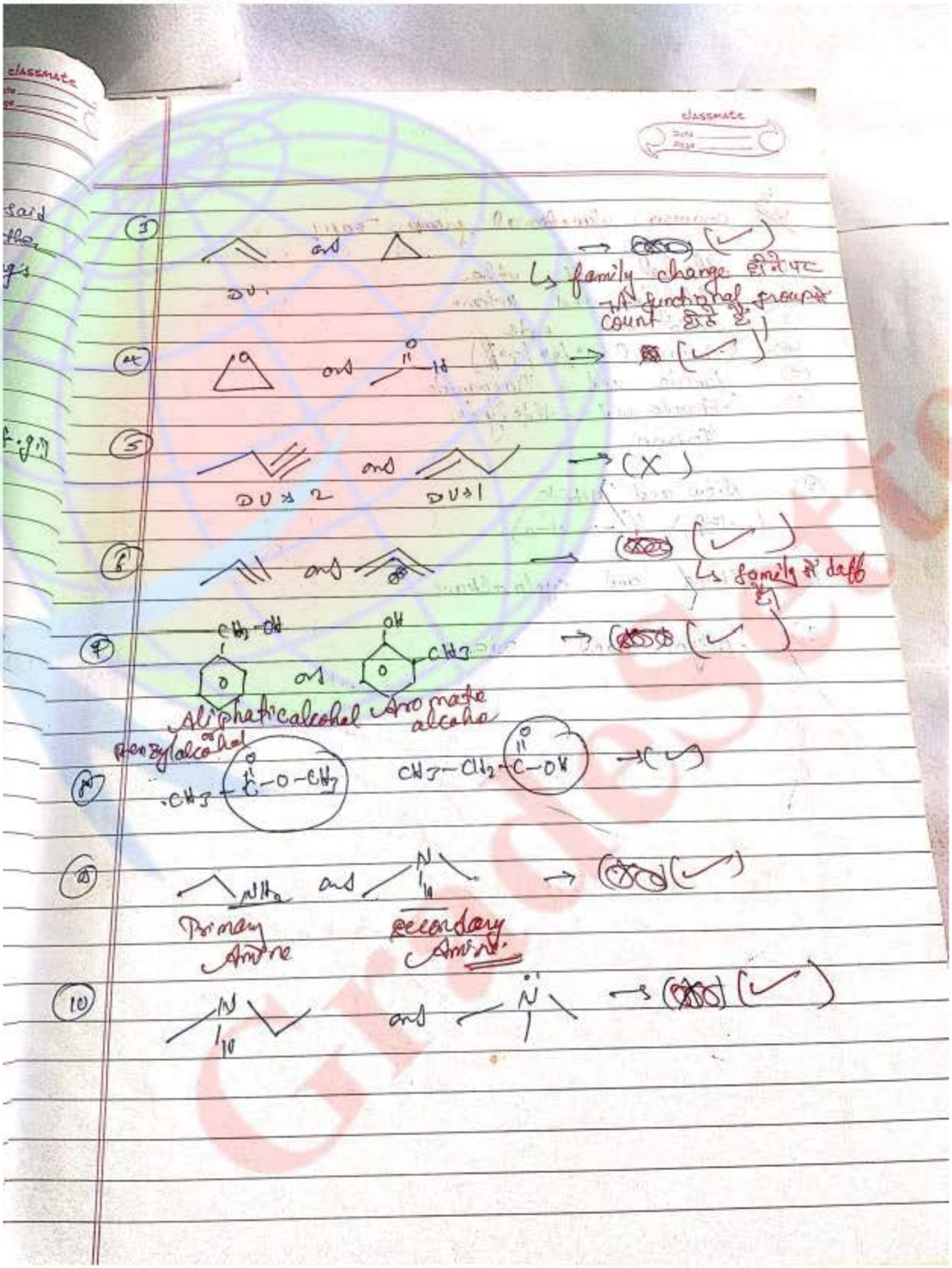
D.U = 1
m.f → same

(2)

and

↪ (X)

m.f → Not same



Note

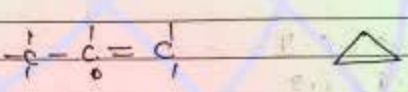
Common functional group part

1. Alcohol and ether
2. Aldehyde and ketone
3. Acid and ester
4. Amines (1°/2°/3°)
5. cyanide and Isocyanide
6. Epoxide and Aldehyde (Darzan)
7. Nitro and Nitrite ($-N\overset{O}{\underset{O}{=}}$) ($-O-N=O$)
8. Alkane and cycloalkane
9. Alkyne and diene

(4) Ring chain Isomerism

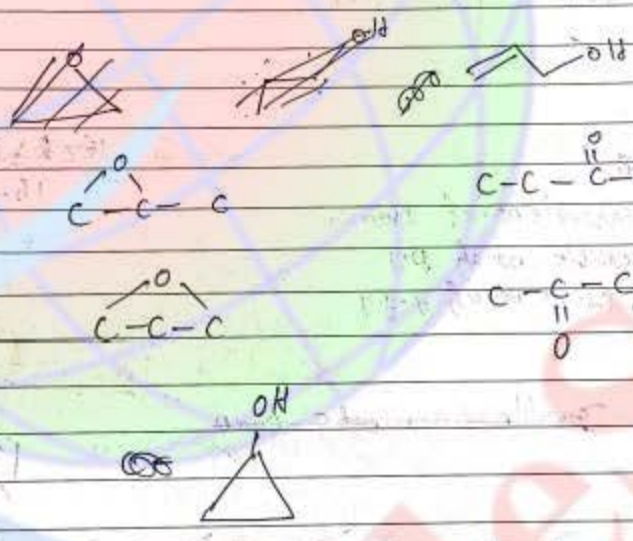
Specific type of f.g.I in which differ to each other in chain and Ring structure.

eg ⇒ C_3H_6



[Ring chain f.g.I]

(2) C_3H_6O



Note All R.C.I are f.g.I but all f.g.I are not R.C.I

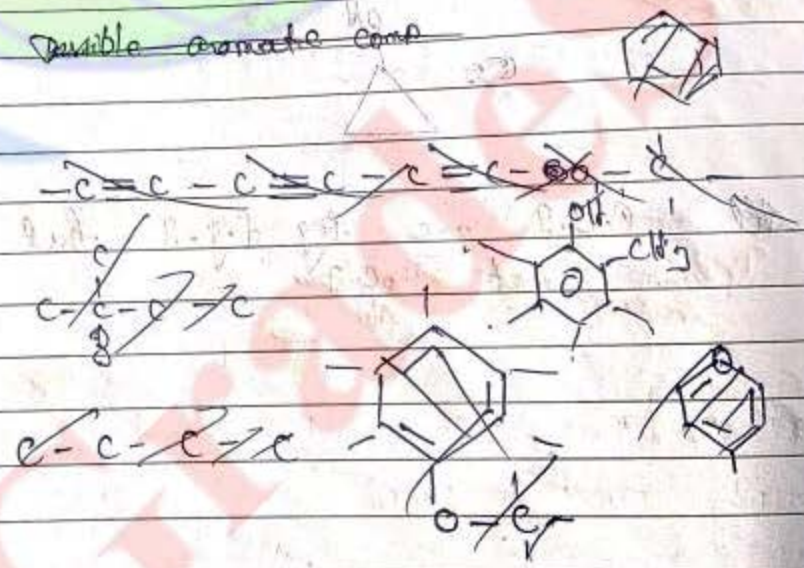
Q) oxygen and Acetaldehyde

a) P.I	a) C.I
b) C.I	b) P.I
c) f.g.I	c) R.C.I
d) G.I	d) G.I

Q) C_4H_8O

a) possible no. of Diomer
b) possible no. of P.I
c) possible no. of f.g.I

Sol/n

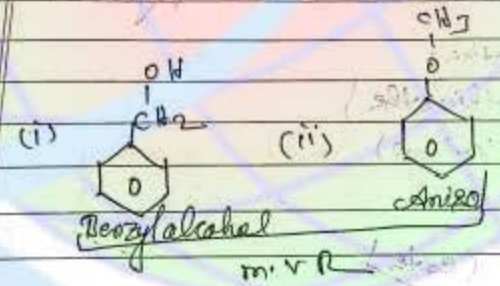


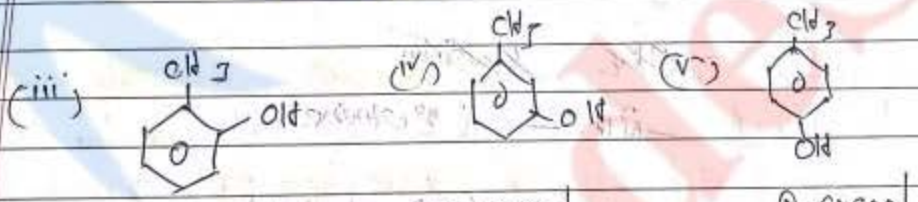
Note

In case of aromatic compound

C_6H_5- (m.v.R) or

C_6H_4 (P.V.R) or





Ans (a) → S, (b) 3, (c) 3 (

(5) Metamerism

Two or more structural isomers which are differ to each other in nature of radical's present either side of polyvalent functional group or differ in nature of alkyl group on both side of function group's

- Structural condition's for metamerism

* functional groups should be polyvalent

eg $-O-$ (ether)

$-S-$ (thioether)

$-\overset{\|}{\underset{O}{C}}-$ (Ketone)

$-\underset{O}{\overset{\|}{C}}-O-$ (ester)

$-\ddot{N}H-$ (2° Amine)

$-\underset{|}{N}-$ (3° Amine)

* All metamer's (Isomer's) should be belongs from same series or same family.

g) metamer

Note

* meta
met

e.g.) CH-

Note

Eg.) metamers of $C_4H_{10}O$

(a) $CH_3-O-CH_2-CH_2-CH_3$ (b) $CH_3-CH_2-O-CH_2-CH_3$

Note
* metamers are may be a.D or P.F but metamerism always dominant over C.F or P.F

Eg.) $CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$ and $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$
(pent-2-one) (pent-3-one)
are

(a) C.F
(b) P.F
(c) F.G.I
(d) metamer

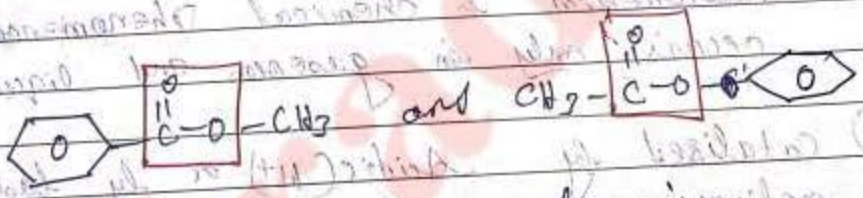
or

(a) C.F
(b) A.F
(c) F.G.I
(d) R.C.F

or

(a) P.F
(b) metamerism
(c) both a & b
(d) None

Note Specific examples



are metamers

Ans

(6) Tautomerism or Desmotropism or Allelomorphism.
Prototropy or Cationotropy or Keto-enol

Tautomerism is specific type of F.G.I in which Isomers/tautomers/tautomers exist in dynamic equilibrium so it is also known as dynamic Isomerism.

Tautomerism arises due to oscillation of polyvalent atom (proton) b/w two polyvalent atoms

Specific features of tautomerism

(1) Turn most given by CARR

(2) tautomerism is chemical phenomenon which occurs only in gaseous and liquid phase

(3) catalised by Acidic (H^+) or by basic (OH^-) medium

(4) No. of σ bonds, π-bonds, lone pairs (alkene) and lone pair of electrons always equal in both Isomers

forms (tautomers).

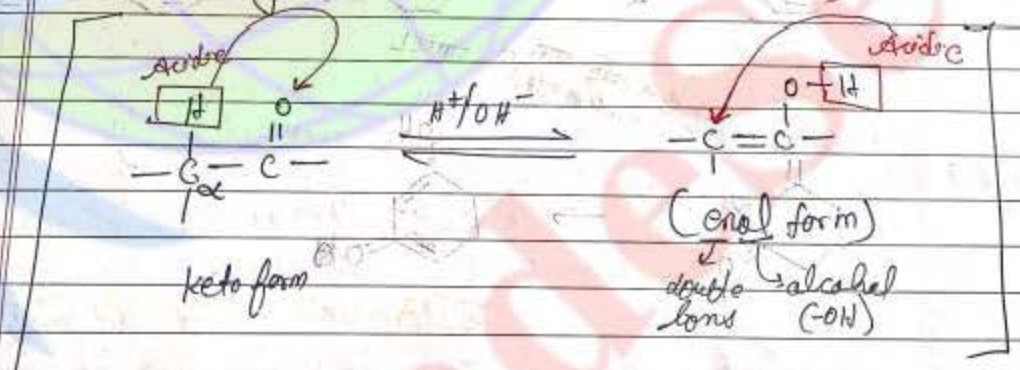
* Structural conditions for tautomerism

① Compound should have acidic hydrogen for oscillation.

(In case of carbonyl and nitro compounds etc.

$-\overset{\overset{O}{\downarrow}}{C}-$ $\quad -N\overset{\overset{O}{\downarrow}}{\rightarrow}O$

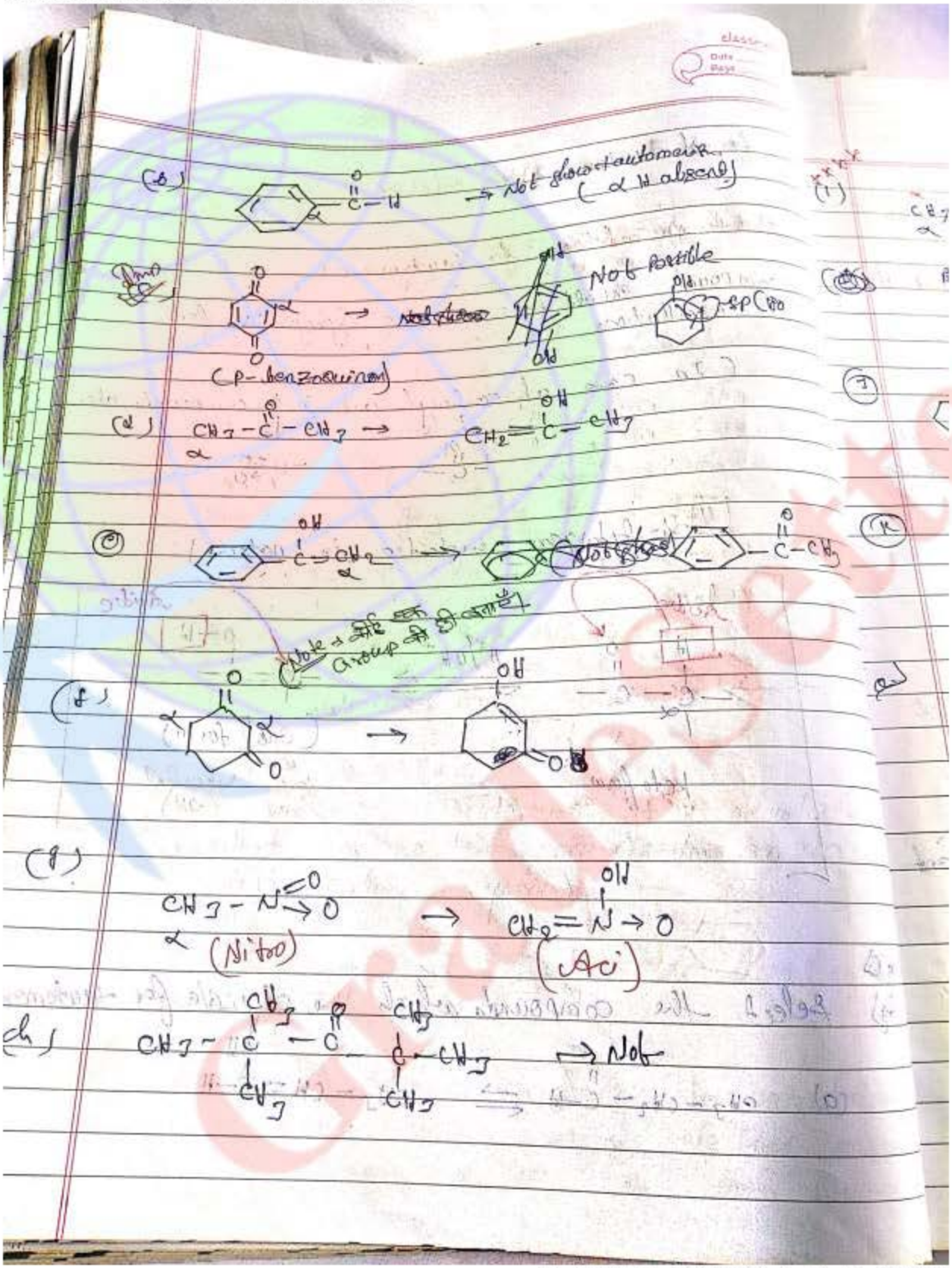
α-hydrogen is acidic in nature)

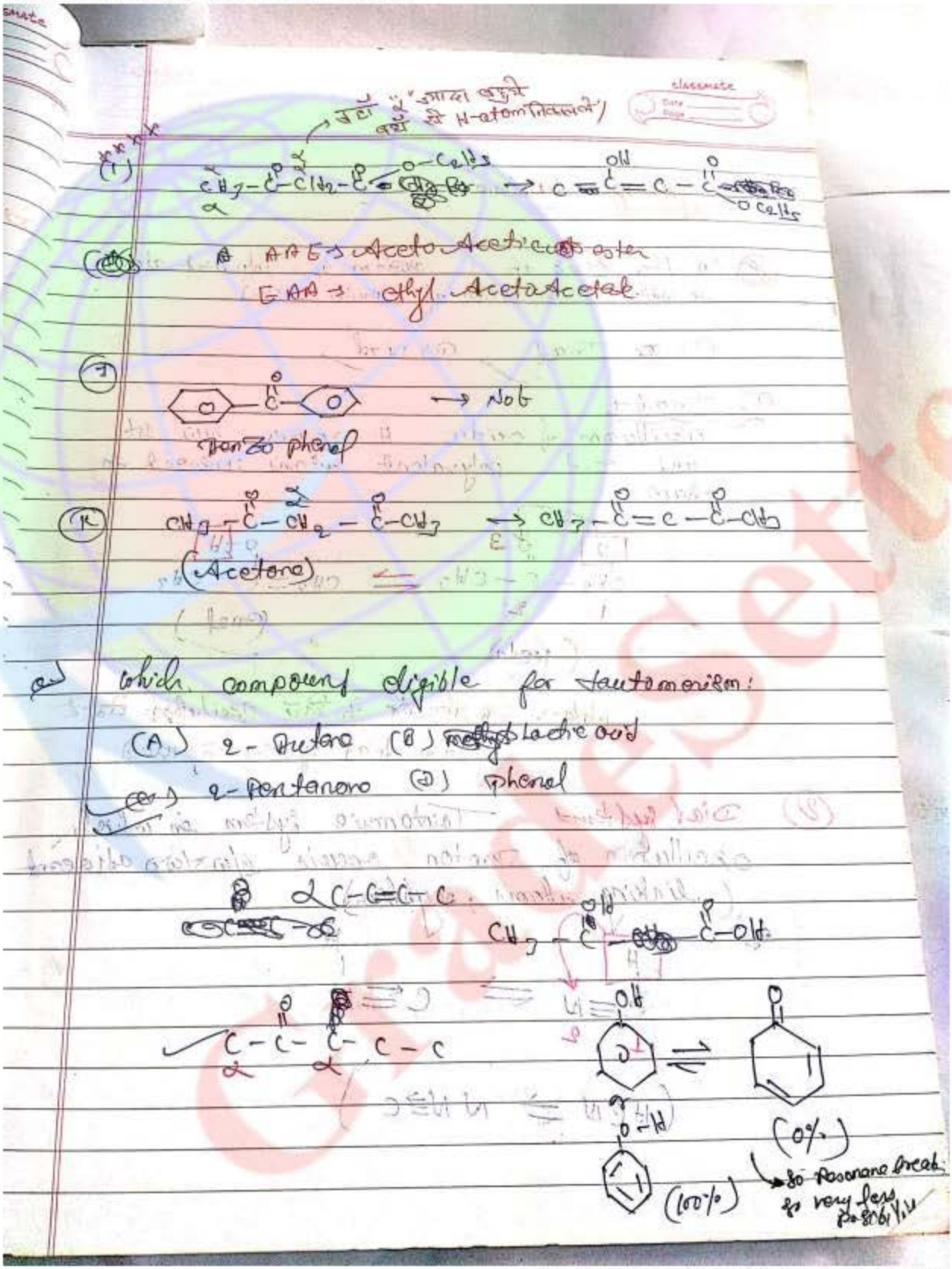


(-A) (+A)

eg: Select the compounds which are eligible for tautomerism

(a) $CH_3-CH_2-\overset{\overset{O}{\downarrow}}{C}-H \rightleftharpoons CH_3-CH=\overset{\overset{OH}{\downarrow}}{C}-H$



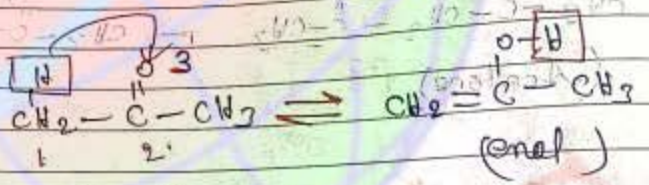


☆ Type of Tautomerism

(A) On the basis of position of polyvalent atoms in which oscillation of proton occurs

(I) Triad (II) Diad

(I) Triad :-
Oscillation of acidic H occurs b/w 1st and 3rd polyvalent atoms present in chain



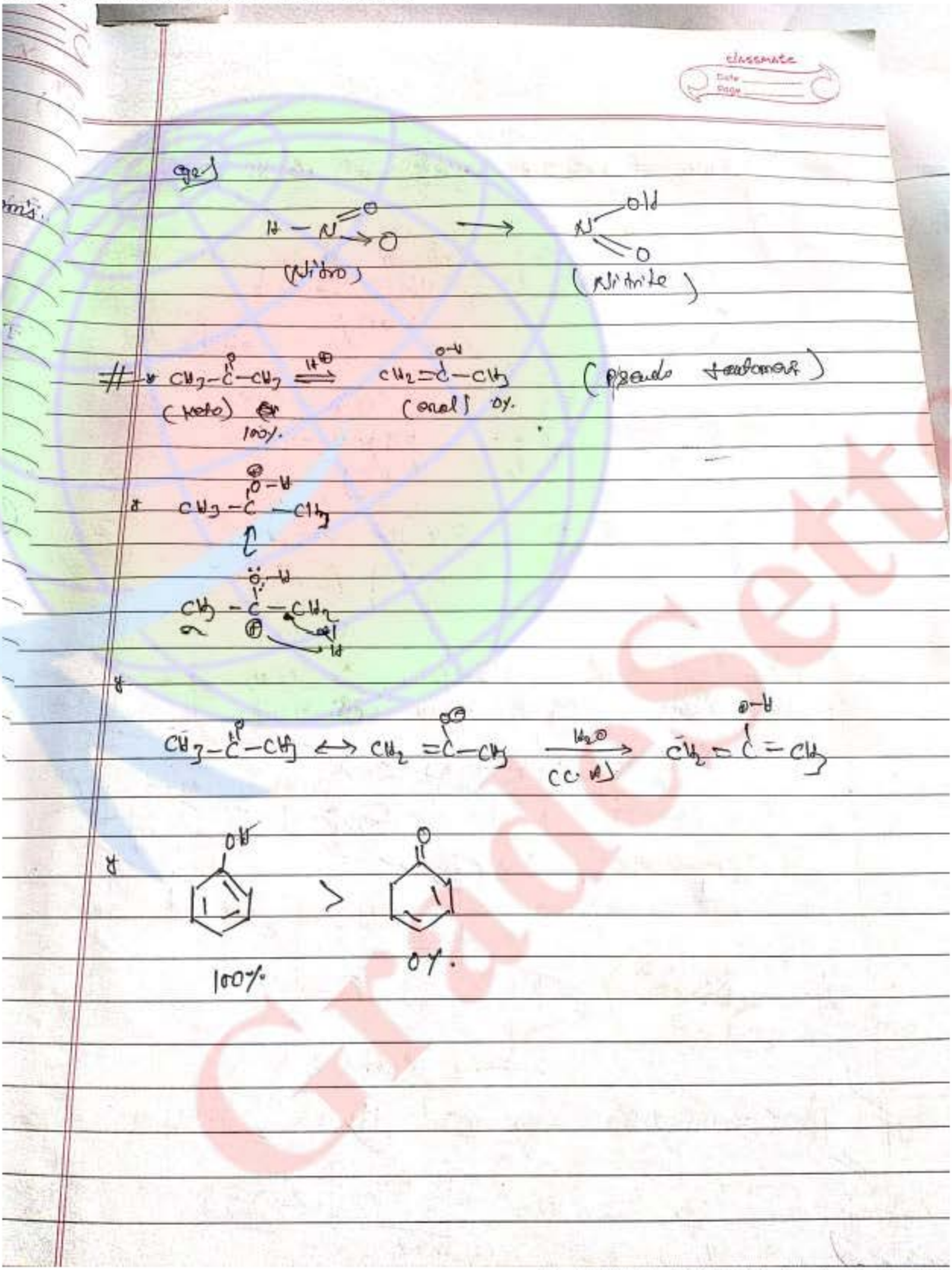
(keto) (enol)

Note → एक अणु में तीन oscillation होता है तब triad system कहलाता है

(2) Diad system :- Tautomeric system in which oscillation of proton occurs b/w two adjacent (linking atoms, neighbour)

eg.

(HCN ⇌ NN≡C)



☆ Special Points

⁂ Applications of m.v.R →

eg→ possible no. of alcohols of $C_4H_{10}O$

Sol^n C_4 — old

m.v.R ⇒ चार होंगे

so, 4 possible

Note

$C_1 \rightarrow 1$
$C_2 - 1$
$C_3 - 2$
$C_4 - 4$
$C_5 \rightarrow 8$
16

eg→ possible no. of alcohol of $C_5H_{12}O$

↳ D.U = 0

Sol^n C_5 — old

m.v.R

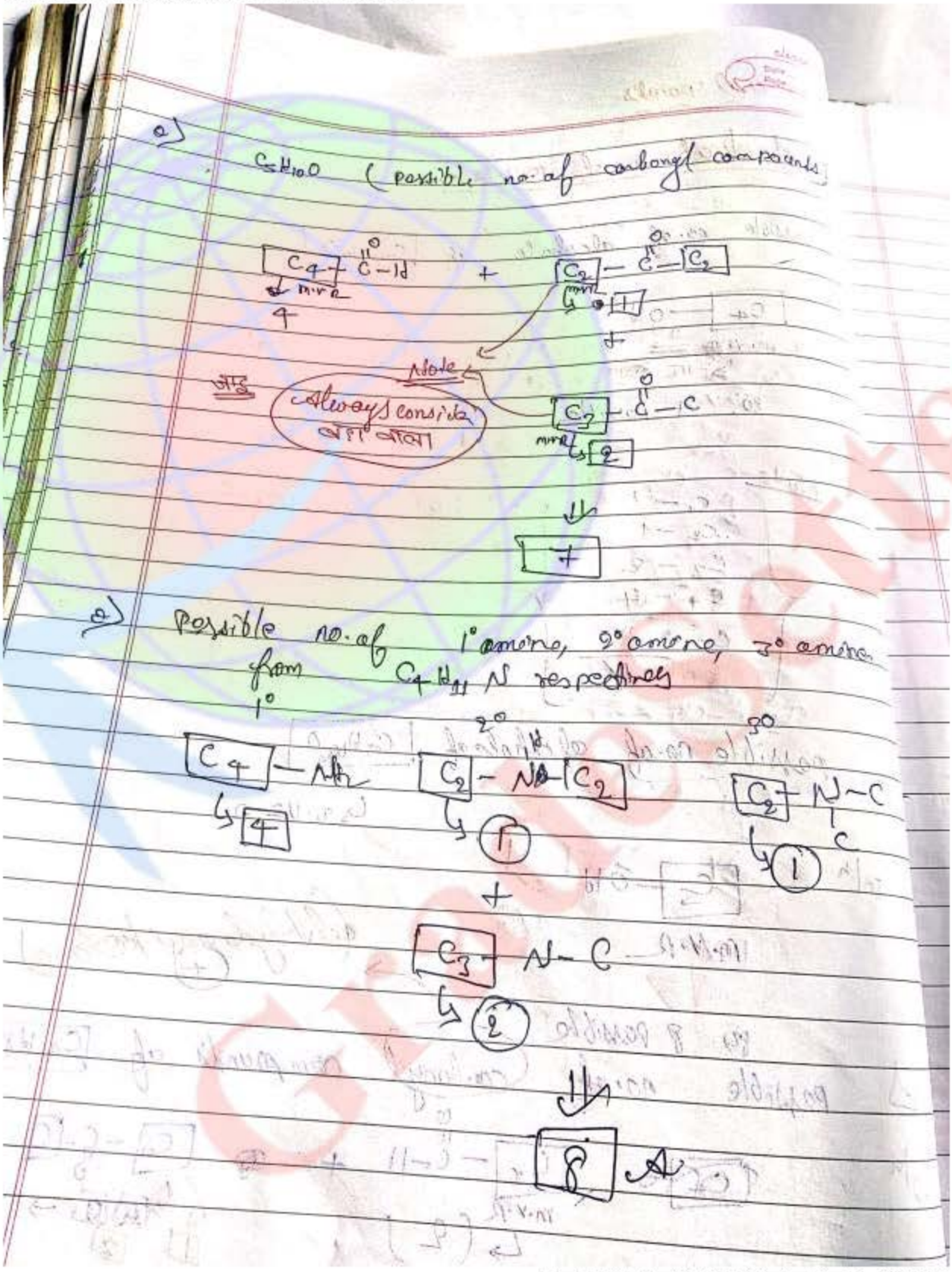
↳ 8 possible

eg→ possible no. of carbonyl compounds of C_4H_8O (aldehyde and ketone)

Sol^n C_4 — $\overset{O}{\overset{\|}{C}}$ — H + C_3 — $\overset{O}{\overset{\|}{C}}$ — H

m.v.R

↳ (2)



Part-B

Stereo Isomerism

Stereo = Spatial (in space)

Two or more compounds which are similar in –
(i) molecular formula
(ii) I/N (IUPAC name)
(iii) S.F (Structural formula)

but, differ to each other in spacial (space) arrangement of atom's or group of atom's are known as Stereo Isomer's and phenomenon Stereo-Isomerism.

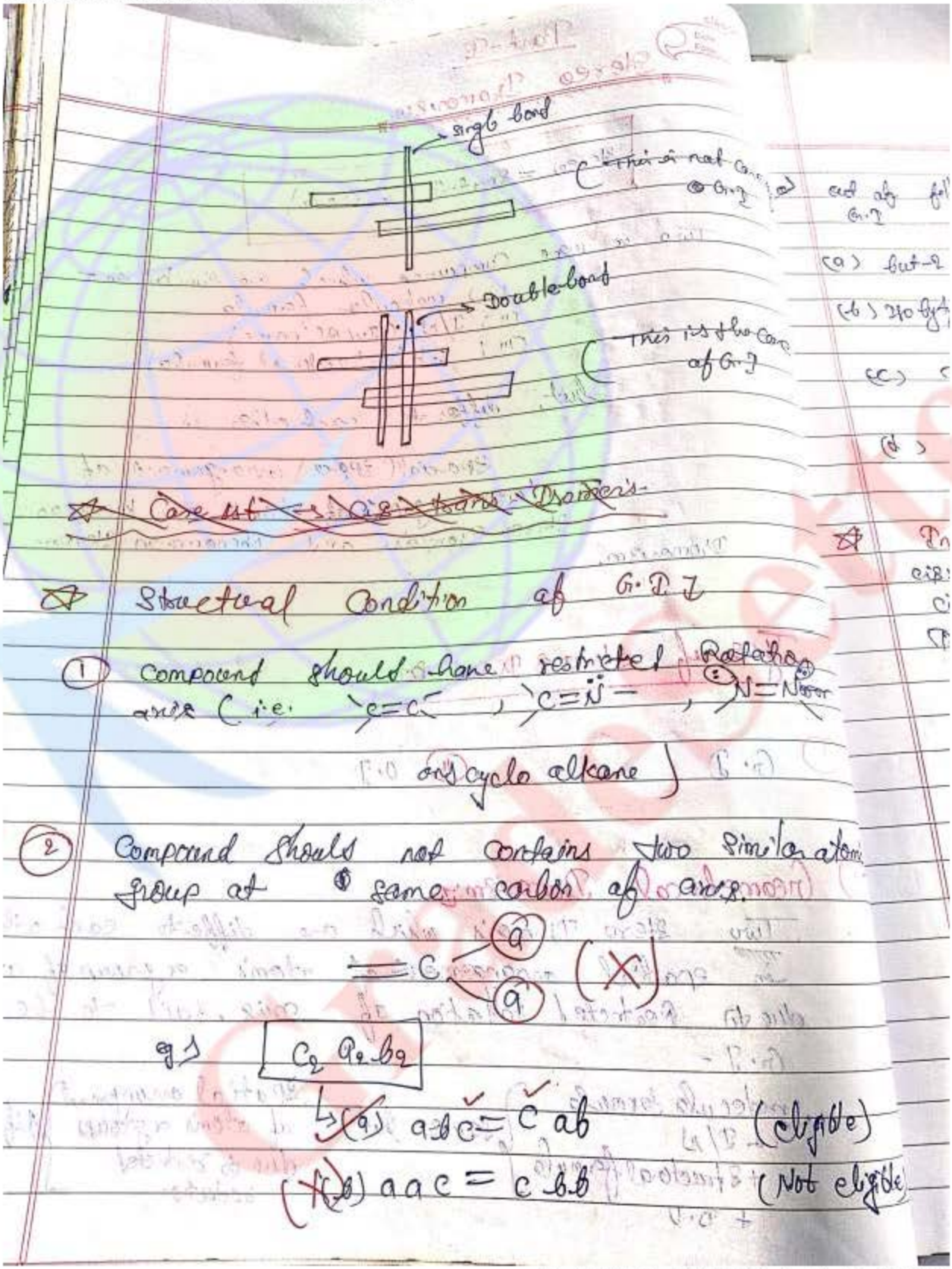
Type of Stero Isomerism

(I) G.I (II) O.I

(I) Geometrical Isomerism

Two stero Isomer's which are differ to each other in spatial arrangement of atom's or group of atom due to Restricted rotation of axis, said to be G.I -

molecular formula + I/N + Structural formula + D.U } Same but Spatial arrangement of atom's or groups due to restricted rotation } diff ⇒ G.I



~~Geometrical Isomerism~~

☆ Structural condition of G.I.I

(1) Compound should have restricted Rotation axis (i.e. $>C=C<$, $>C=N-$, $-N=N-$ or cycle alkane)

(2) Compound should not contains two similar atom group at same carbon of axis.

$=C<^{a}_{a}$ (X)

q) $C_2a_2b_2$

↳ (a) $aabc = \check{c}\check{a}b$ (eligible)

(X) (b) $aac = cbb$ (Not eligible)

Q) Out of following compounds which is not exhibit G.I

(a) But-2-ene C – C = C – C (✓)

(b) Isobutylene C – C = C (H)(H), with C below (X)

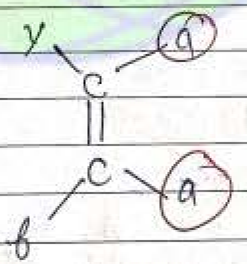
(c) Propene C – C = C (H)(H) (X)

(d) But-1-ene (H)(H) C = C – C – C (X)

In cis and trans Geometrical Isomerism

cis:-

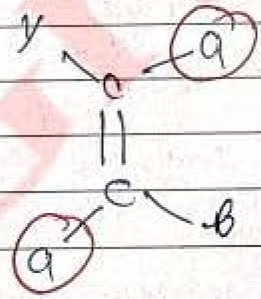
cis represents two similar group or atom's present at same side.



same side (cis)

Trans:-

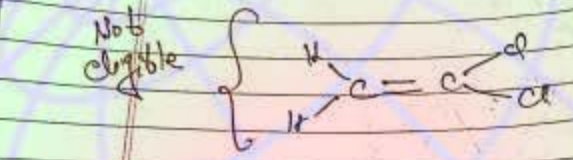
Same group or atom's at opposite side



opposite side (Trans)

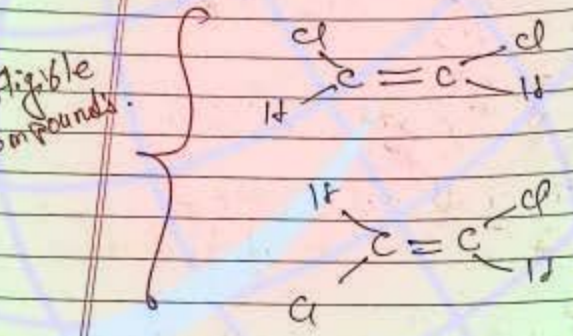
q1 $C_2H_2Cl_2$ M.F

Not eligible



(Not eligible for G.I)

Eligible compounds.

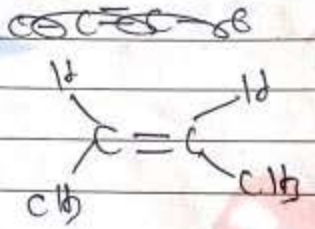


(Cis) (G.I)

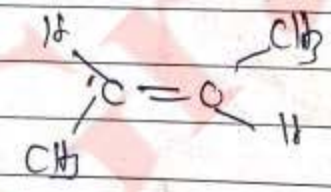
(Trans) (G.I)

q2) C_4H_8

$\frac{10-8}{2} = \frac{2}{2} = 1$ double bond



Cis-But-2-en



Trans-But-2-en

Note — cis, trans IUPAC name में उपसर्ग है। इस नाम का भाग है।

Note

(1) $CH_3-CH=CH-CH_3$

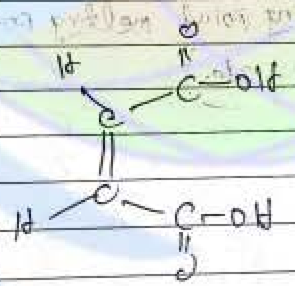
Bet-2-ene

(2) 

(Cis - Bet-2-ene)

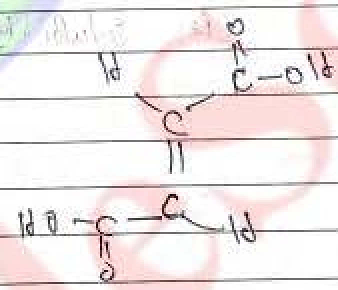
→ Note:- अगर example इस तरह के structure को दर्शाता है, तो cis, trans बताना जरूरी है।

$C_4H_4O_4$



maleic acid

and



Fumaric acid

WWW.GRADESETTER.COM

★ Some Imp. points about G.I →

① G.I non-Interconvertible at room temperature

cis ⇌ Trans

Not Possible

② G.I similar in chemical Properties but differ in physical properties

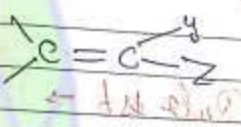
(ie solubility, dipole, Boiling point, melting point stability etc)

E-Z system

Generally the system is applicable in compounds which contains all four groups or atoms non-identical

eg:→

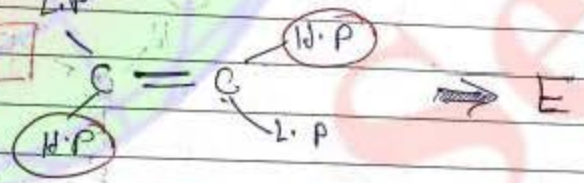
abc = cyz or



E → Entegegen → opp. side

↳ high priority group or atoms when present opp. to each other.

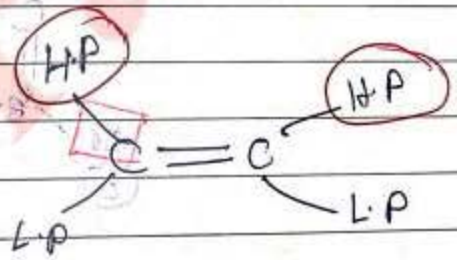
eg.



Z → (Zusamann) → same side

↳ high priority group or atoms when present same side to each other.

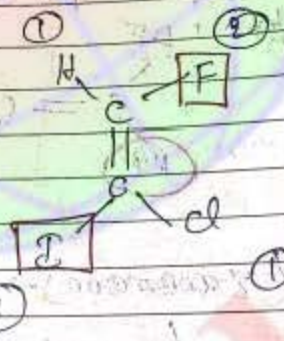
eg.



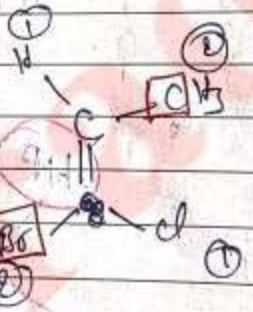
To determine or decide relative Priority of atoms or groups by CIP (Cahn/Ingold and Prelog) Rule or Sequence rule

* Rule 1st → Priority will be decided by atomic number of atom which directly bonded with carbon atom

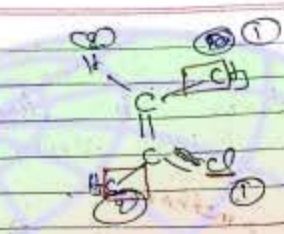
eg 1



eg 2



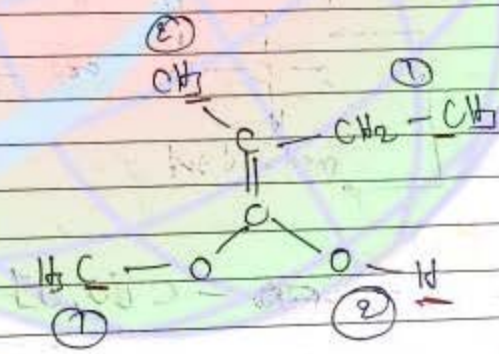
Ex:



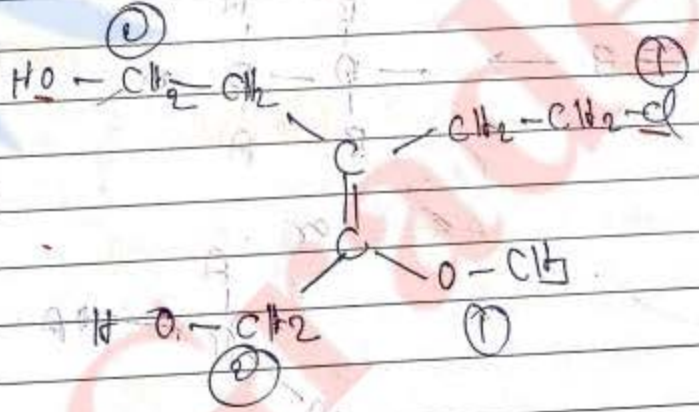
⇒ Z and trans

Rule 2nd:

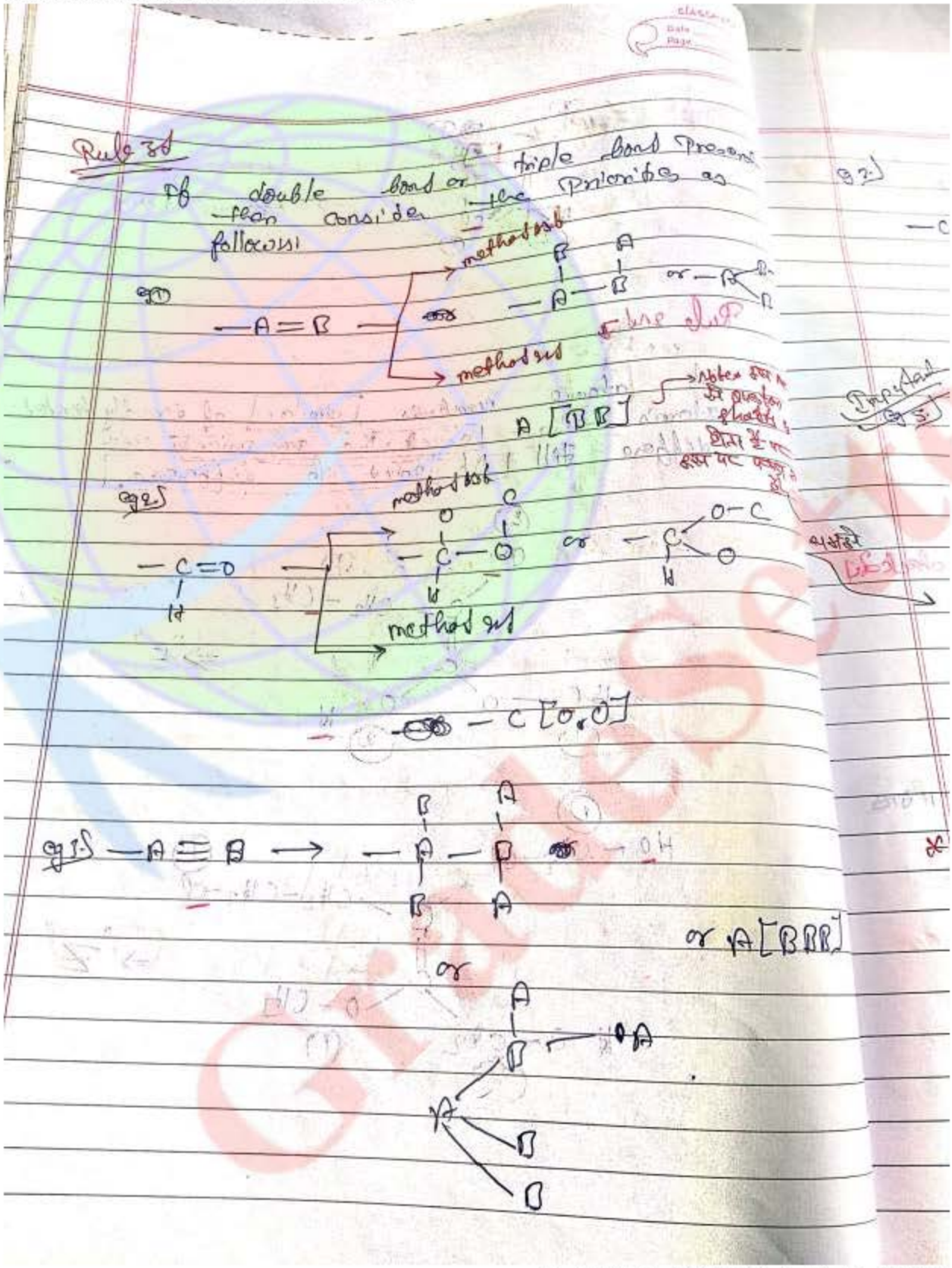
If atomic numbers [similar] of directly bonded atoms than [check the priority after] differ till [1st point of difference]

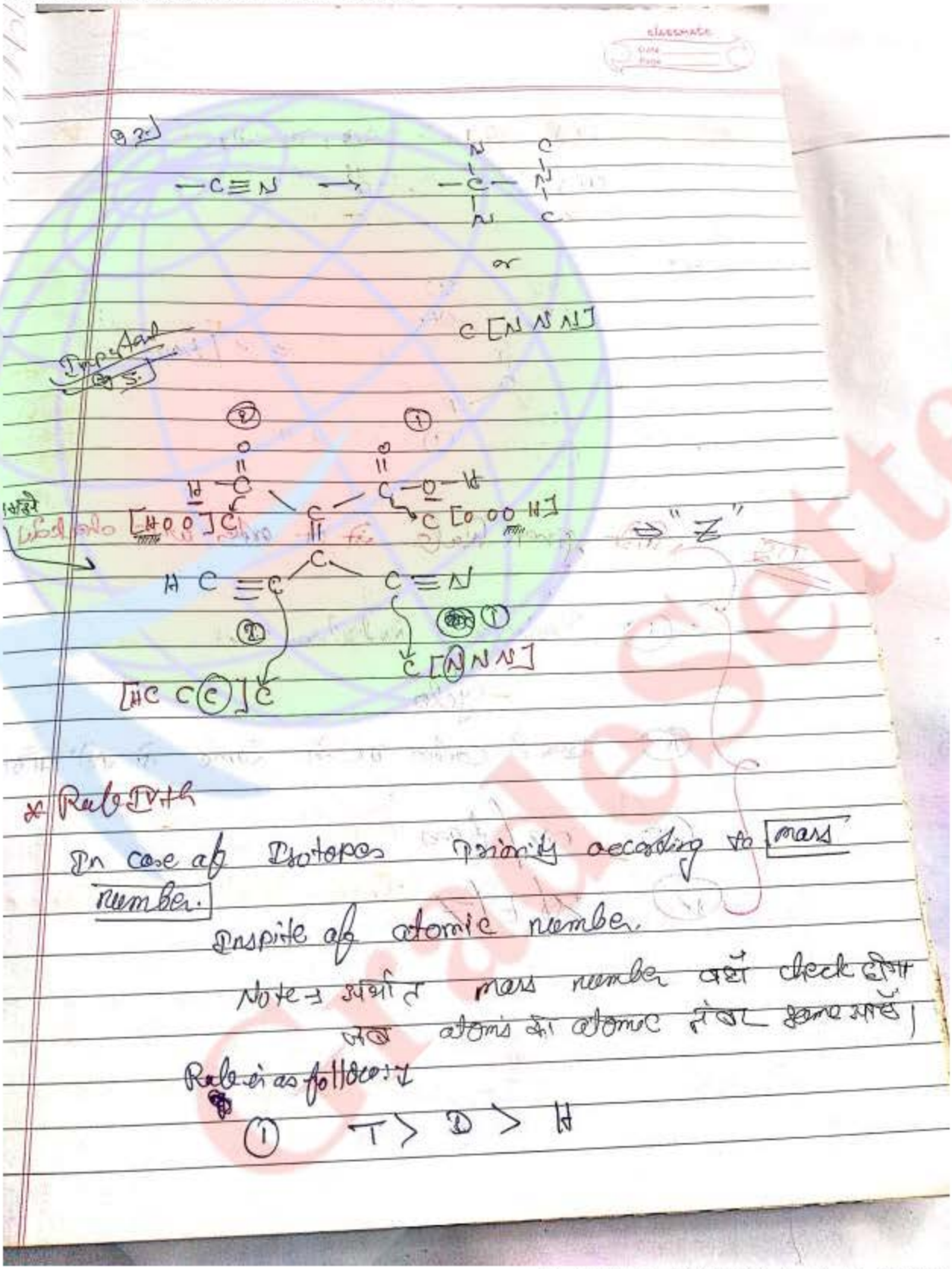


⇒ "E"



⇒ "Z"





* Rule IV th

In case of Isotopes priority according to mass number.

Inspite of atomic number.

Note - अर्थात mass number वहाँ check होगा जब atoms के atomic नंबर same आएँ।

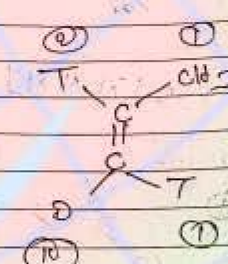
Rule is as follows:

(1) T > D > H

(ii) $-CT_3 > -CD_3 > -CH_3$

(iii) $-O^{18} > -O^{16}$

eg:-



⇒ Z / trans

नोट → सिर्फ given Rule से ही order wise check करें

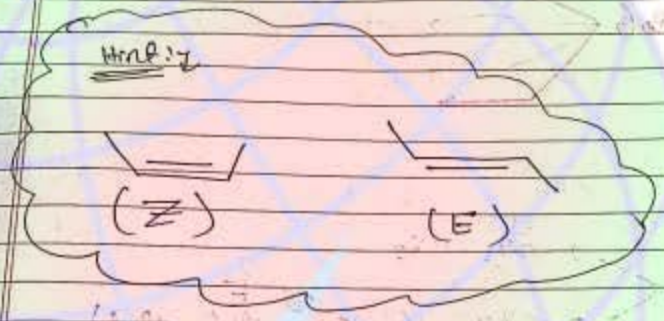
(i) Restricted Rotation होगा
[π bond या] or cyclo

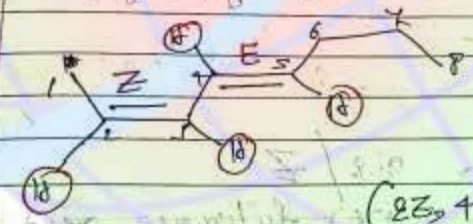
(ii) एक ही Carbon पर दो Same नहीं आने चाहिए

(iii) cis / trans

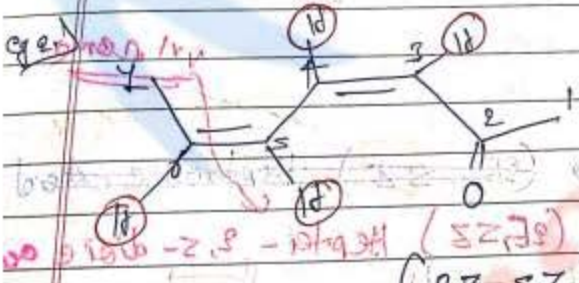
(iv) E/Z

☆ IUPAC naming on the basis of "E and Z"



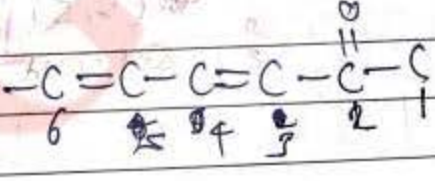


(2Z, 4E) octa-2, 4-dion

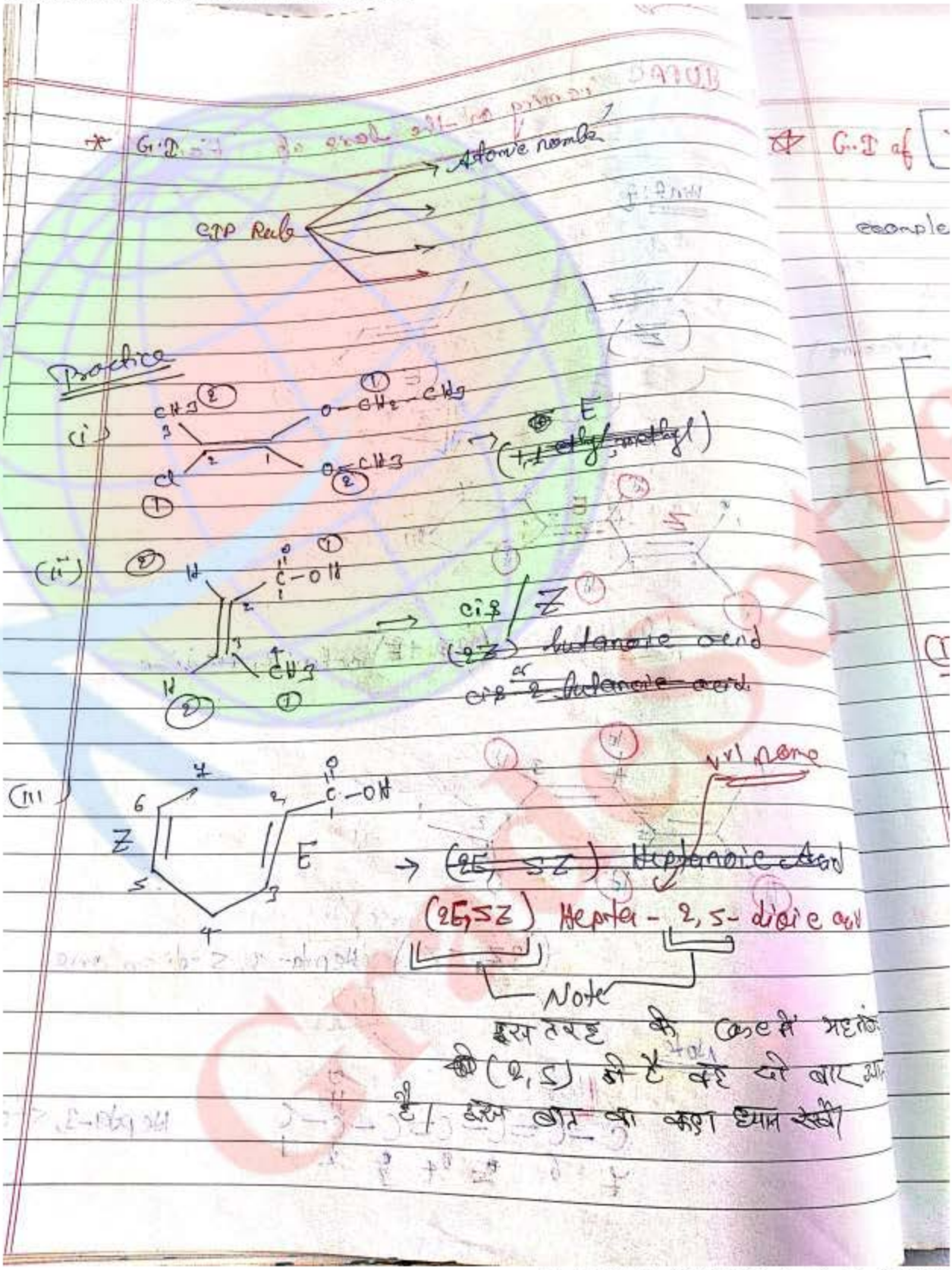


(3Z, 5Z) Hepta-3, 5-dion one

Note



Hepta-3, 5-dien one



☆ G.I of $\left[>C=\ddot{N}-\right]$ an's

examples from [oximes] $\left[>C=\ddot{N}-OH\right]$

$$\left[>C=O + H_2\ddot{N}-OH \longrightarrow H_2O + >C=\ddot{N}-OH\right]$$

aldehyde/ketone (Carbonyl Comp) — hydroxyl amine

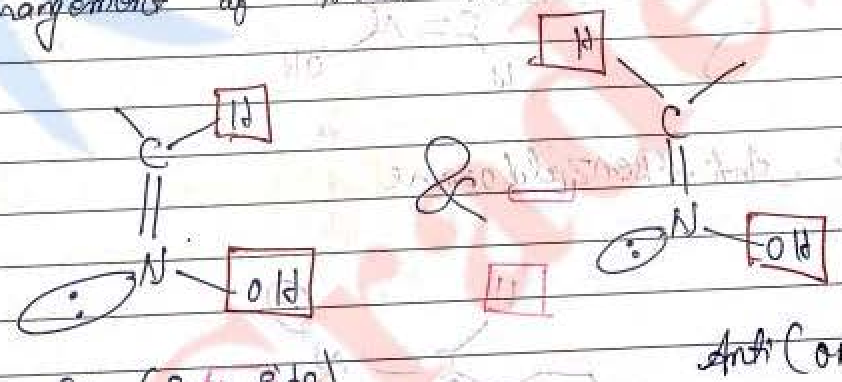
जब aldehyde से बने → Ald Oxime

or

जब ketone से बने → Ket Oxime

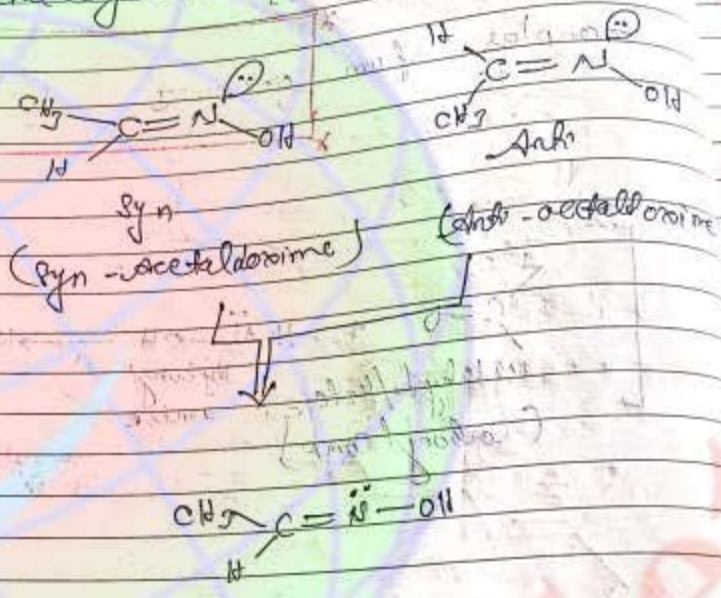
① G.I in aldoximes

Geometry will be decided according to spacial arrangement of H and OH

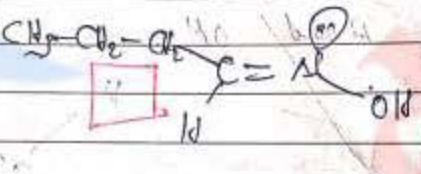


Syn (same side) & Anti (opp side)

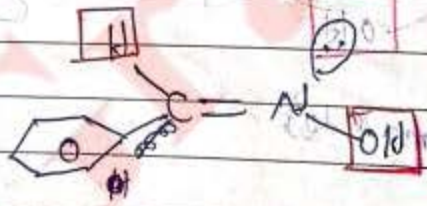
eg.) ~~Acetaldehyde~~ Acetaldoxime



eg.) ~~Syn-butyraldoxime~~ Syn-butyraldoxime



eg.) Anti-Benzaldoxime



(b) G.I in Ketoximes

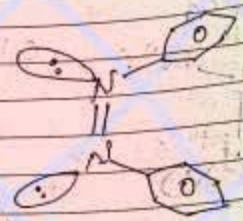
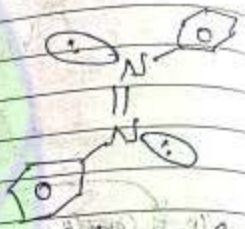
Note: Syn के case में OH के same side वाला group का name ही पहले आएगा। यहाँ कोई पक्का वाला RULE नहीं लगाएँगे।

Syn - methyl - ethyl Ketoxime

or

Anti - ethyl - methyl Ketoxime

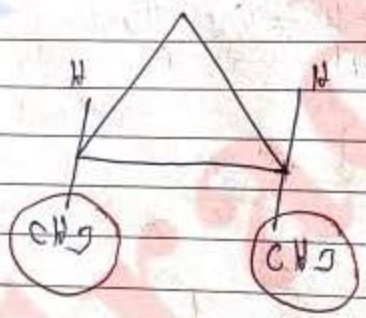
(c) G.I in  are (Azo anz

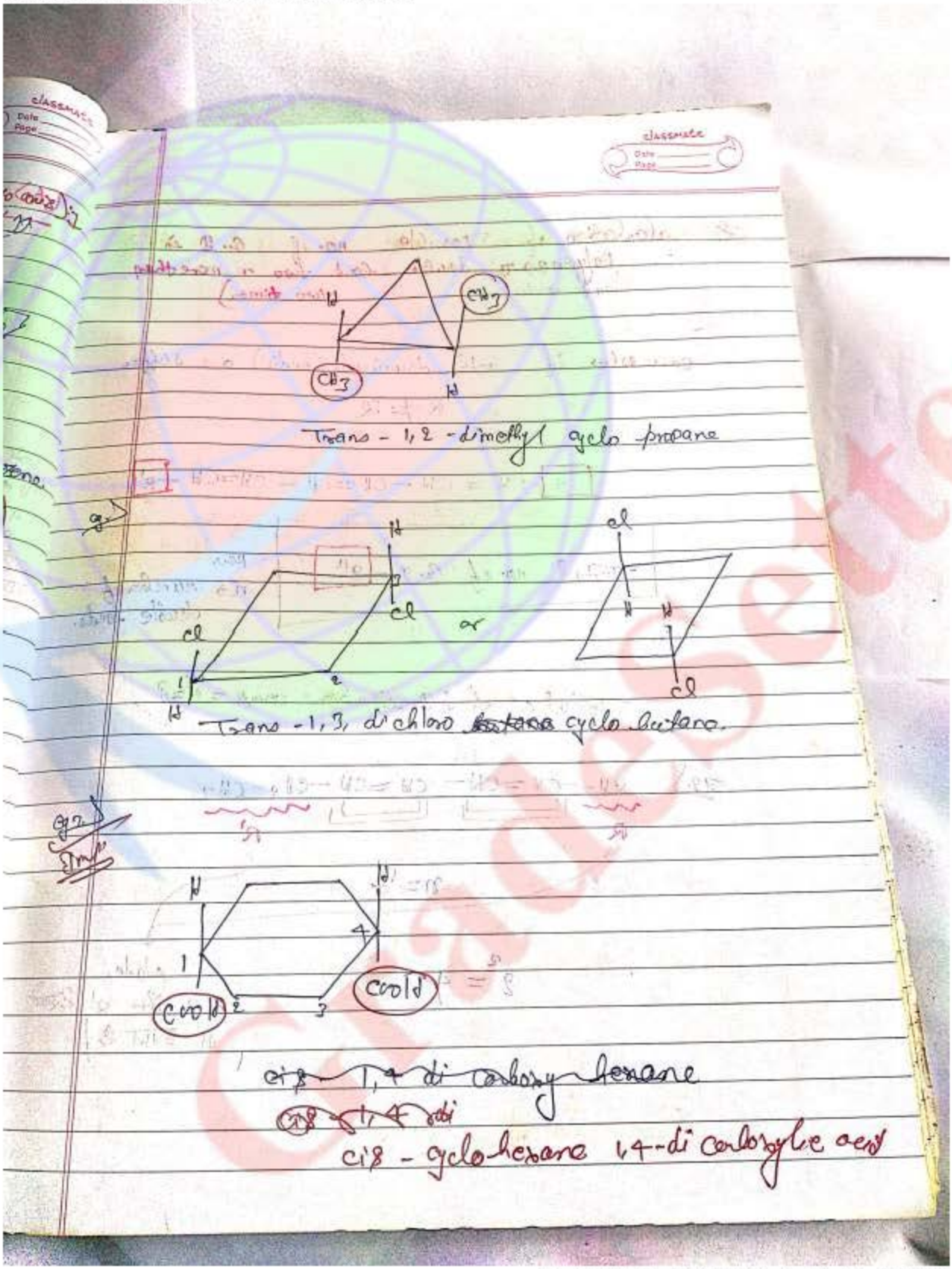
Syn- Azo benzene
(Ct. pair on same side)

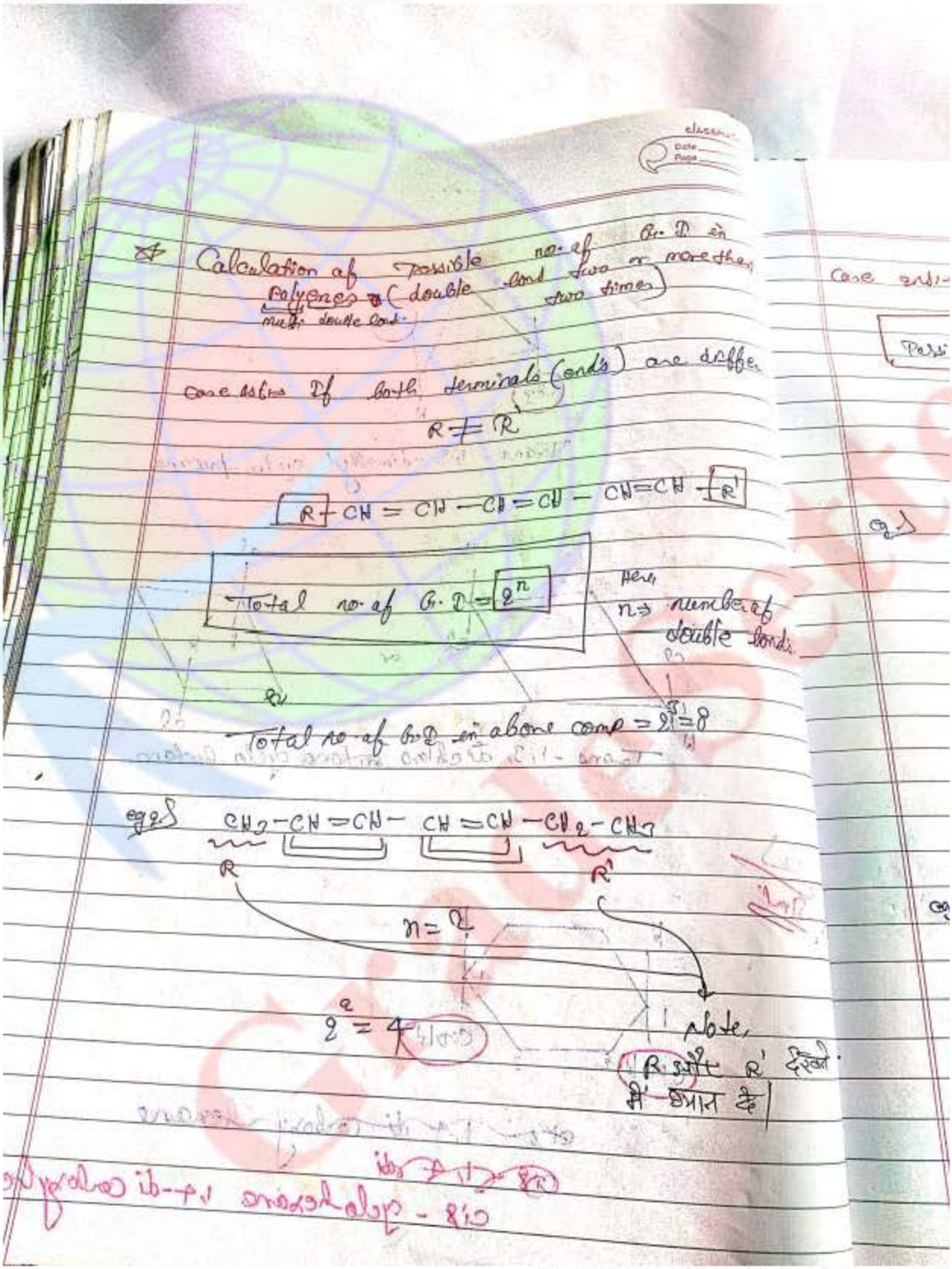
Anti- azo benzene
(Ct pair on opp side)

(d) G.I in cyclo alkanes



Cis- 1,2- di methyl cyclo Propane.
(same comp on same side)





★ Calculation of possible no. of C.D in Polyenes (double bond two or more than two times)
multi double bond

Case I:- If both terminals (ends) are diffe.

$R \neq R'$

$R - CH = CH - CH = CH - CH = CH - R'$

Total no. of C.D $= 2^n$

Here
n ⇒ number of double bonds

Total no. of C.D in above comp $= 2^3 = 8$

eg:- $CH_2 - CH = CH - CH = CH - CH_2 - CH_3$

R R'

$n = 2$

$2^2 = 4$

Note:
R और R' दोनों में अलग है।

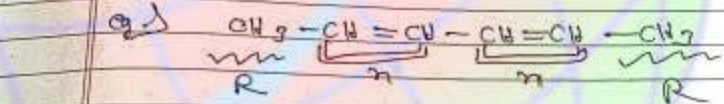
Case arises when both terminals are same.

Possible no. of G.I = $2^{n-1} + 2^{p-1}$

if n = even, $p = \frac{n}{2}$

if n = odd, $p = \frac{n+1}{2}$

Q.1)



$n = 2$

$p = \frac{2}{2} = 1$

G.I = $2^{2-1} + 2^{1-1}$

$= 2^1 + 2^0$

$= 3$

Q.2)

$CH_3 - CH = CH - CH = CH - CH = CH - CH_3$

Optical Isomerism

Optical → light

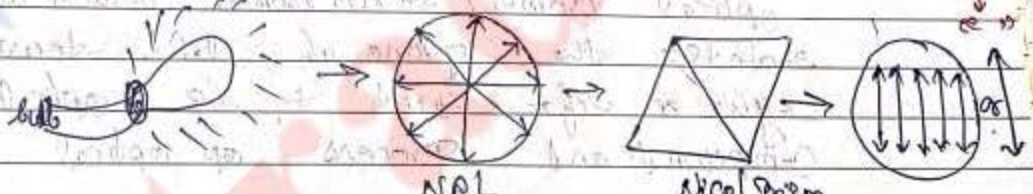
Stereo Isomers which are differ to each other in behavior against rotation of "PPL" (plane polarised light)

or

Stereo Isomers said to be optical Isomers similar in physical and chemical properties but exhibit different behavior against rotation of plane of PPL.

✱ PPL → (plane polarized light)

light whose vibrating plane vibrate in only one (or single) direction.

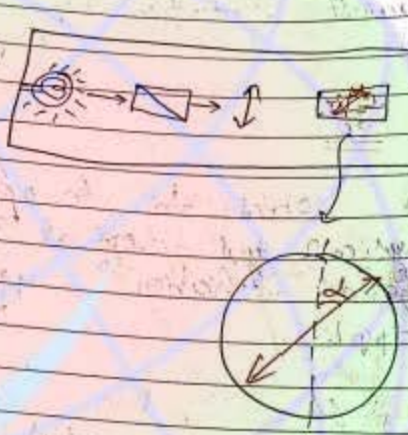


(Non-polarised light)

[Calcite → crystalline CaCO3]

Qa

✡ Polarimeter :-
Apparatus (or Device) which measures extent of rotation of P.P.L.

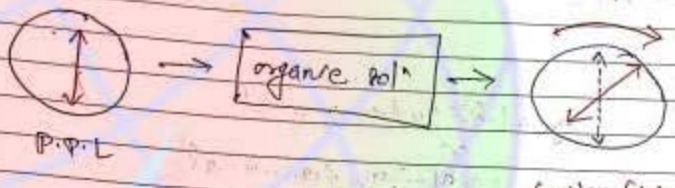


✡ Optical Activity or optical active compound :-
optical Isomer / stereo Isomer which able to rotate the plane of P.P.L. towards right or left said to be optical active compound and process optical activity

① Dextrorotatory Isomer / Comp :-
[Dexter = Right / ↻ / clockwise]
or
Right hand rule.

Qa

optical active compound which rotate the ~~magneti~~ vibrating plane towards right (clockwise) said to be dextrorotatory denoted by small "d" or positive arithmetic sign (+)



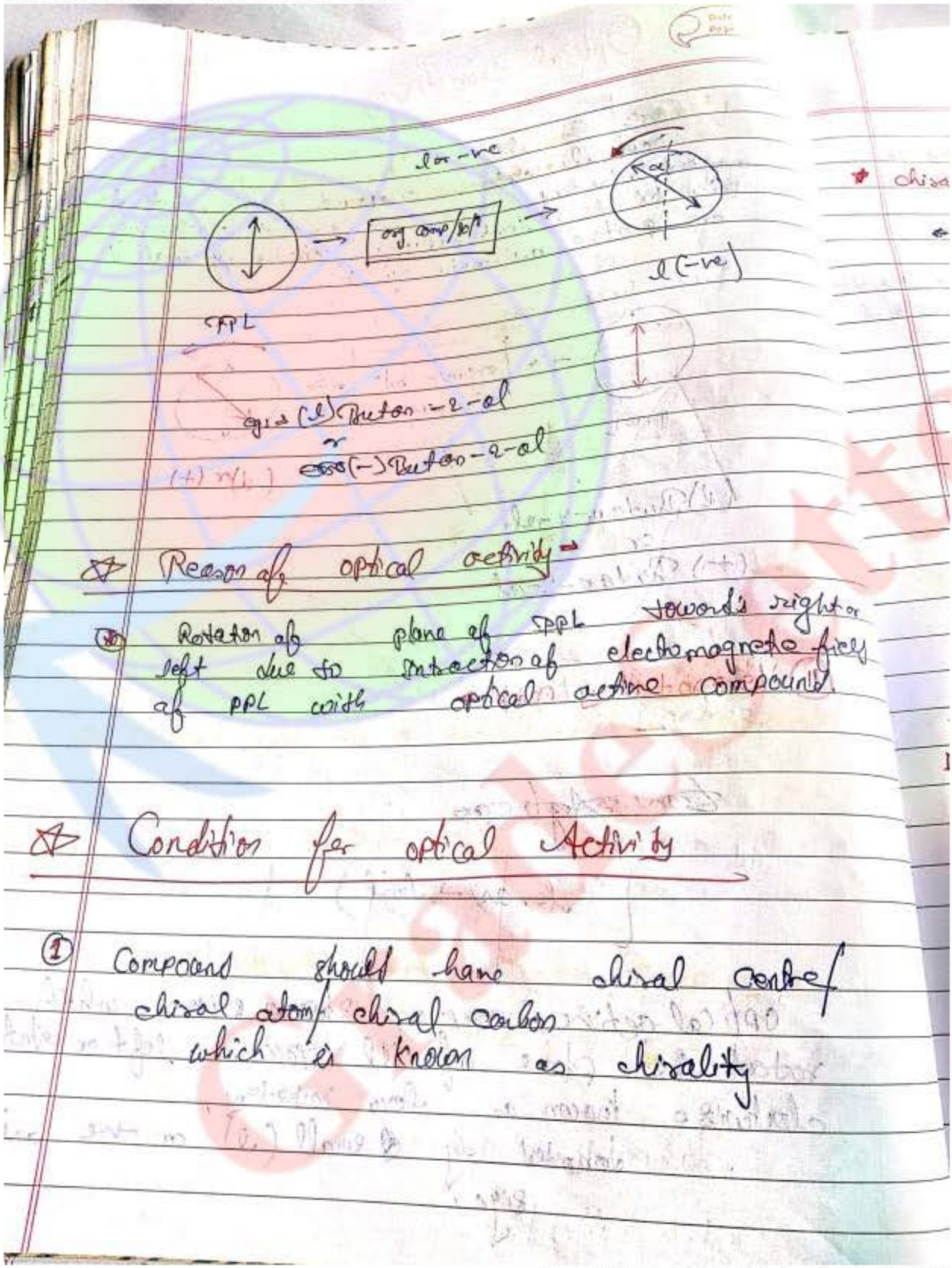
(d) Butan-2-ol
or
(+) Butan-2-ol

(II) Levorotatory comp:-

~~Laevo Anti~~

[levas → left]

optical active comp. or ~~steric~~ isomer which rotate the plane of PPL towards left or anti-clockwise known as levo rotatory
denoted by small (l) or -ve arithmetic sign



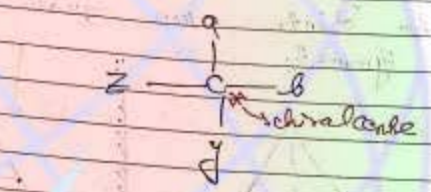
☆ Reason of optical activity →

① Rotation of plane of PPL towards right or left due to interaction of electromagnetic field of PPL with optical active compound.

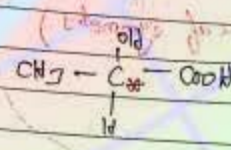
☆ Condition for optical Activity

① Compound should have chiral centre/ chiral atom/ chiral carbon which is known as chirality

* chiral carbon/ chiral atom/ chiral centre
  Atom or a centre of a compound contains all four valencies non-identical (different)

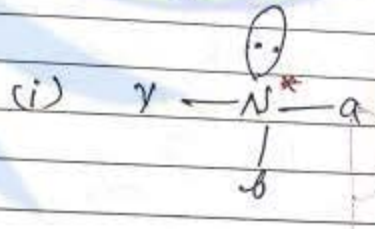


eg

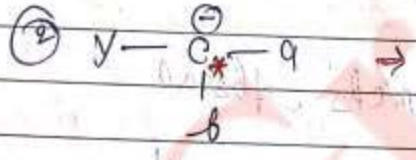


⇒ Lactic acid

Extra example

(i) 

⇒ Here N is also chiral centre

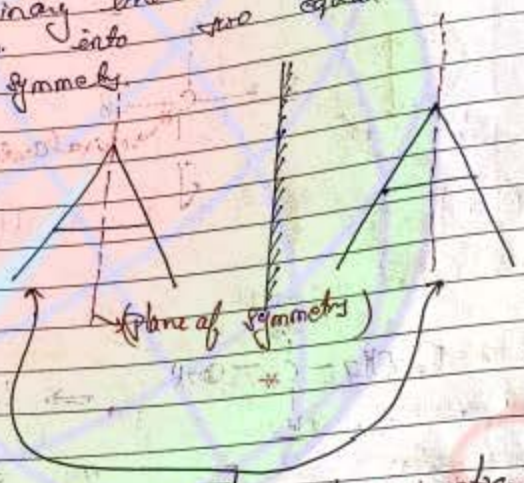
(2) 

② Absence of 1st element of symmetry of organic compounds.

① Plane of symmetry

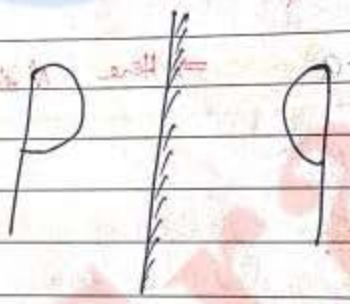
Imaginary line or section which divides whole comp into two equal half said to plane of symmetry.

eg i)



Super Impossible so optically Inactive

eg 2)



plane of symmetry Absent

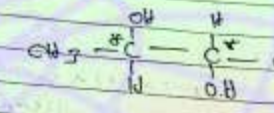
so

Non-Super Impossible!

so

optically Active

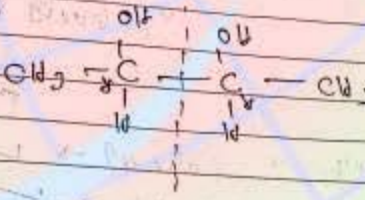
(3i)



P.O.S Absent
∴ optically Active

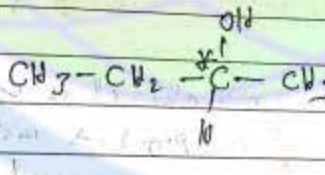
① Presence of chiral centre
② Absence of plane of symmetry
→ (then comp. show optically Active)

(3j)



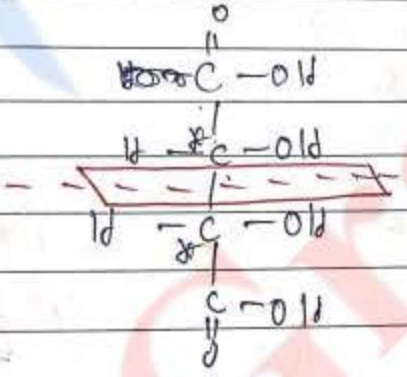
⇒ P.O.S ⇒ Present
⇒ ∴ optically Inactive.

(3k)



⇒ chiral ⇒ —
⇒ P.O.S ⇒ Absent (✗)
∴ optically Active

(4)



→ Tartaric Acid.

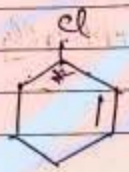
⇒ chiral ⇒ —
⇒ P.O.S ⇒ Present
⇒ optically Inactive
or
meso (mean's mid)

Enantiomers

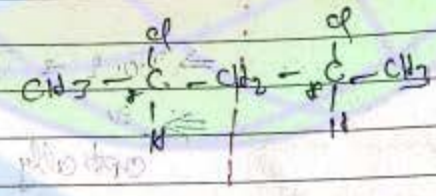
Some

(5) 
(Tautomerism)

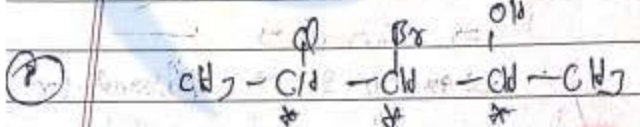
→ chiral = ✓ (2)
→ P.O.S = Absent
so compound is optically active

(6) 

→ chiral = ✓
P.O.S = Absent
so optically Active

(7) 

→ chiral → ✓
→ P.O.S → ✓
so compound optically Inactive

(8) 

→ chiral = ✓
P.O.S → ~~is~~ absent
so compound optically active

Enantiomer's ⇒ optically active (1) non-super impossible mirror Image (1)

Some Imp. definitions / terms →

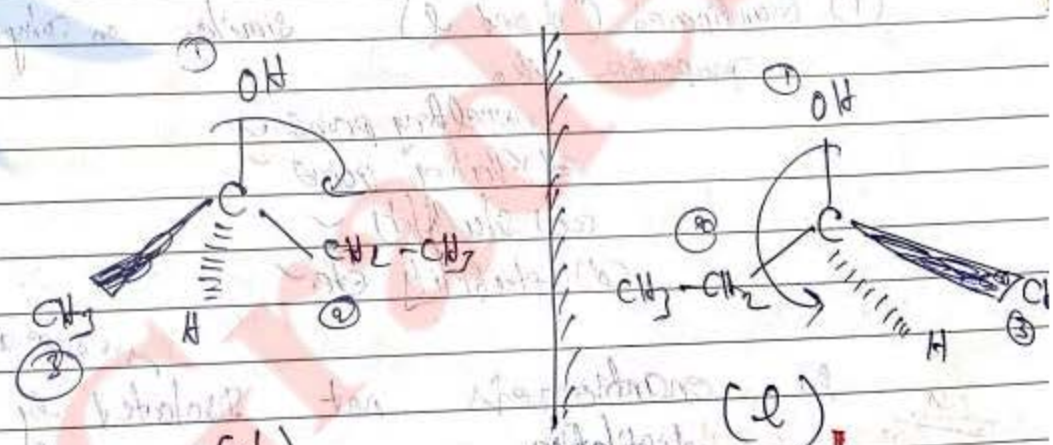
① Enantiomers :→ or Enantio Isomers or Anti pods

[Enanto ⇒ opp / mirror Image
morphs / meres ⇒ parts]

Two optical active Isomers which are mirror Images to each other said to be enantiomers which are same in mag. of Angle of rotation but differ in direction
Both enantiomers non super Impose

eg: 3-methyl-2-butanol

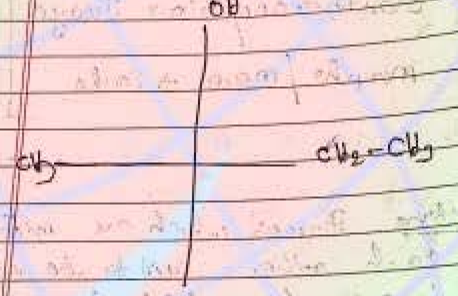
$CH_3-CH(CH_3)-CH(OH)-CH_3$ (butan-2-ol)



Rq

① optically active — d dolor l-rod

By fisher projection



Specific features of enantiomer's

① Enantiomers (d and l) similar in physical properties like
- (a) melting point
- (b) boiling point
- (c) solubility
- (d) stability etc

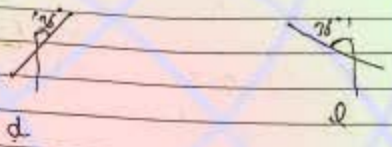
Rq So enantiomers not isolated (or separate) by fractional distillation

Enantiomers

Ra, Ra, Ra

(d and l)

(2) Enantiomers equal or similar in magnitude of angle but in opposite direction



(3) Enantiomers exhibit diff rate of rex^n with optical active reactant

Rq

d + x (optically active) $\xrightarrow{K_1}$ (P) Product

$K_1 \neq K_2$

l + x (optically active) $\xrightarrow{K_2}$ (P) Product

(4) Rate of rex^n similar when enantiomers react with optically inactive reactant

Rq

d + Y (optically inactive) $\xrightarrow{K_3}$ P Product

$K_3 = K_4$

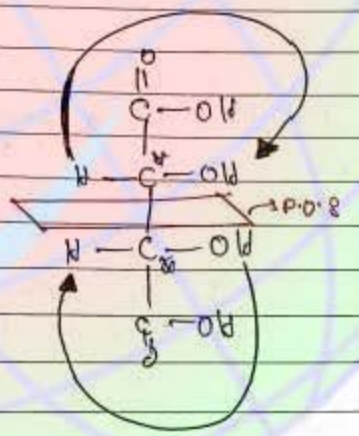
l + Y (optically inactive) $\xrightarrow{K_4}$ P (Product)

(2) Meso - Compound

Optical or stereo isomer in which Plane of symmetry (P.O.S) occurs said to be meso compounds

meso compound optically inactive in nature.

Reason :→



Here Internal compensation take place.

meso-tartaric acid

θ_{net} = Zero
i.e. angle of rotation

Both equal Half's rotate the PPL opposite to each other with same magnitude so due to complete compensation of rotation comp exhibit

$\theta_{net} = 0$ (zero)

it is known as Internal Compensation.

③ Dia stereo. Isomer Dia stereomers.

Stereo Isomers which are not mirror Images to each other

Note

mirror Image में समान "d" और "l" का Angle different होता।

Examples ① All G.I (cis-trans) / (a) syn-anti / (c) (E-Z)

② d and meso
some angle — Zero angle

③ l and meso
d — some angle — Zero angle

Rational formula of compounds given below:-

HOOC – CH(OH) – CH(OH) – COOH

(I) Tartaric Acid

(II) Tartaric acid

(III) Tartaric Acid

(I) → P.O.S → X

(II) → P.O.S → X

(III) → P.O.S → ✓ → meso

optical active

optical active

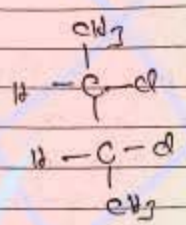
optical inactive

(1) Enantiomers → I and II

(2) Diastereomers → I and III or II and III

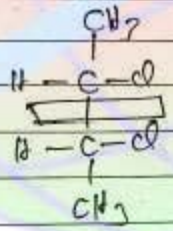
(4) meso → III

Q) Enantiomer of 2,3 dichloro butan give +40° angle of rotation than
(i) what is the angle of next enantiomer
(ii) what is the angle of compound



(i) −40°

(ii)



meso comp

Angle Zero

④ Racemic mixture →

Equimolar mixture of enantiomers (d and l) known as racemic mixture denoted by (dl) or (±) or (Rs)

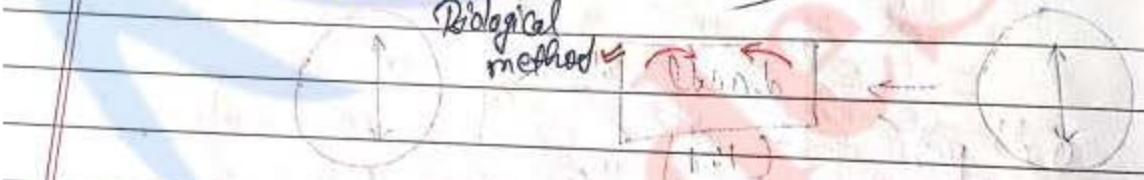
Racemic mixture is optically inactive in nature due to complete cancelation of angle of rotation by "d" and "l" enantiomers forms process is known as complete compensation

Resolution (Seperation)

Seperation of optical active enantomeric form d' & l' from racemic mixture

~~that~~ then process said to be resolution

dl (mixture) → Resolution By physical or chemical or Biological method → d (optically active) + l (optically active)



Ra

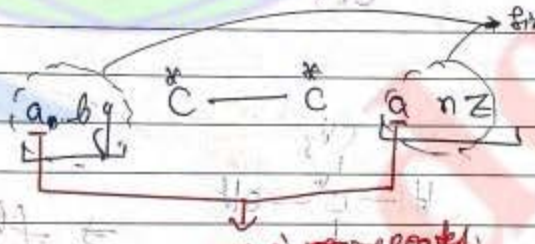
⑥ Erythro - threo nomenclature/ orientation :-

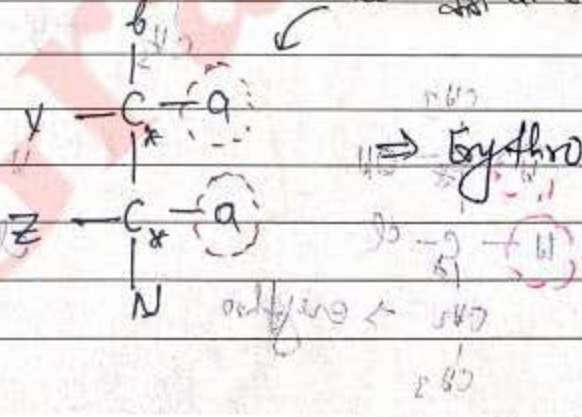
*	Erythro → Same side *
*	Threo → opposite side *

* Structural conditions for erythro and threo orientation :-

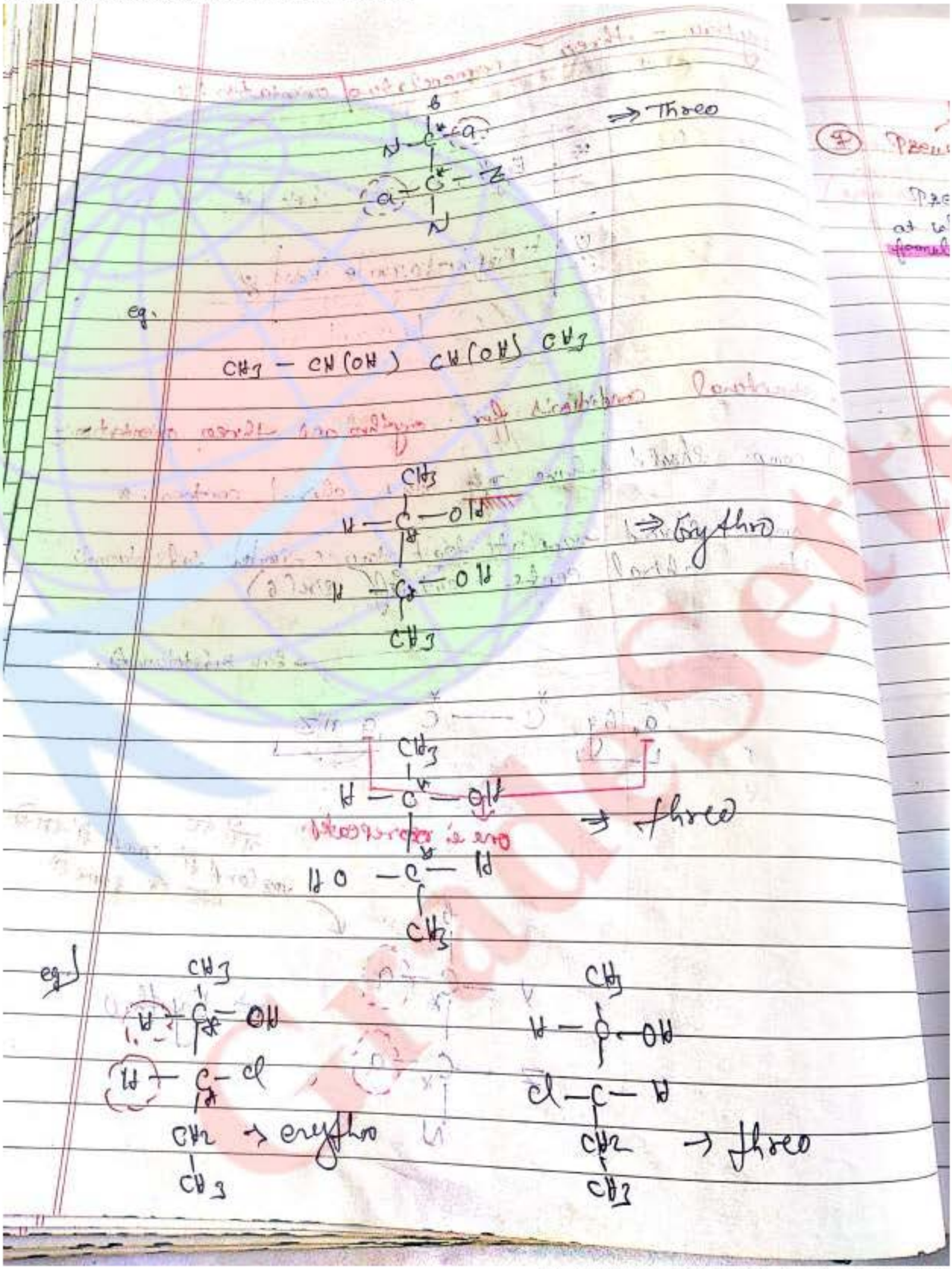
(i) Comp. should have only two chiral centres.

(ii) Comp. should have at least two similar substituents at chiral centre out of six (6)





यहाँ पर Comp में comp में same जो same के same है।



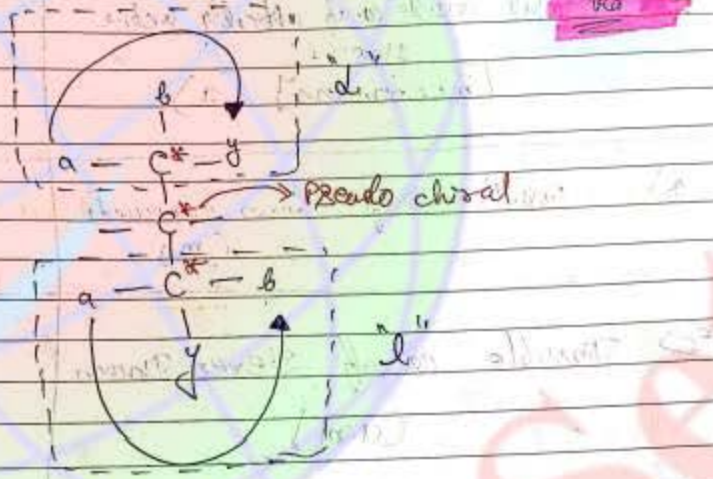
Ps

(means false)

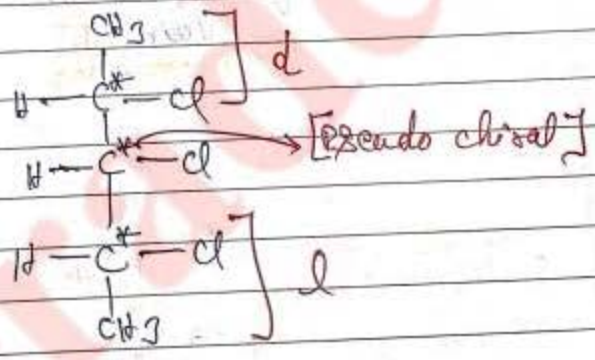
(P) Pseudo -chiral centre

Pseudo chiral said to be that type of carbon at which two group's are similar in molecular formula but differ to each other in orientation (d and l)

Ps

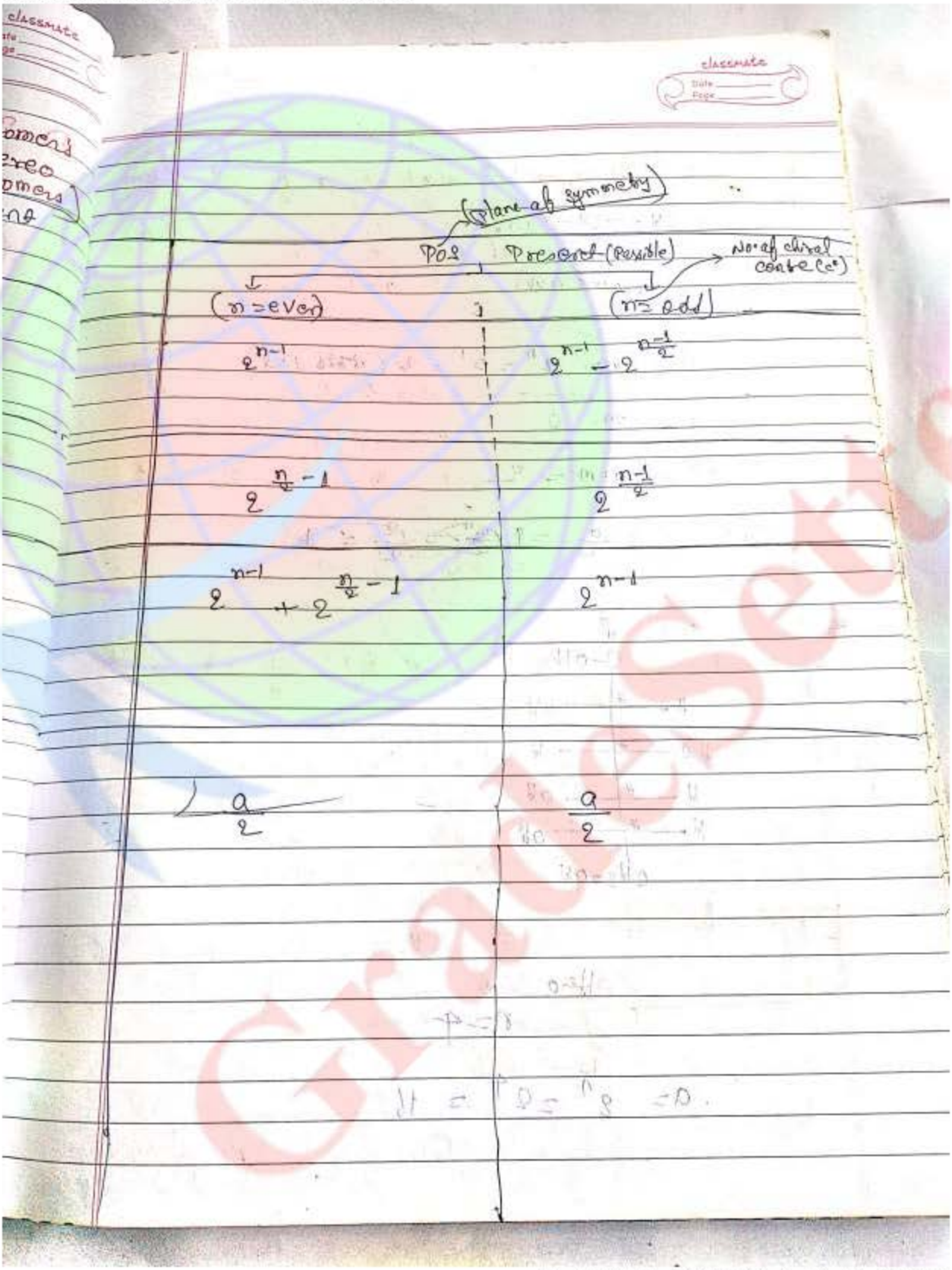


Pseudo chiral or centre or false chiral centre

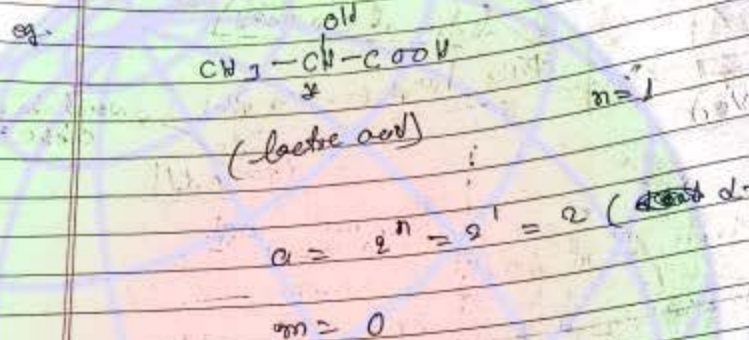


(8) To determine Posible no. of Dsome Cstereo Dsomers

S.No	Nature	POS absent
Imp 1.	Total Possible no. of optically active Dsomers [Enantomers] (a)	2^n
2)	Possible no. of meso Compounds (m)	0
Imp 3.	Possible no. of stereo Dsomers (a+m)	2^n
(4)	Possible no. of enantiomeric Pair	$\frac{a}{2}$



eg.



(lactic acid)

$n = 1$

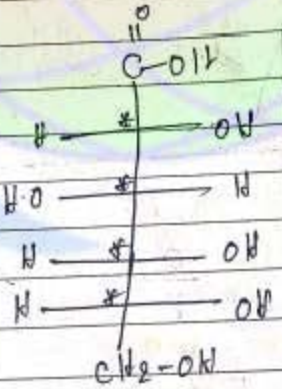
$a = 2^n = 2^1 = 2$ (optical d+l)

$m = 0$

$a + m = 2$

$\frac{a}{2} = 1$

eg.



Here

$n = 4$

$a = 2^n = 2^4 = 16$

q.)

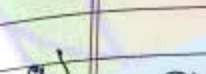
$n = 2$ (Here, n is even)

$a = 2^{n-1} = 2$

$m = 2^{\frac{n}{2}-1} = 2^{1-1} = 2^0 = 1$

$a + m = 2 + 1 = 3$

q.)



$n = 3$

$a = 2^3 = 8$

$m = 0$

$a + m = 8$

q.⑤

$n = 3$ (odd)

$a = 2^{3-1} = 2^{\frac{2}{2}} = 2^2 - 2^1 = 2$

$m = 2^{\frac{2}{2}} = 2$

$a + m = 4$

(9) SR (Specific rotation) = observed angle or

↳ symbol ⇒ $[\alpha]_T^\lambda$

Specific rotation is observed angle of rotation of organic solution with unit concentration (1 g/mm) with unit conc. present in 1 dm (1 dm = 10 cm) polarimeter tube or Polarimeter at constant temp and wavelength

[T = 25°C / λ = 589 nm]

(1 dm = 10 cm)

$$[\alpha]_T^\lambda = \frac{\alpha_{observation}}{C \times l}$$

↳ conc. ↳ length

Here

α_{obs} = Angle of rotation observed in degree (°)

C = Conc of org. comp in gm/ml

l = length of tube in dm
(1dm = 10cm)

Q) Calculate SR when conc of solution of ... 2gm per 10 mm present in 25cm long tube angle of observation is +17.4° at 25°C Temperature and 589 nm wavelength.

Sol^n

17.4

10) R-S Configuration [Absolute Configuration]

R ⇒ Rectus (clockwise)

[↻]

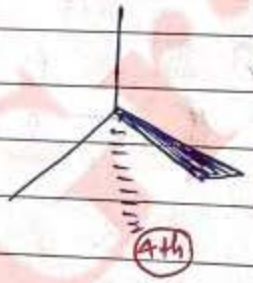
S ⇒ Sinister [Anticlockwise]

[↺]

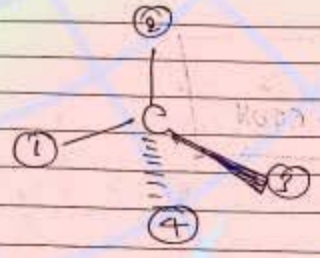
① For dash-wedge formula ⇒ (3-D represented

Case IIth

When 4th Priority (last Priority) present at dash position



Step 1st :- Decide or Assign the priority order of substituents and chiral centre by CIP - Rule / Sequence rule.



Step 2nd :- Give rotation

1 2 3 ons

Note :- Ignore the 4th priority if rotation in clockwise direction.

~~Than configural~~

Now

Ignore the 4th carbon

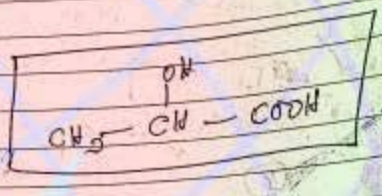
If

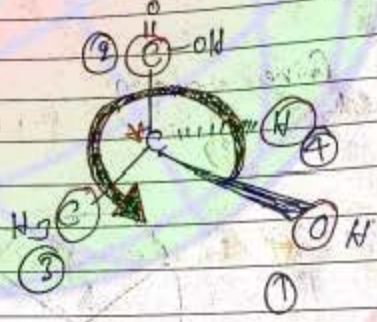
Than Configuration will be R.

ans

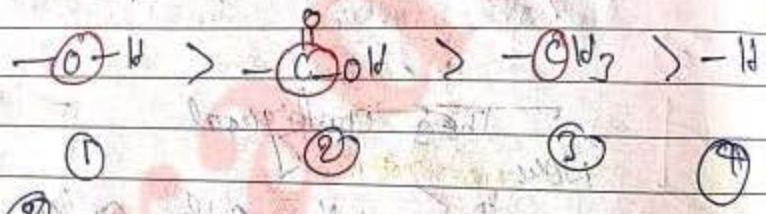
if rotation in Anticlockwise direction the configuration will be S

eg.

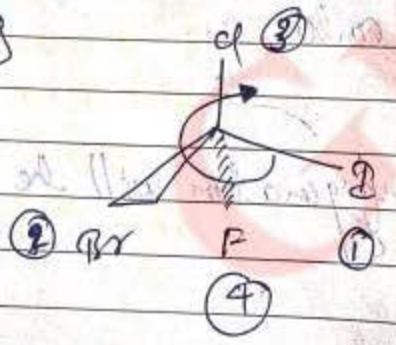




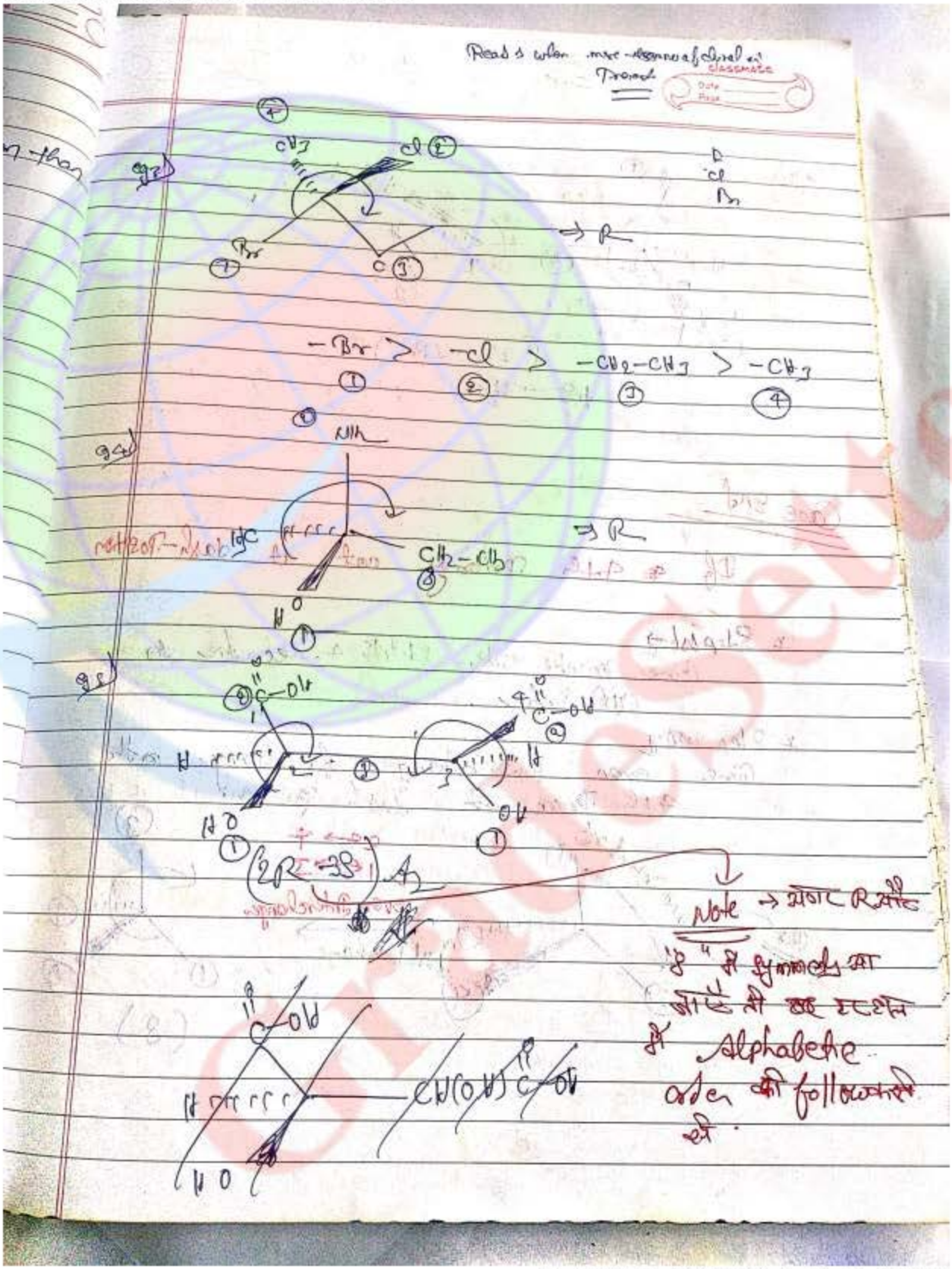
⇒ S-lactic Acid

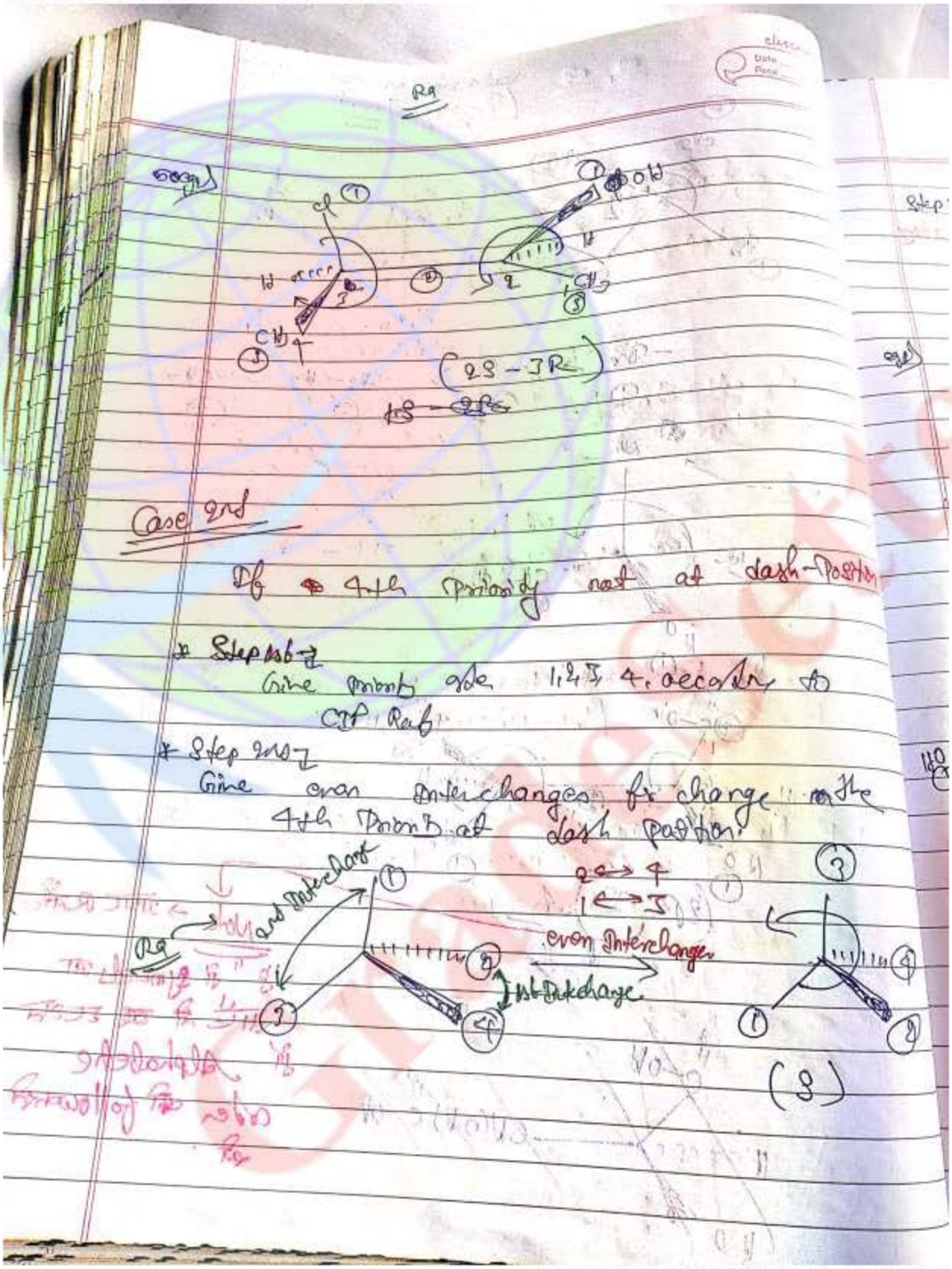


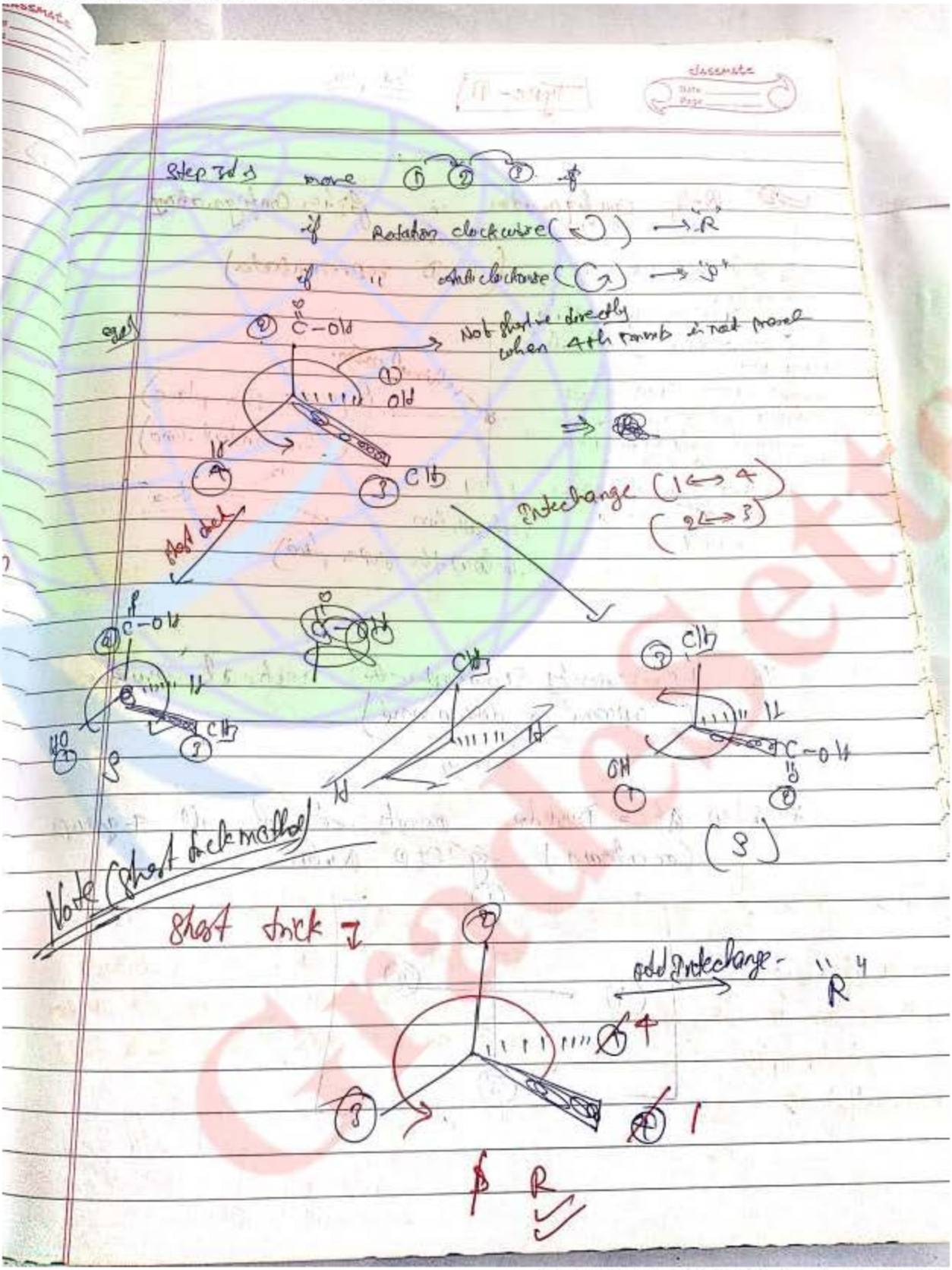
eg 2



→ R



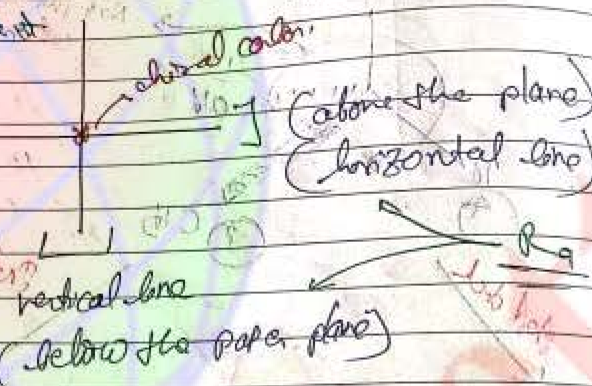




Type- B   Ra , Ra

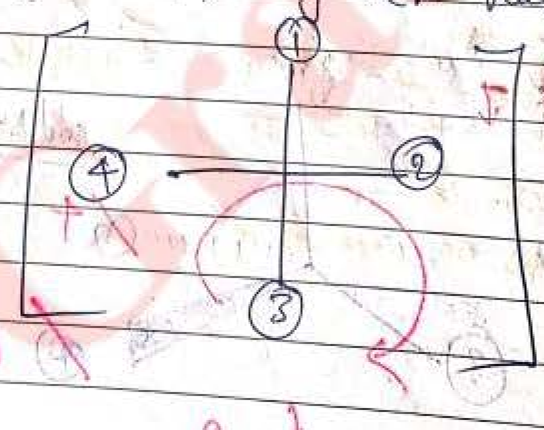
(2) R-S configuration or fisher configuration
(2-D representation)

Note इसमें बस एक बात याद रखें :-> अगर "4th" Priority उपस्थित होता तो भी Rule है उसी Rule से naming करें लेकिन अगर "4th" Priority उपस्थित नहीं होगा तो भी General Rule से ही name होगा बस उत्तर उल्टा लिख दें (बस उत्तर को उल्टा लिखें fisher formula के लिए)



If 4th priority present at vertical axis (upward or downward) → Ra

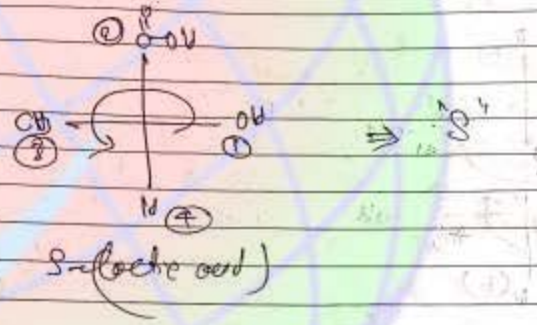
* Step 1st → Provide priority order of all 4 groups (or atoms) by CIP Rule

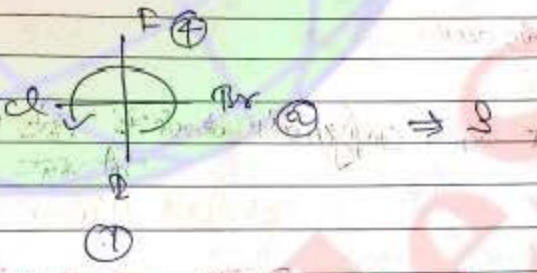


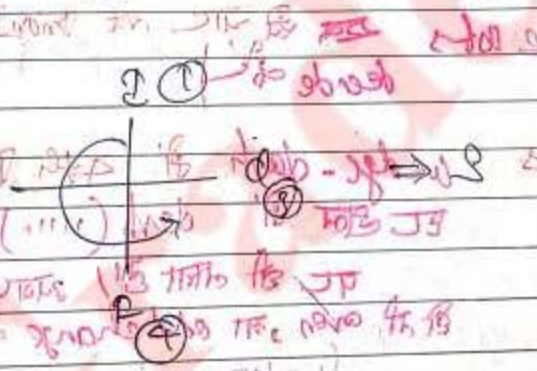
Step ends migrate

if rotation is in clockwise direction → "R"

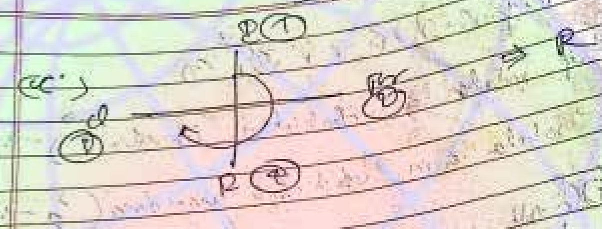
if rotation is in anti clockwise direction → "S"



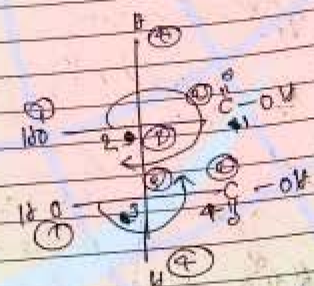




Rq



Q9.



(R, S) - Taken out.
(2R, 3S)

Rq → यहाँ R, S configuration decide करके fix 1, 2 ... भी लगाते हैं

* Step 1st: एक ही बार में priority order decide करें।

Step 2nd: wedge-dash में 4th priority हर हाल में dash (''''') position पर ही लाना है। अगर नहीं आ रहा हो तो even, या odd change करके लाए

↳ उतना नाम A/a General Rule

→ opposite every name A/a General Rule

Note

① If ... symmet...

Case

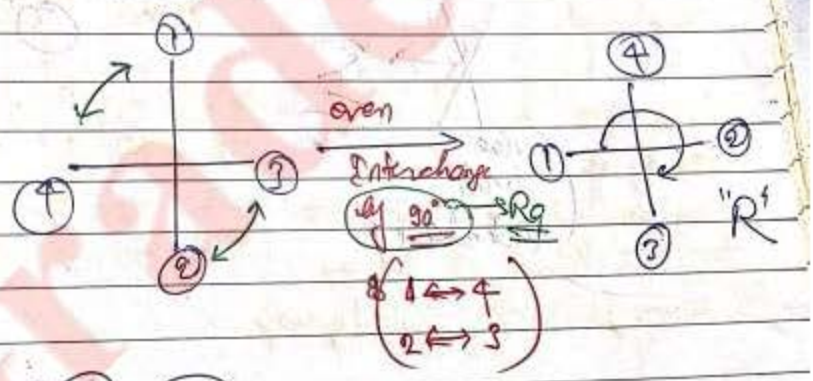
Note

① If chiral centre two or more than two types and symmetry will be present in molecule then "R" is always dominant over "S".

Case 2nd → If 4th Priority is not present at vertical axis then

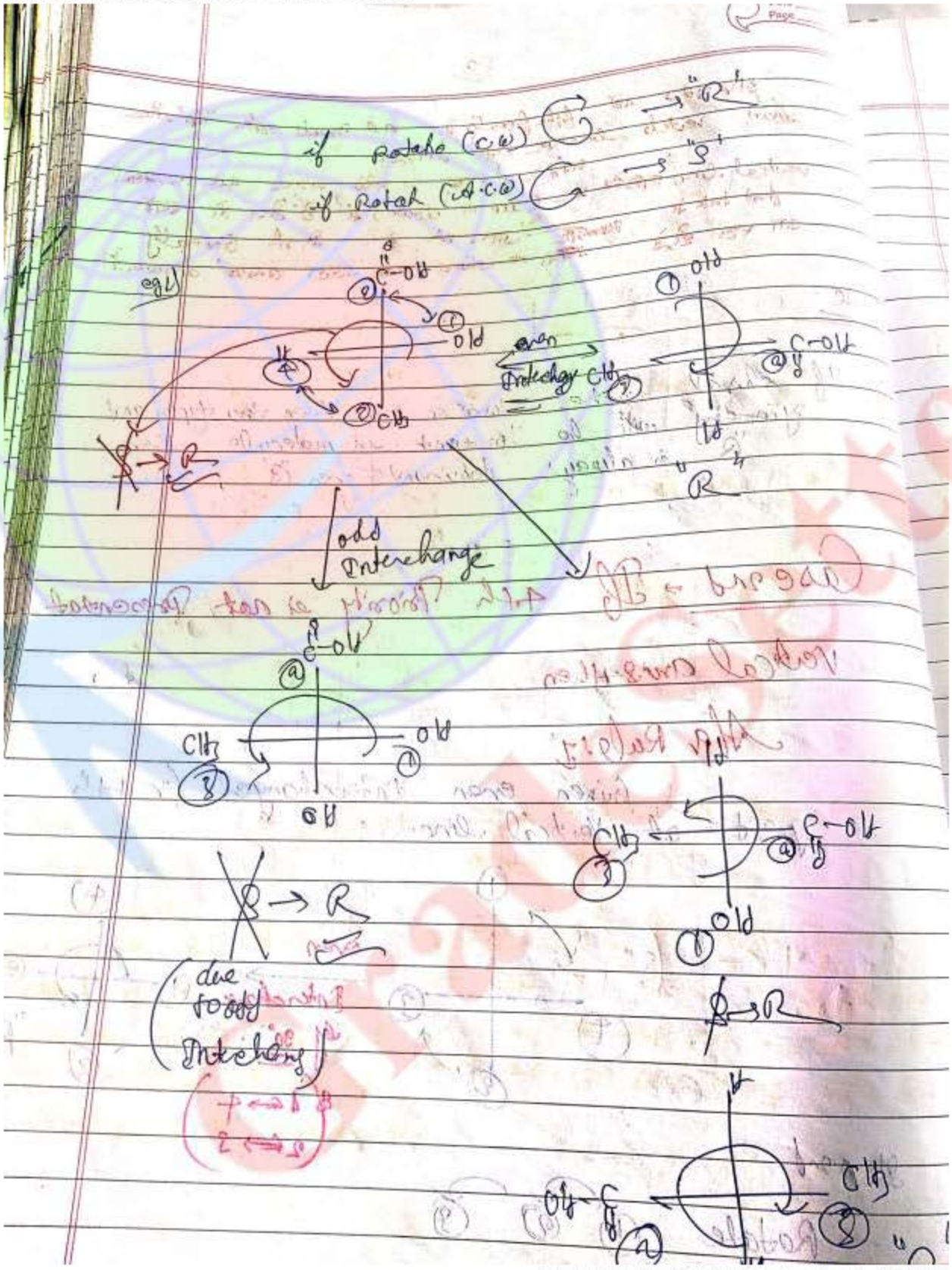
Ala Rule:-

Given even Interchange for 4th position at vertical line.



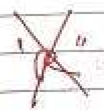
Step 2nd

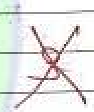
Rotate ① ② ③



Short trick

If 4th priority not at vertical axis or longitudinal axis then given rotation from without Interchange.

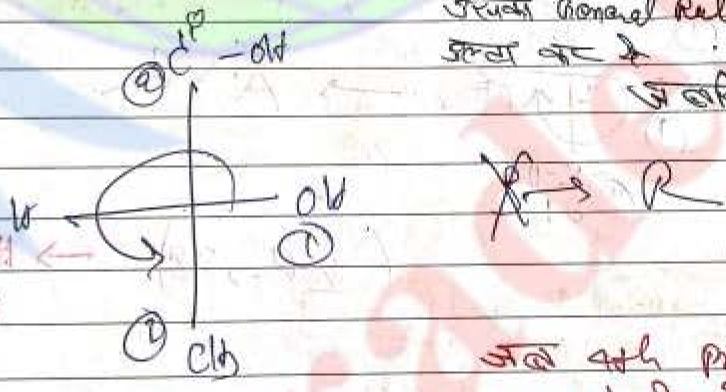
If Rotation in (C.W) ↻ →  → S

if Rotation in (A.C.W) ↺ →  → R

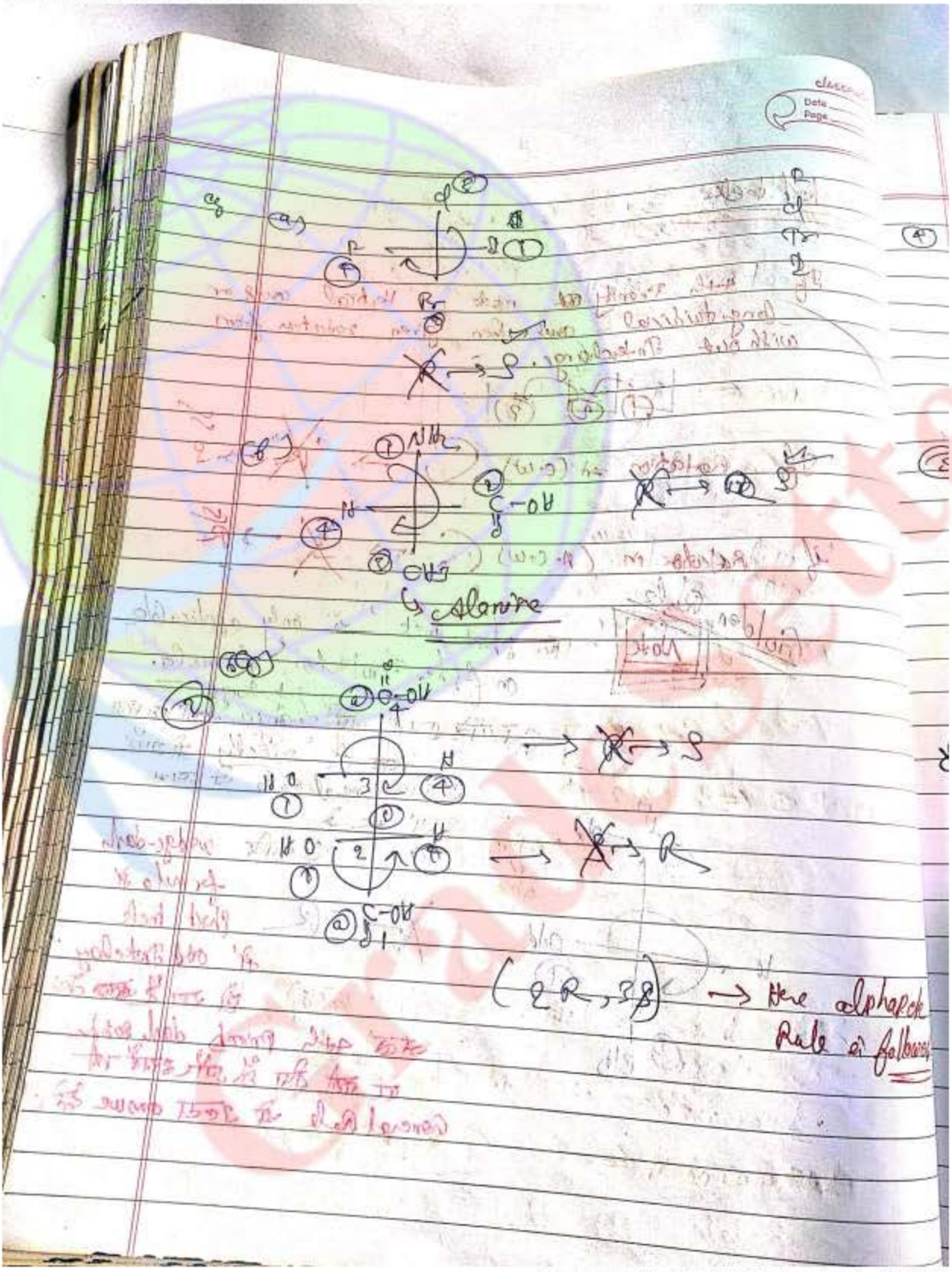
Golden Rule

Note — This short trick is only applicable on Fischer Projection formula.

क्योंकि इसमें interchange / change नहीं [illegible] जब भी directly आ जाएँ उसका General Rule से उसका उल्टा करते हैं



जबकि wedge-dash formula में short trick में odd Interchange हो रहा है तब जब 4th priority dash bond पर नहीं होता है और इसमें भी General Rule का उल्टा answer देते हैं

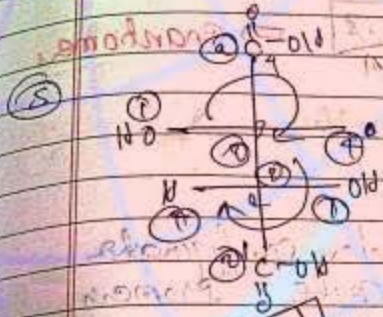


Q9

→ X → R

→ X → R

(2R, 3R)



X → S

X → S

(2S, 3S)

Special Point

Support

(1) Compound have same configuration at all chiral carbons then compounds will be Identical

R

eg: 2R, 3R → Identical.

2R 3R only 2R 3R

are Identical

(2) If compound have one configuration at each chiral centre or both chiral centre Diomers will be enantiomers

2R 3R and 2S 3S ⇒ enantiomers

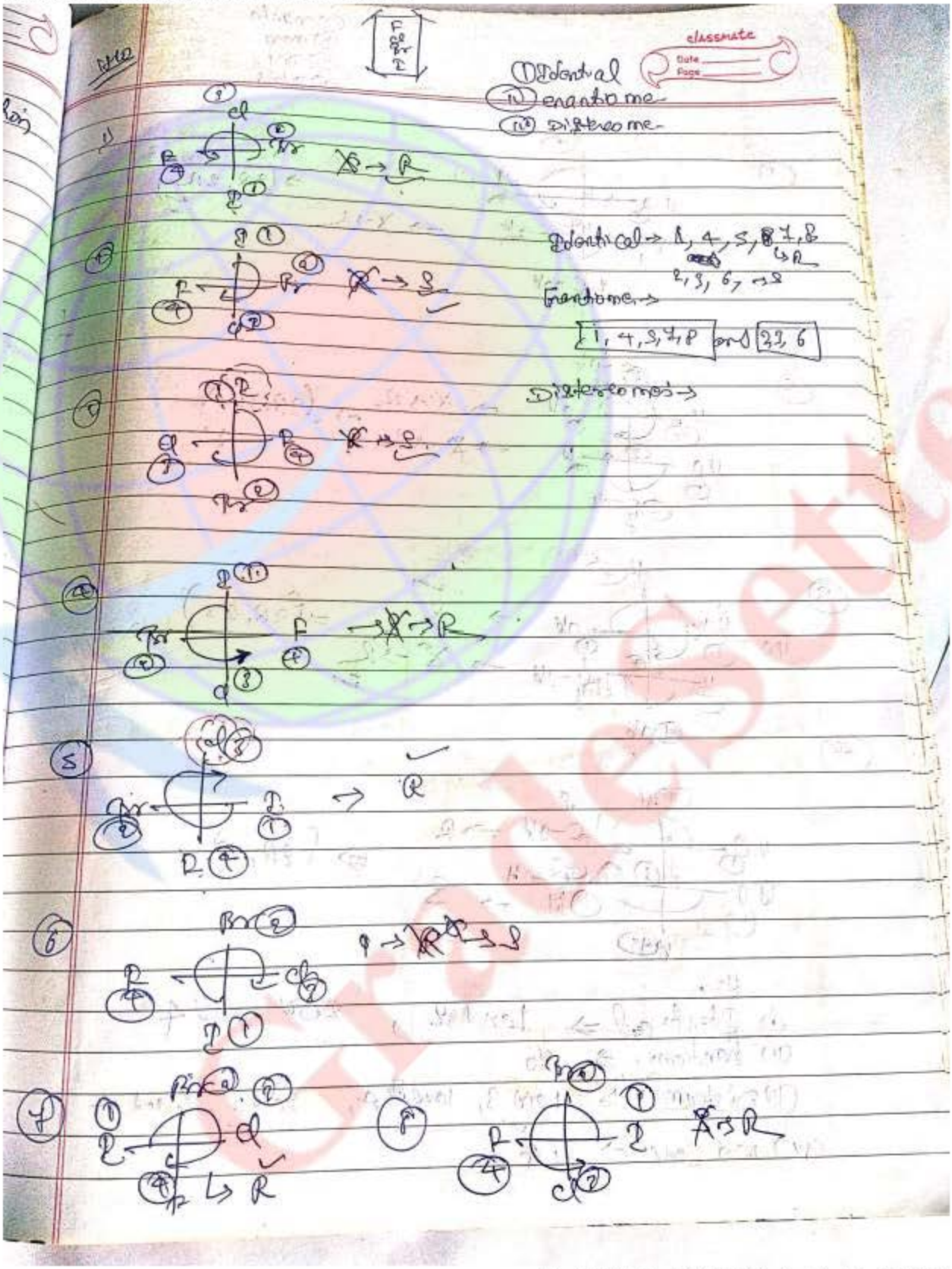
(3) If compounds have similar configuration at any single chiral centre Diomers will be diastereomers

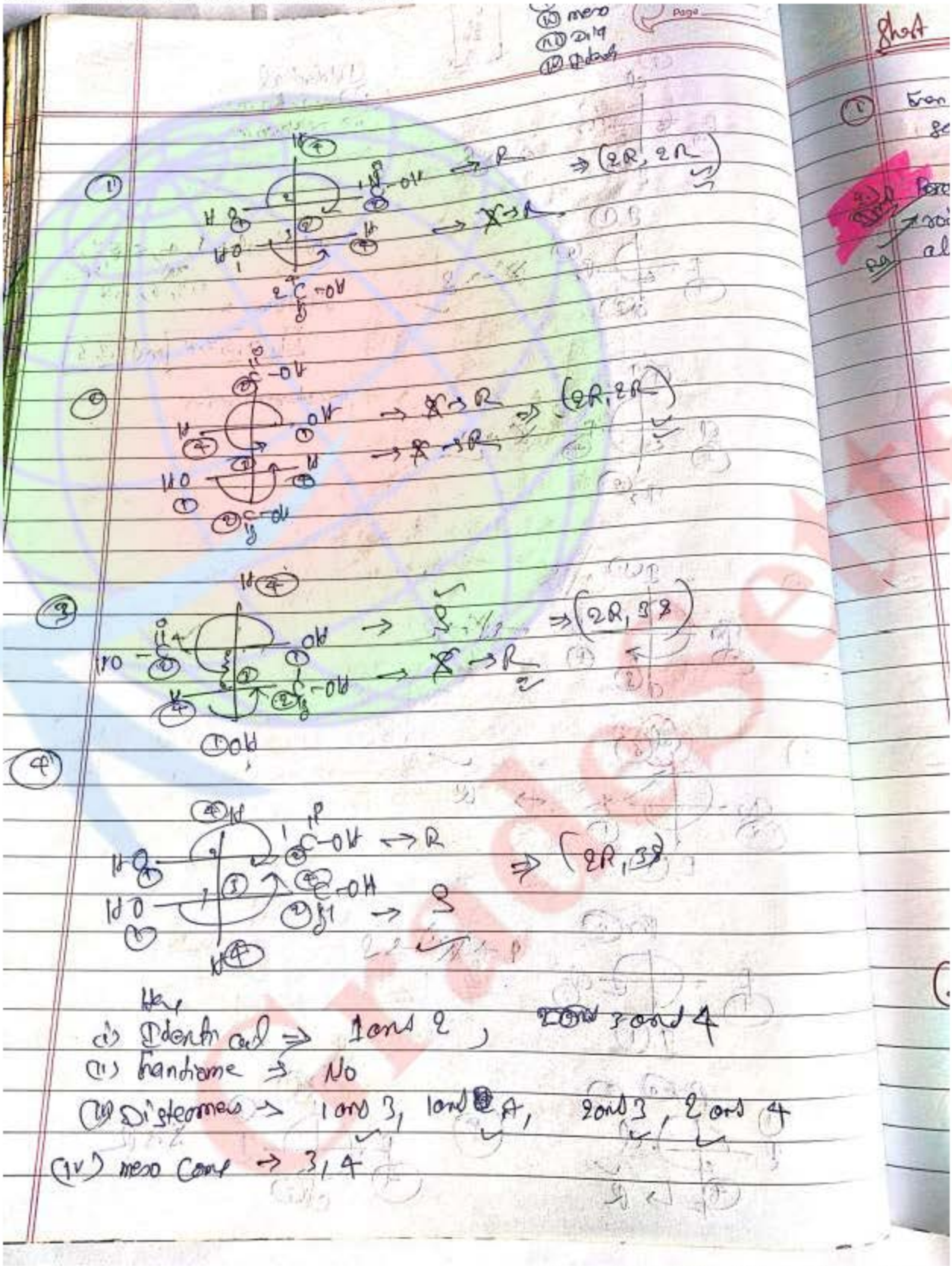
2R 3S and 2R 3R ⇒ Diastereomers

If only one is similar

(4) If compound is symmetrical and both chiral centers give opposite configuration then compound will be meso compound

2R 3S ⇒ meso compound



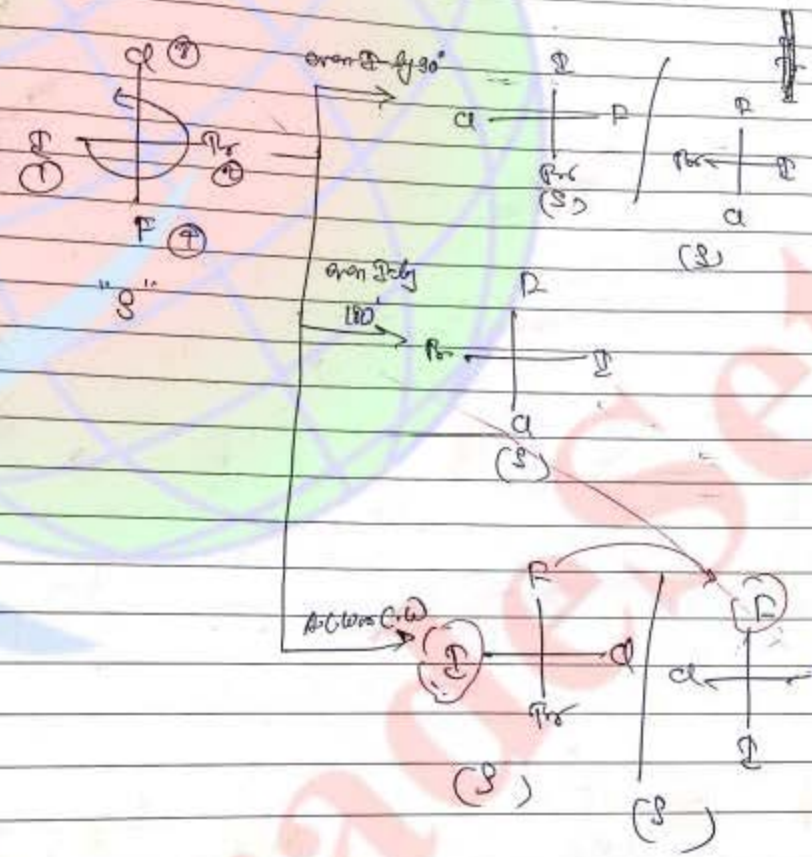


Key,
(i) Identical ⇒ 1 and 2, 3 and 4
(ii) Enantiome ⇒ No
(iii) Diastereomers ⇒ 1 and 3, 1 and 4, 2 and 3, 2 and 4
(iv) meso Comp ⇒ 3, 4

Short trick (To solve many questions very easily)

(1) Two ligands interchanges by 90° / 180° always give same Configuration.

(2) Fix any one valencies / ligand / substituent and rotate other three clockwise or anticlockwise configuration always remains same.



(3) If Comp. Contains more than one chiral centre then
(i) Identical comp. have same configuration at each chiral carbon (or centre)

2R 3R ; 2R 3R

Relative configuration [D-L system]

Ra

1. This system is based upon standard Glyceraldehyde (simplest sugar) molecules, and all configuration designated in respect of Glyceraldehyde relative.
2. This system is applicable only in Sugars and amino acids.
3. Configuration will be decided by OH (Sugar) and by NH_2 (amino acid) at chiral centre.

(a) D ⇒ -OH (in Sugar) / $-NH_2$ (in amino acid)

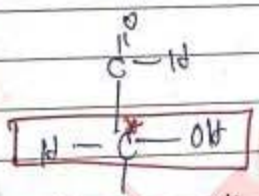
R.H.S at C^* (chiral carbon)

(b) L ⇒ -OH (in Sugar) / $-NH_2$ (in amino acid)

L.H.S at C^* (chiral carbon)

4. If Sugar or amino acid contains more than one chiral centre then configuration will be decided at Penultimate carbon (C^*) or Last chiral carbon (C^*)

Ra



Here, (+) and (−) indicate direction of Rotation of P.P.L

D-Glyceraldehyde

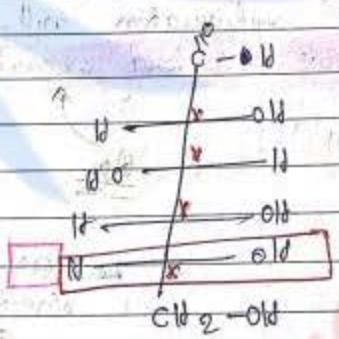
or

D(+) Glyceraldehyde or D(−) Glyceraldehyde.

Note

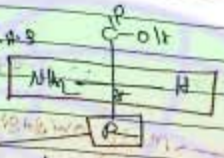
There is no co-relation between configuration (Dand L) and Rotation (+,-) of P.P.L.

L-Glyceral dehyde
or
L(+) Glyceral dehyde
or
L(-) Glyceral dehyde



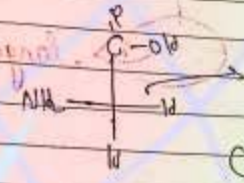
D-Glucose
or
D(+) Glucose

* Concept of Amino acid



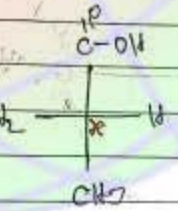
L-α Amino acid

① R = H (Glycine (simplest Amino acid)



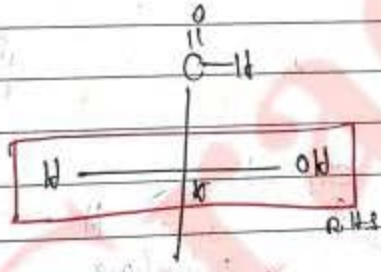
(Optically inactive)

(ii) R = CH_3 (Analine)

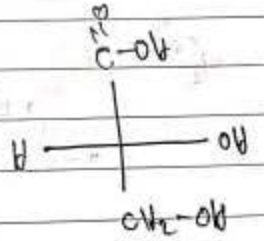


(L- Analine)

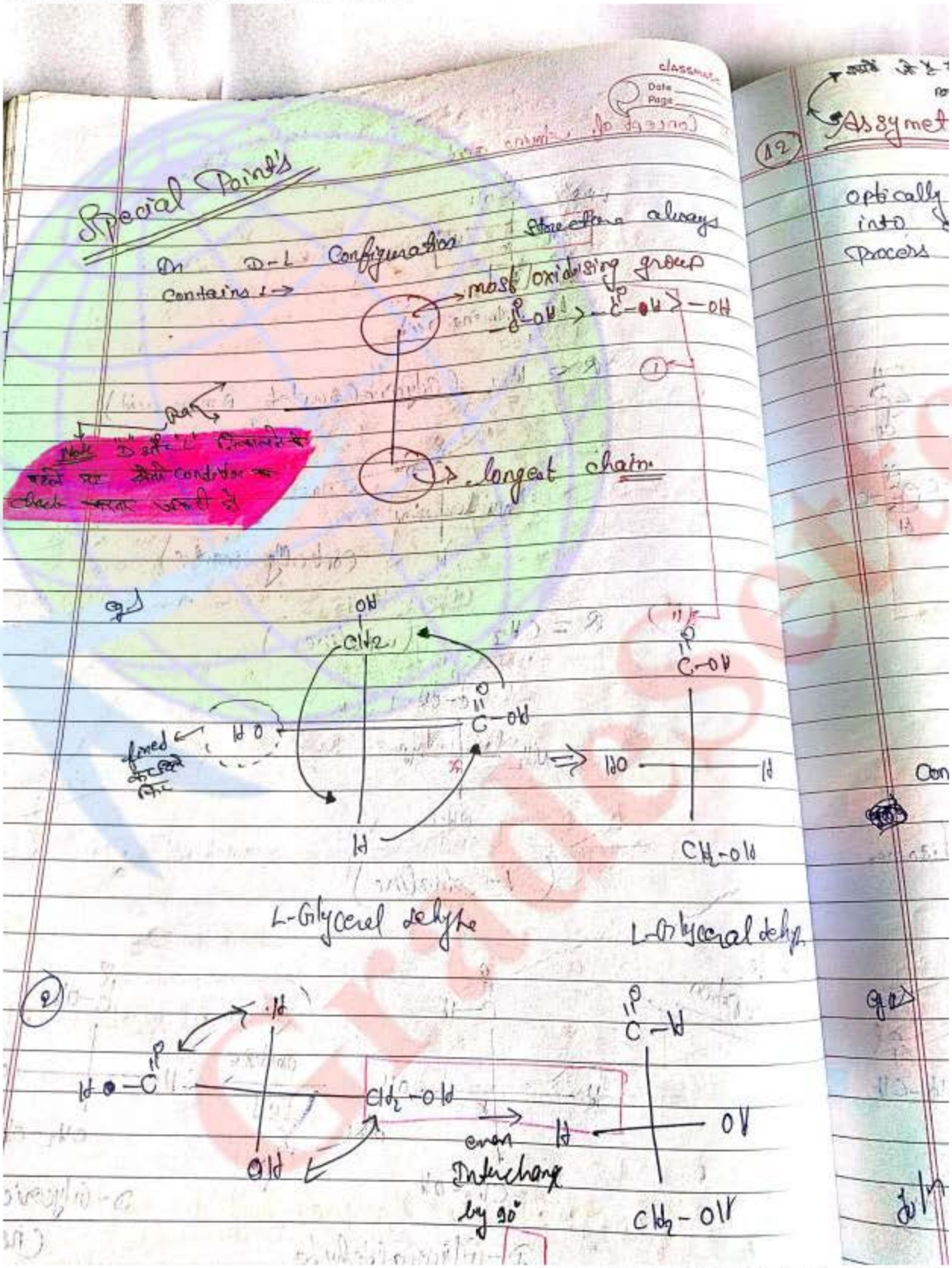
Note exception



D-Glyceraldehyde

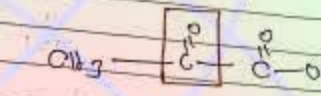


D-Glyceric Acid (non-sugar)



(12) Asymmetric Synthesis → Achiral (Convert) chiral

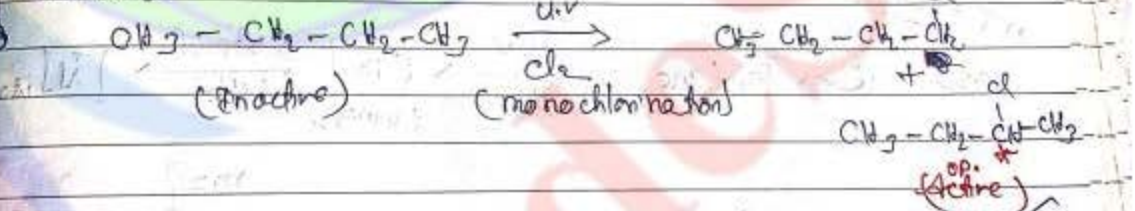
optically inactive compound (achiral) convert into optically active compound (chiral) by chemical process said to be asymmetric synthesis.



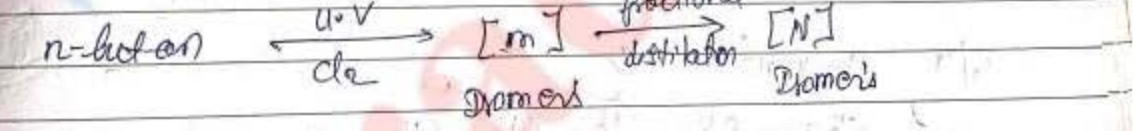
(Pyruvic acid) (Achiral)

(−) Lactic acid
chiral

Concept:-



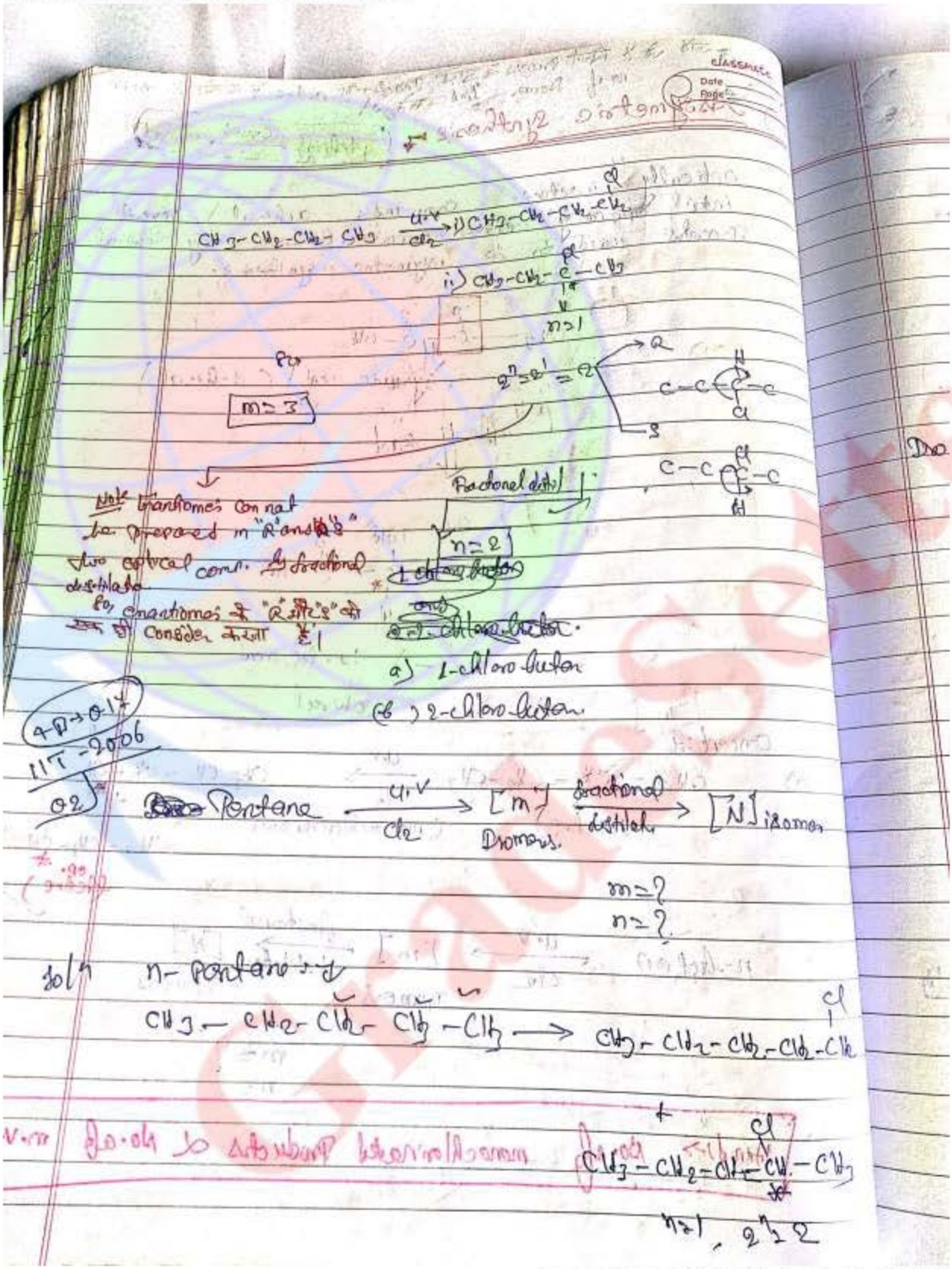
(Inactive) (monochlorination) (op. Active)



Ques n-butane → [m] Isomers → [N] Isomers

m = ?
n = ?

Hint:- No. of monochlorinated Products ∝ No. of m.v.R



Stereoisomerism

$CH_3-CH_2-CH_2-CH_3 \xrightarrow[Cl_2]{UV} CH_3-CH_2-CH_2-CH_2Cl$

i) $CH_3-CH_2-\underset{Cl}{\overset{Cl}{C}}-CH_3$ (n=1)

For m=3

Note: Enantiomers cannot be prepared in "Racemic" two optical comp. by fractional distillation

For enantiomers of "Racemic" consider करना है।

Fractional distil.

n=2

1-chloro butane

2-chloro butane

a) 1-chloro butan

b) 2-chloro butan

Do

4D → 01%

IIT - 2006

O_2

Pentane $\xrightarrow[Cl_2]{UV}$ [M] Isomers $\xrightarrow{\text{Fractional distillation}}$ [N] isomer

m = ?

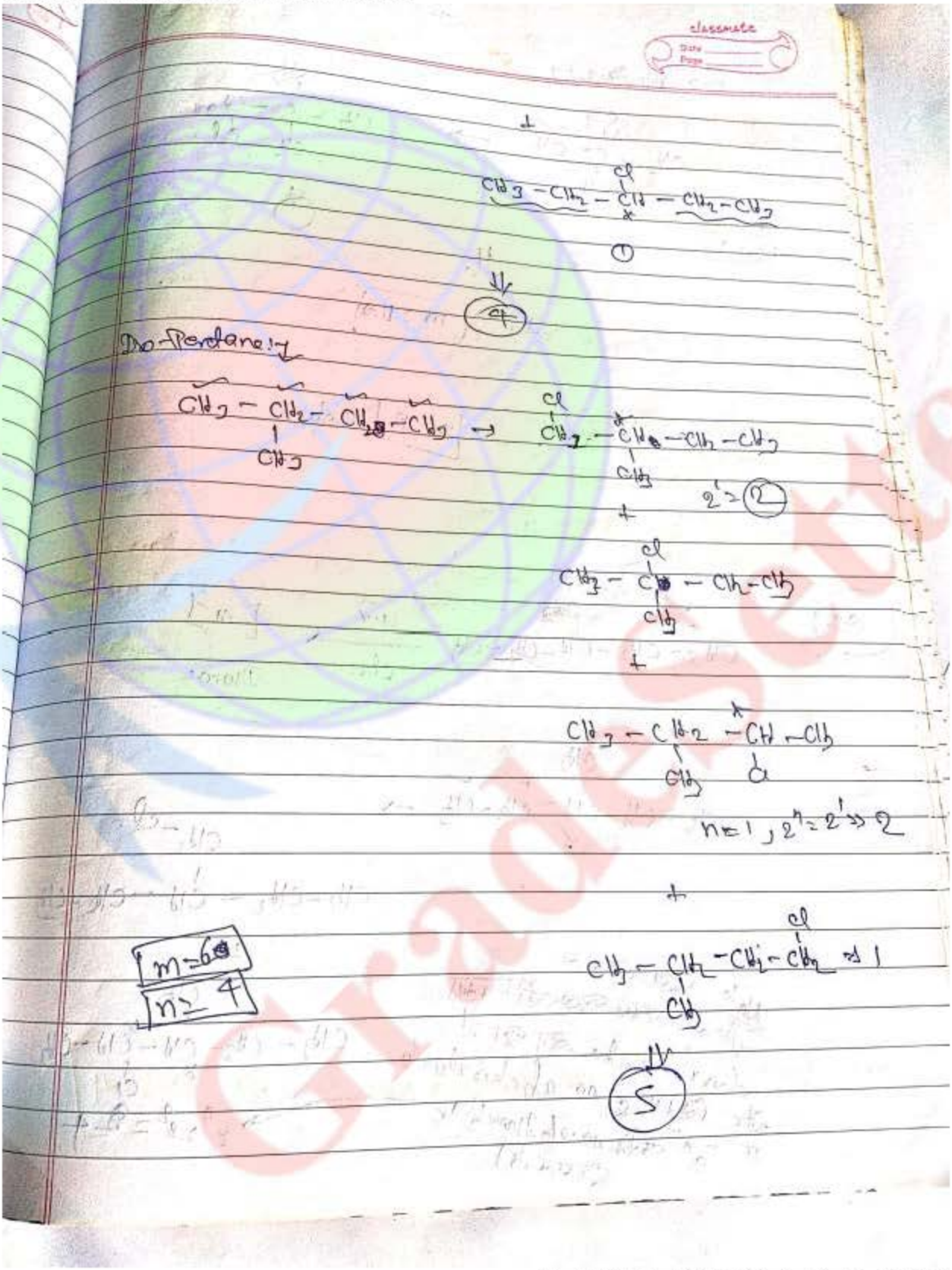
n = ?

Sol: n-Pentane :-

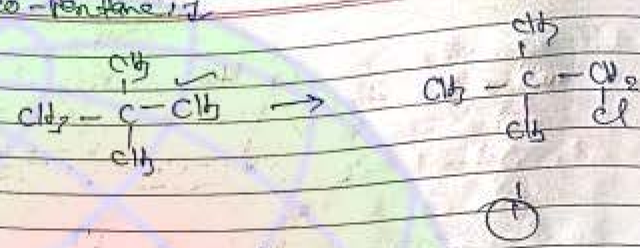
$CH_3-CH_2-CH_2-CH_2-CH_3 \longrightarrow CH_3-CH_2-CH_2-CH_2-CH_2Cl$

$CH_3-CH_2-\underset{Cl}{CH}-CH_2-CH_3$

n = 1, 2, 3, 2



neo - pentane : I



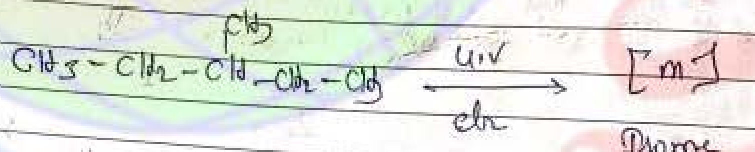
[m = 1]

[n = 1]

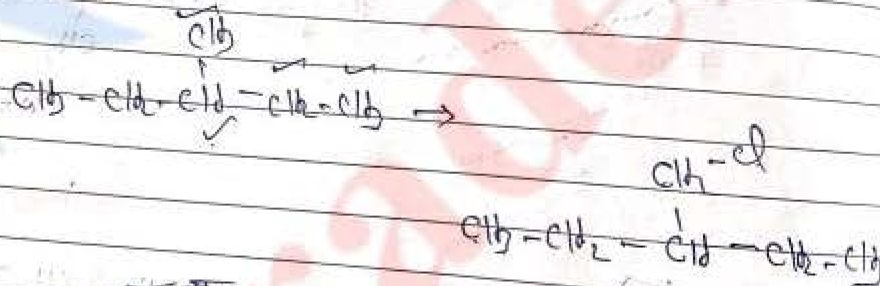
Total [m = 11]

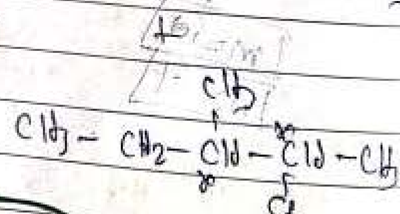
[n = 8] Ans

Q2.

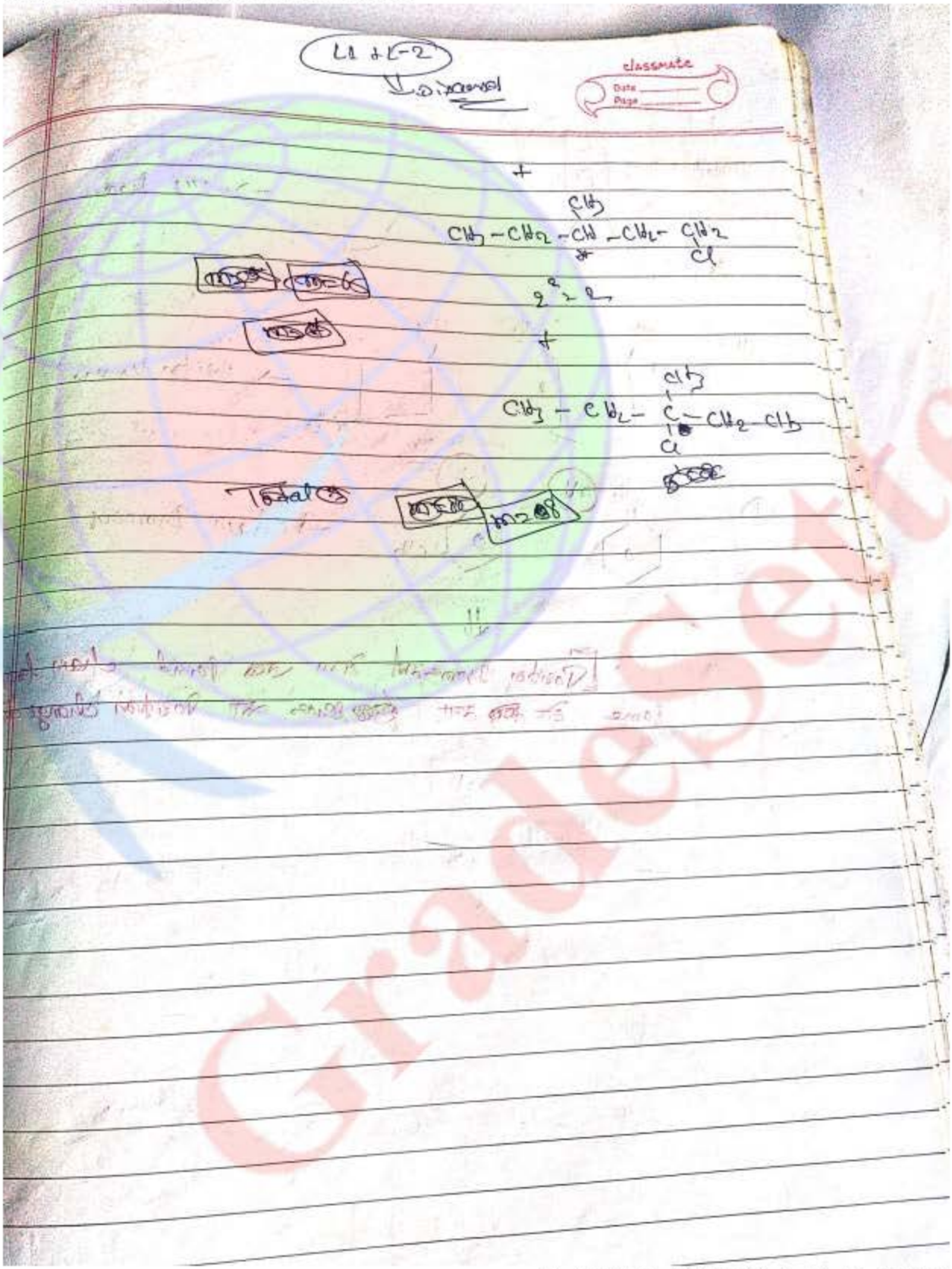


Diome

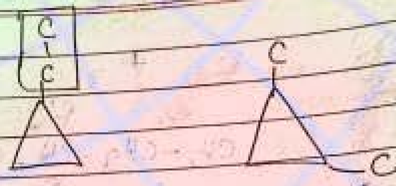




Note जिस कार्बन का प्रकार देखना होता कितना chiral centre बन रहा है उसमें कितना no. of chiral centre है "2^n" करके no. of Diome निकाल लें → $2^n = 2^2 = 4$



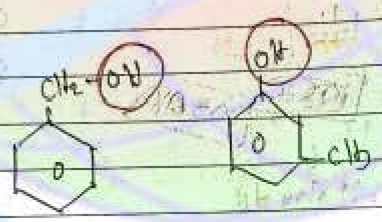
Note

(i) 

→ chain Isomer

(ii) 

→ Position Isomer

(iii) 

→ chain Isomers

⇓

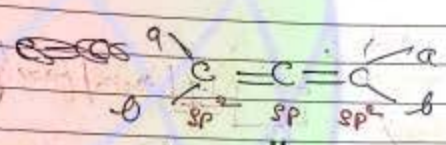
[Position Isomerism होगा जब Parent chain length same हो तथा functional group का Position change करे]

Extra Point

Comp are optically active without chiral centre →

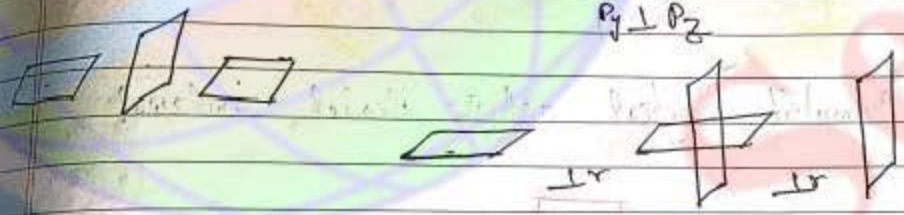
(1) chiral centre is not necessary to show optical isomerism.

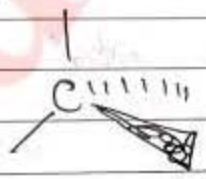
(2) Allenes

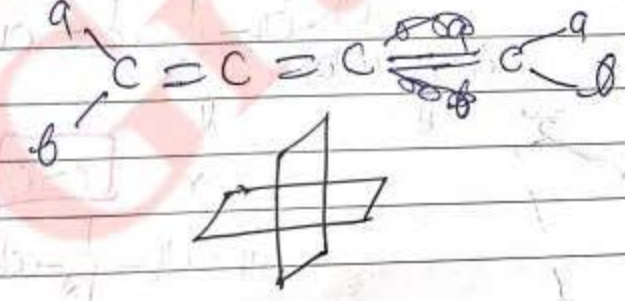


2 P orbitals

$P_y \perp P_z$







Entry Point
(tricky method)

① optical active compound Identification

(a) Simplest (minimum number of carbon) optical active compound

eg) Simplest optical active alcohol contains?

Sol^n

OH

$CH_3-CH_2-\underset{H}{\overset{*}{C}}-CH_3$ ⇒ 4 carbon

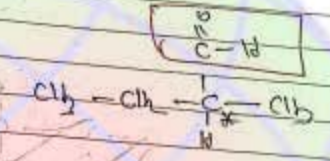
eg) Simplest optical active alkene?

$CH_3-CH_2-\underset{H}{\overset{*}{C}}-\underset{H}{C}=CH_2$

or C=C

$CH_3-CH_2-\underset{H}{\overset{*}{C}}-CH_3$

a) Structure of simplest optical active aldehyde

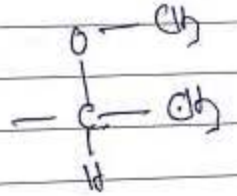


⇒ sc Ans

b) Optical active Compounds from molecular formula

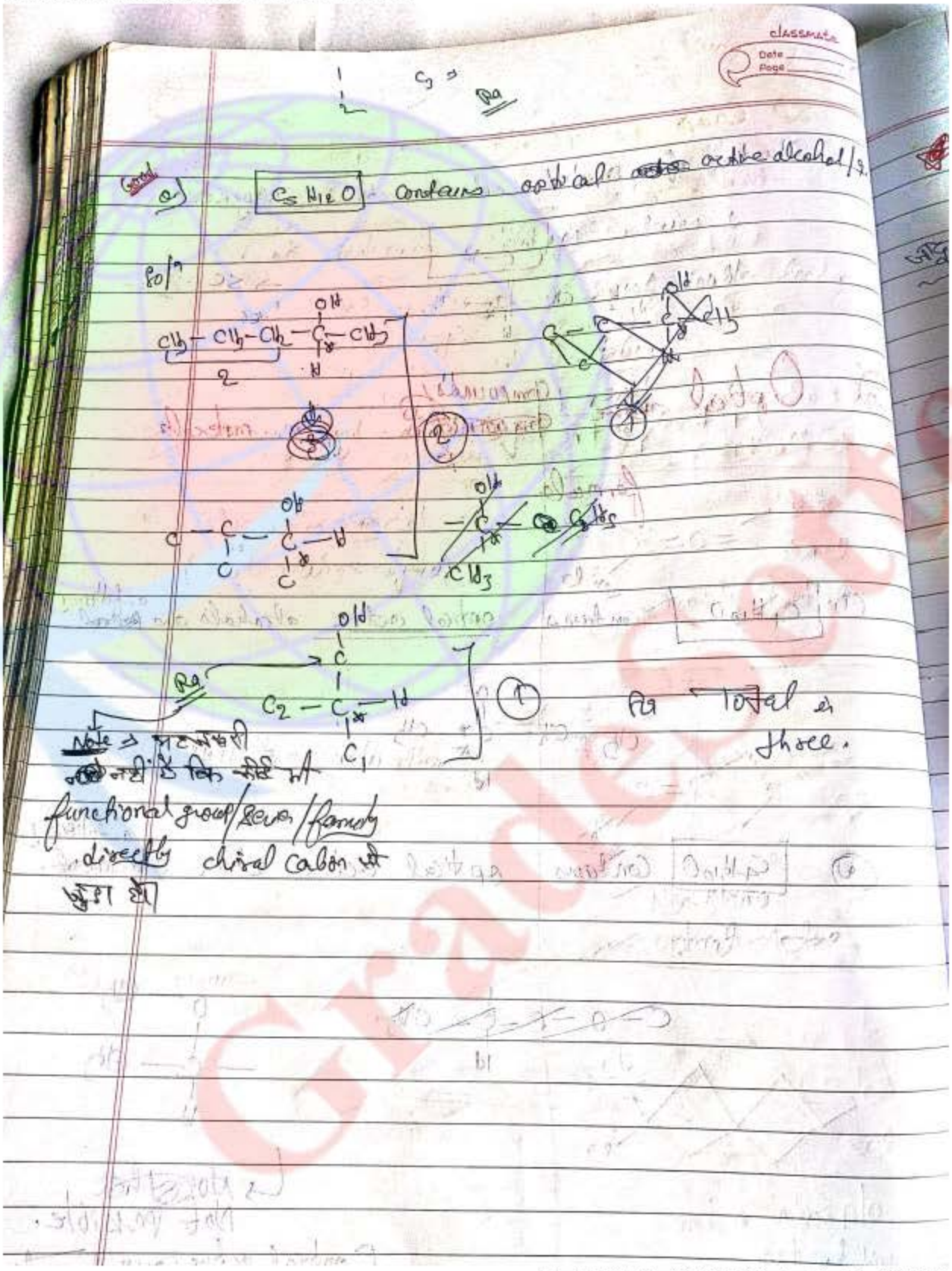
① $C_4H_{10}O$ contains optical active alcohols are as follows

② $C_4H_{10}O$ Contains optical active ethers are as follows



↳ Not possible.

(optical active compounds are not possible)



Optical activity ⊛ Comp: which does not contain chiral carbon:-

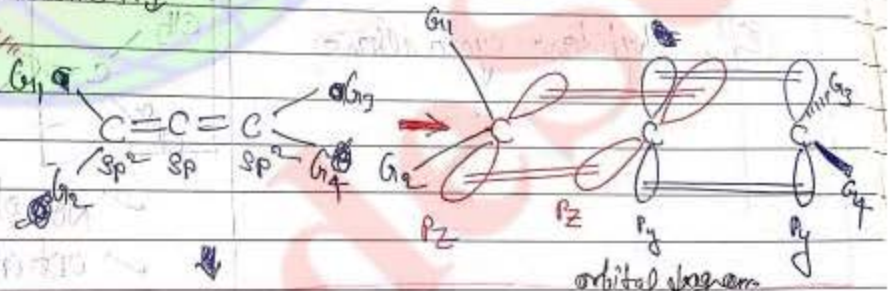
chiral carbon is neither necessary nor sufficient condition for optical Activity

Some comp exhibit optical Activity without presence of chiral centre also known as chiral molecule.

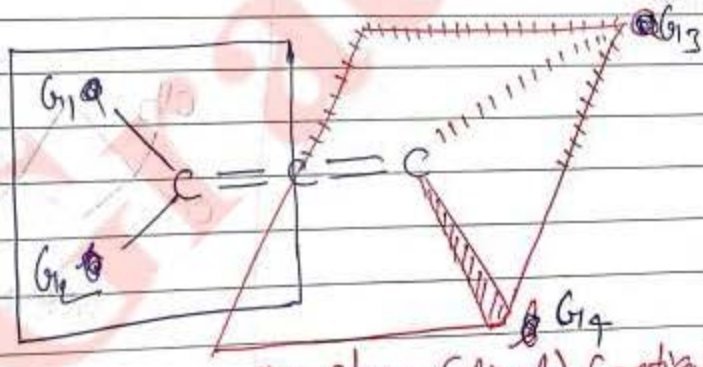
Reason:-
due to Non-Planar Geometry

eg:- Allenes, Alkylidene-cycloalkane, Spiranes and Biphenyles.

eg① Allenes:-



orbital diagram



2-D diagram.

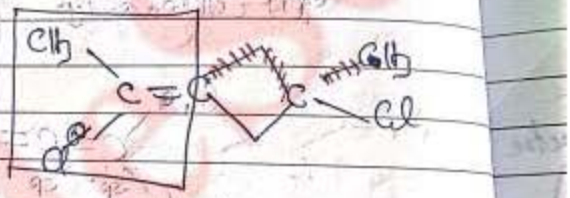
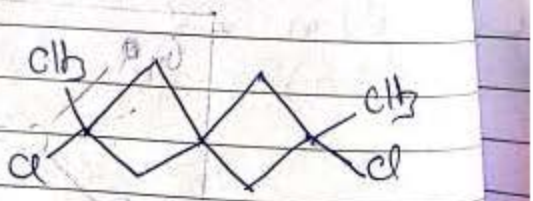
Non-Planar (chiral) (optical compounds)

Condition

chiral molecules always contains :-

(a) Continues [even] number of double bond or ring's

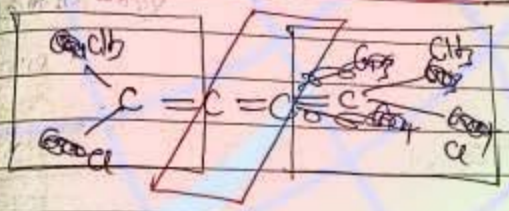
(b) $G_1 \neq G_2$ and $G_3 \neq G_4$

Example	[even] $G_1 \neq G_2$ / $G_3 \neq G_4$ (Non-Plane optically Active
① double bond or ring or Continues	
① Allenes or (Commulative polyene)	 Non-Plan Optical Isomer
② Alkylidene cycloalkane 	 Non-Planar optical-Active Isomers
③ Spirane 	 Non-plan optical Isomerism

[odd]

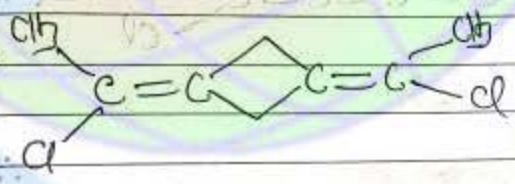
planar (but if) may be G.I

if $G_1 \neq G_2$ and $G_3 \neq G_4$



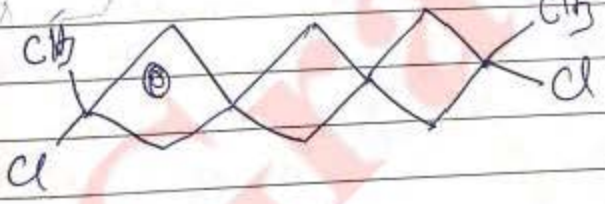
⇒ this represent G.I

⇒ non-optical



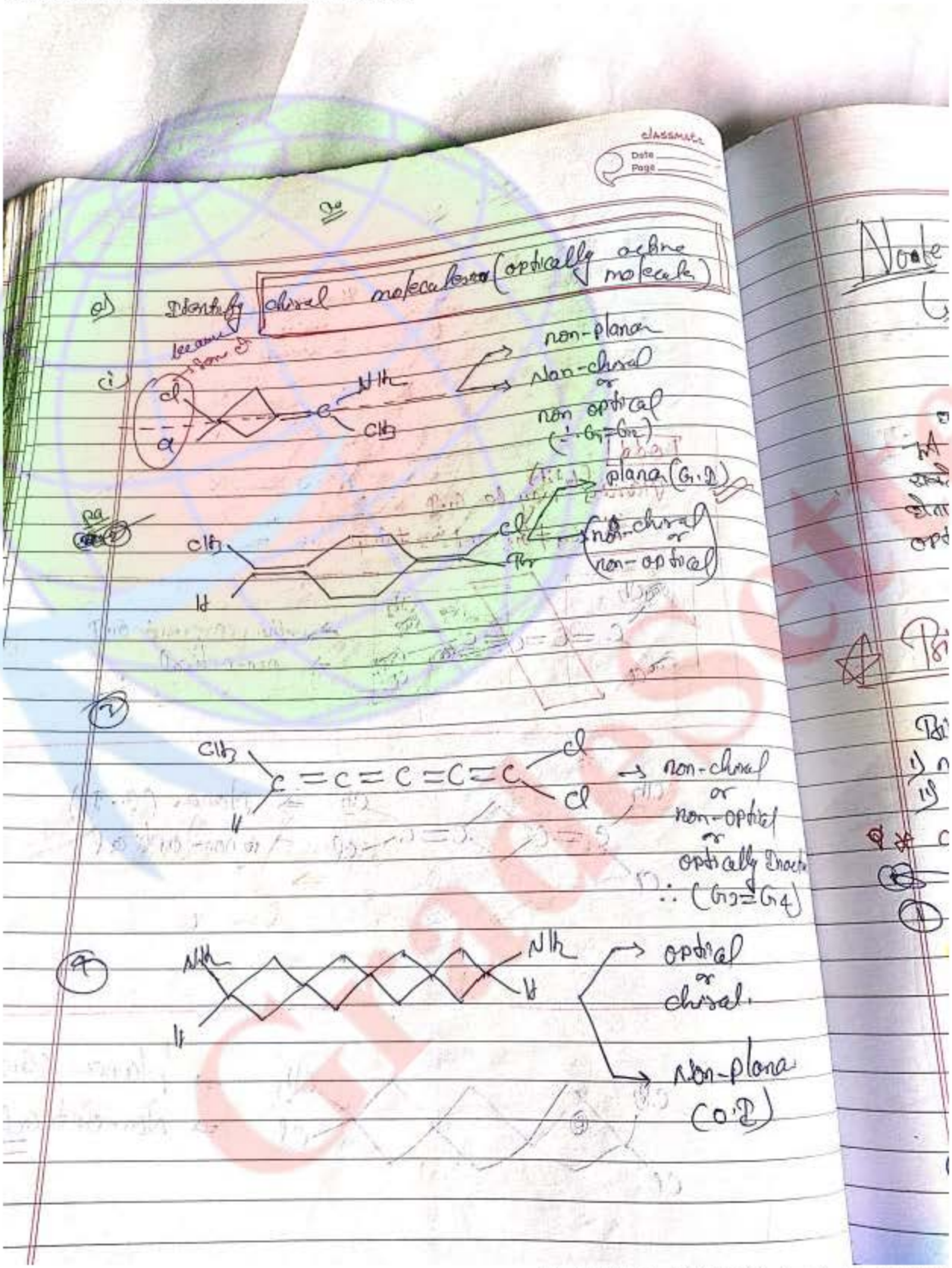
⇒ planar (G.I)

⇒ non-optical



⇒ planar (G.I)

⇒ Non-optical



Note (Imp)

↳ Optical होने का main condition chiral नहीं है

अर्थात Comp. chiral है तो optical होगा ही लेकिन अगर chiral नहीं है तब भी optical हो सकता है अर्थात हम यह नहीं कह सकते हैं कि optical comp. में chiral carbon का होना जरूरी है। chiral carbon नहीं होने पर भी optical हो सकता है जैसे - Allene, Alkylidene cycloalkane, spirane and Biphenyls.

लेकिन सभी optical comp. हर हाल में planar होना चाहिए।

☆ Biphenyls

Biphenyl exhibit :-
(i) non-planarity
(ii) optical activity

★ Conditions of biphenyls to show optical activity :-

① Three or more than three bulky group's present at ortho position. → Ra

(due to steric hindrance both ring exist ⊥ to each other)
(non-planar)

② Bulky group's are :-

(1) $-\overset{O}{\overset{\|}{C}}-OH$

(II) $-SO_2N$

(III) $-\overset{O}{\overset{\|}{C}}-Cl$

(IV) $-\overset{O}{\overset{\|}{C}}-NH_2$

(V) $-\overset{O}{\overset{\|}{C}}-OH$

(VI) $-C(CH_3)_3$

(VII) $-NO_2$

(VIII) $-CN$

Rq (IX) $-I$

(X) $-Br$ etc

Note Smaller groups:

(I) $-Cl$

(II) $-F$

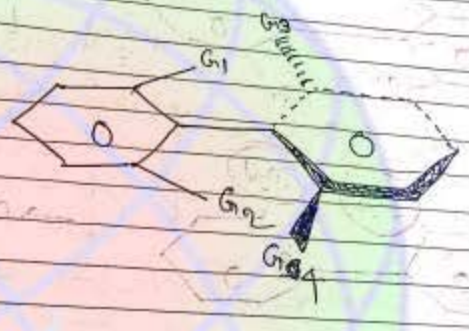
(III) $-CH_3$

Rq → (IV) $-OCH_3$

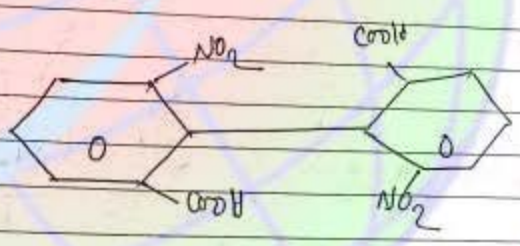
(V) $-NH_2$

etc

(iii) $G_1 \neq G_2$ and $G_3 \neq G_4$

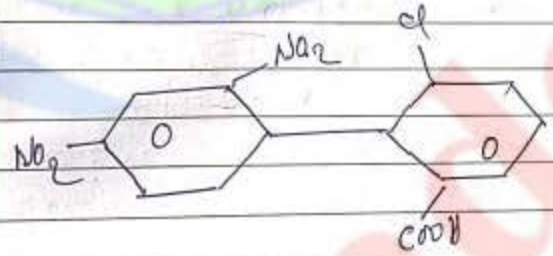


eg(i)



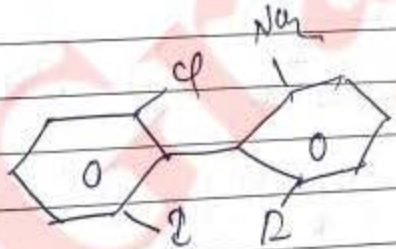
→ chiral

eg(ii)

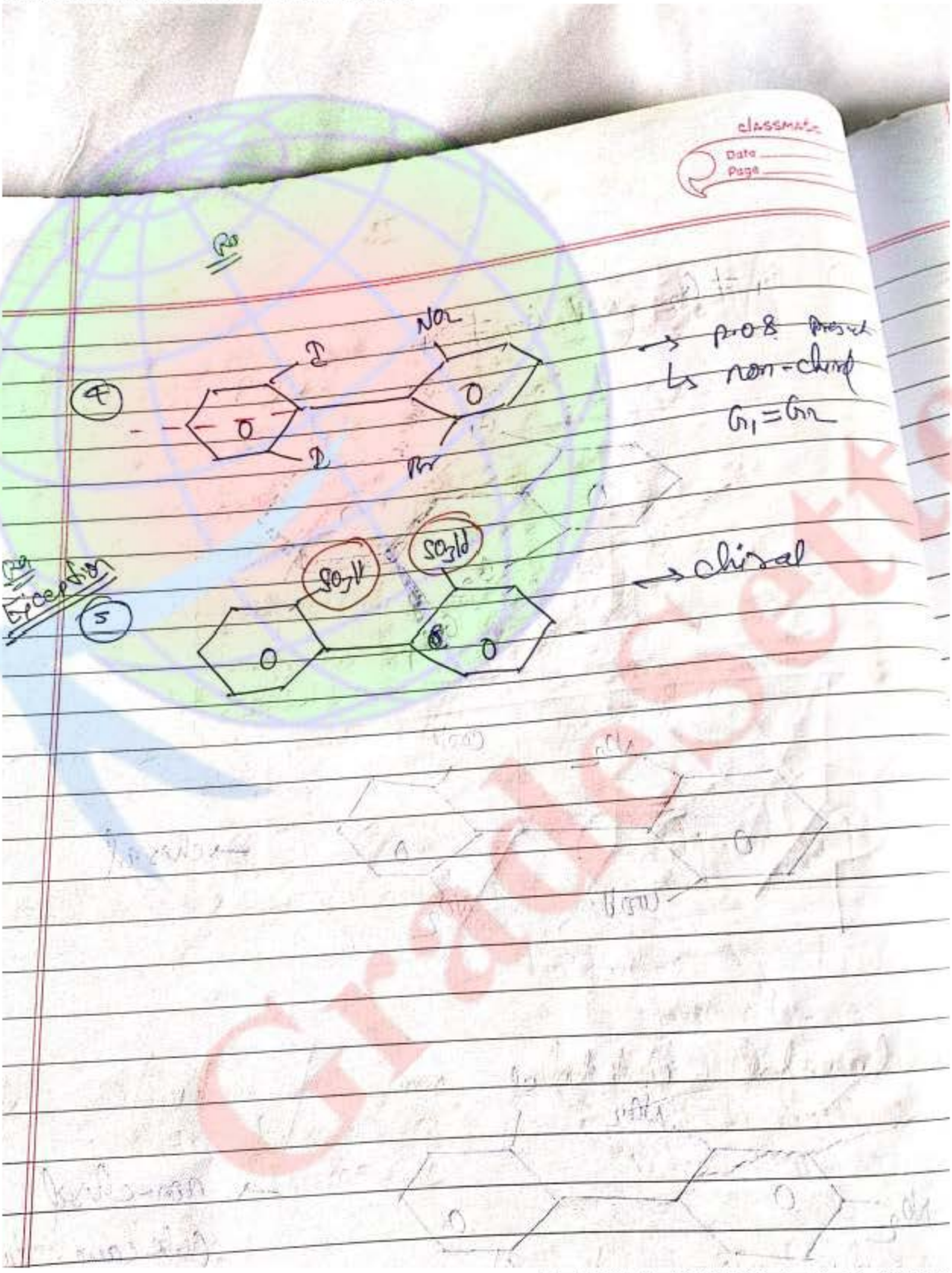


→ non-chiral
(because bulky groups not at ortho position

eg(2)



→ non-planar
(because more small gro



Conformational / Rotational Isomerism

Isomerism arises due to free rotation around single bond (σ-bond) and Isomers of compounds said to be Conformers / rotamers

* Structural condition:

(1) Compound should have continuous 3-σ bonds

M — N — O — P

Eg 1) N — O — H ⇒ Not show conformers

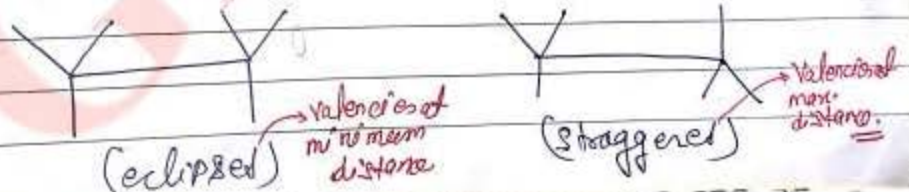
Eg 2) N — O — O — H ⇒ show conformers

Eg 3) N — CH_2 — CH_2 — N ⇒ show conformers

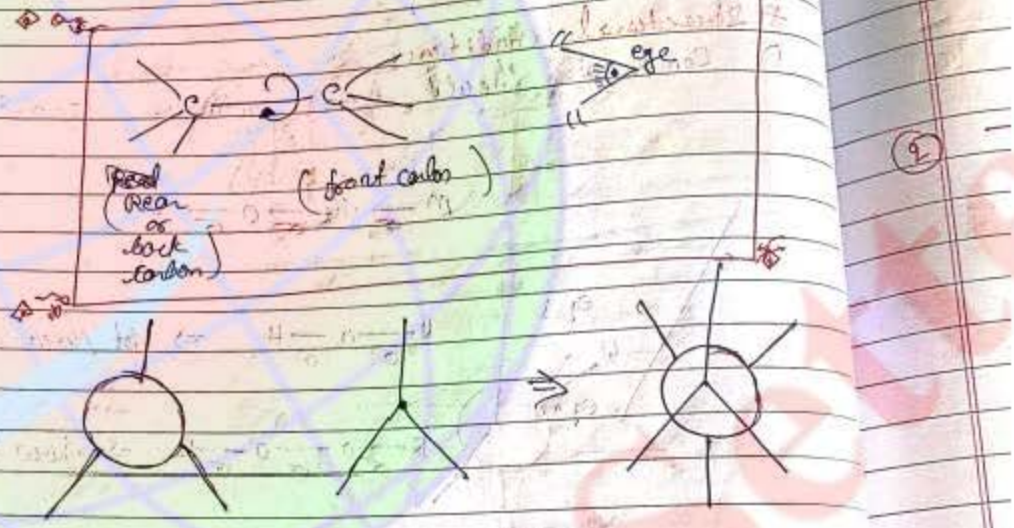
Eg 4) ⇒ show conformers

* Re-presentation / projection:

(1) SAW-HORSE projection (3-D Projection)



(2) NEW MANN'S Projection

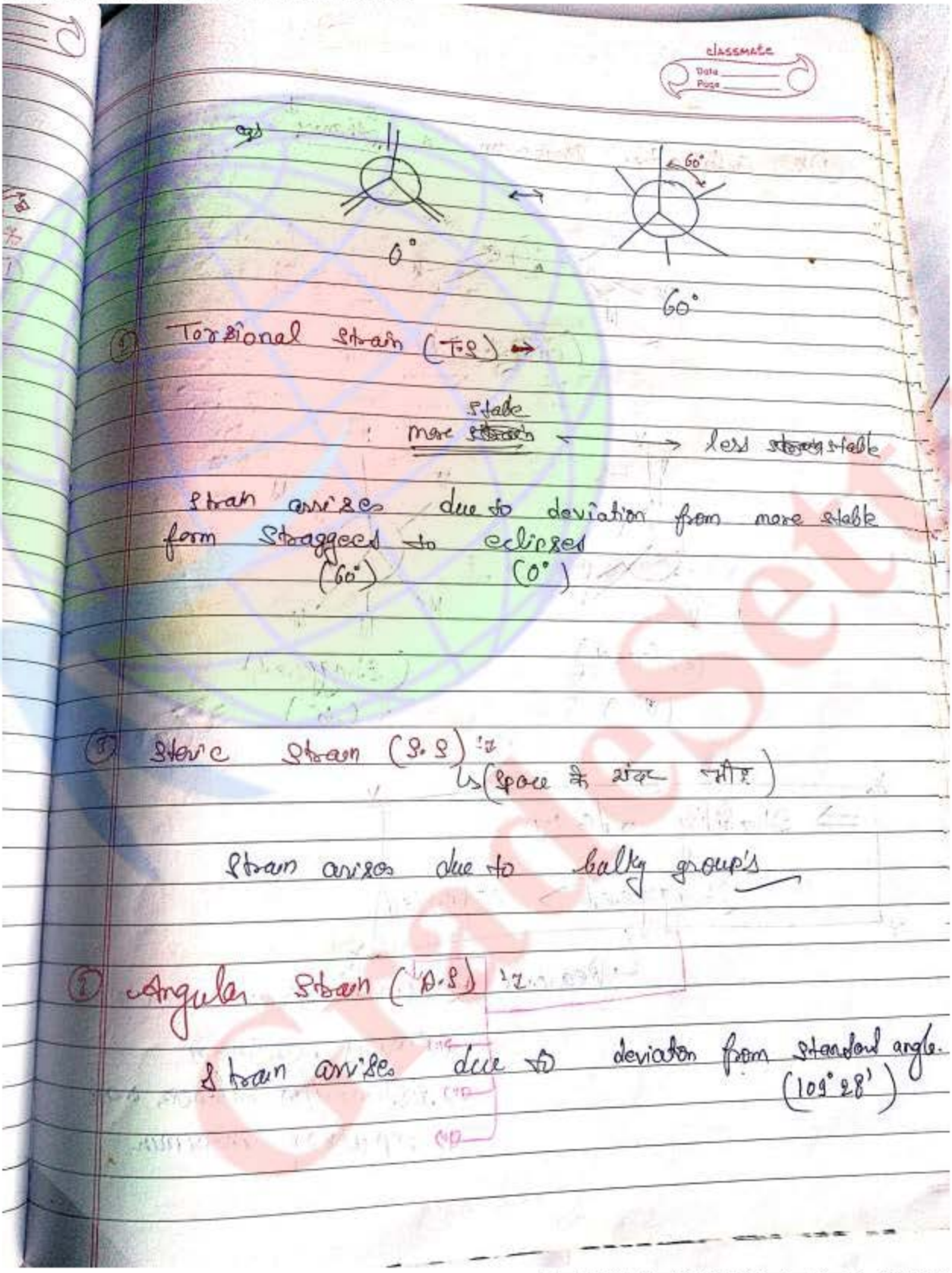


☆ Definition / Terms related to Conformational Isomers :-

(1) Dihydral angle :- Angle b/w two valencies

eg :-

0° 60°



(2) Torsional Strain (T.S) →

stable
more ~~stable~~ ⟷ less ~~stable~~

Strain arises due to deviation from more stable form Staggered (60°) to eclipsed (0°)

(3) Steric Strain (S.S) :-
↳ (Space के कारण होता है)

Strain arises due to bulky group's

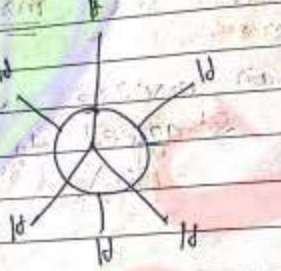
(4) Angular Strain (A.S) :-

Strain arises due to deviation from standard angle. (109°28')

① Conformation Diagram of ethane

(Gen Strain)

(eclipsed)
(0°)



(Staggered)
(60°)

⇒ Stability order :-

Staggered > eclipsed

↳ Reason : ① Torsional Strain minimum
② energy minimum
③ distance b/w valences max
④ repulsion minimum

Ra

(3) Conformers present b/w eclipsed (0°) and staggered (60°) are known as skew-form

(5) Ethane contains infinite number of conform's due to infinite number of skew.

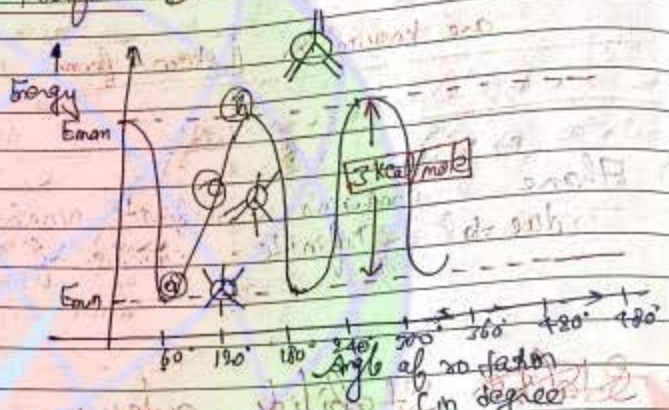
(2) Stability ord. :-

staggered > skew > eclipsed

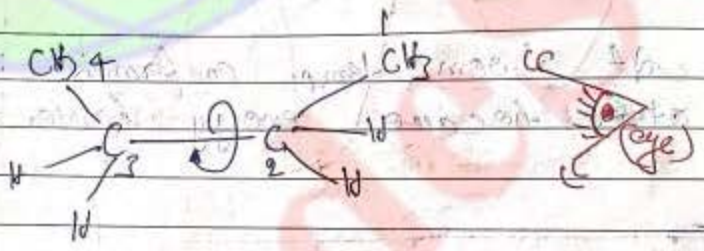
(4) At room temp. conformers never isolate by each other because energy barrier is very low (3 kcal/mole or 12 kJ/mole) which is easily available at room temp. by collision's

Ra

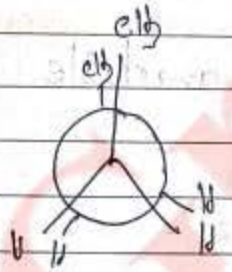
Energy Profile :-



(2) n-butan (C2-C3 axis)



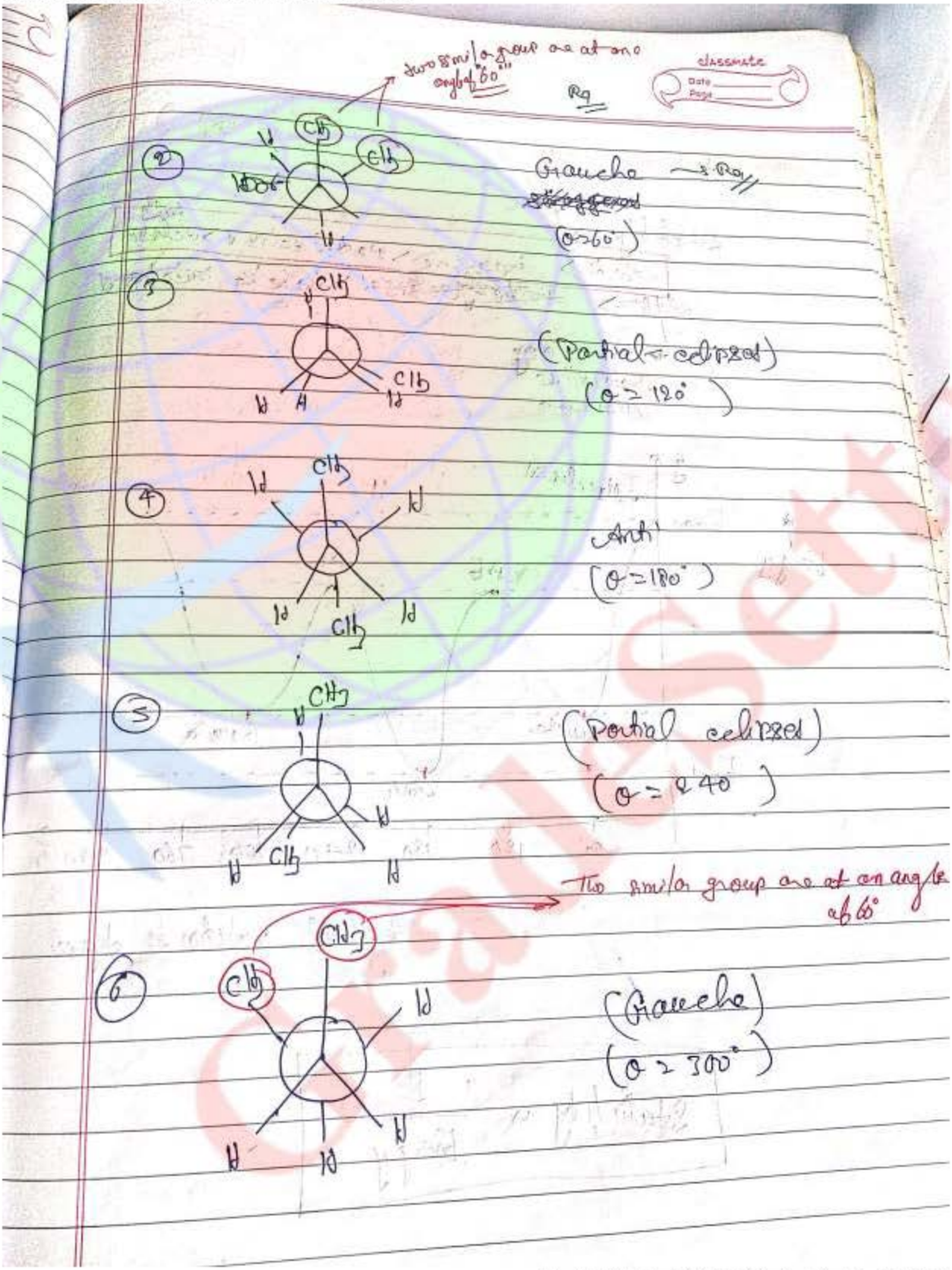
(1)



Ra

fully eclipsed

($\theta = 0°$)



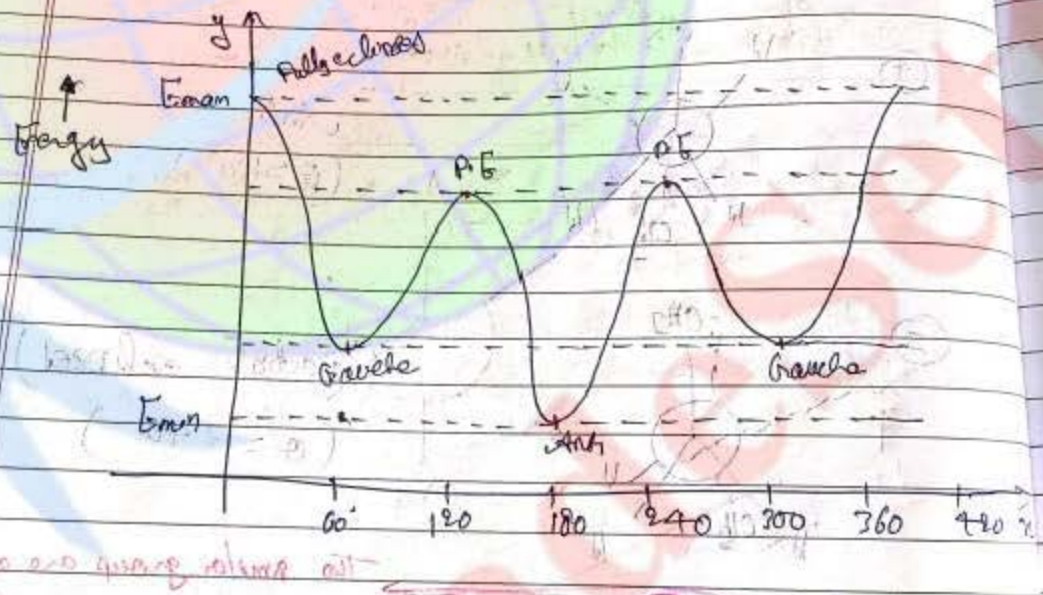
Note

Stability of de

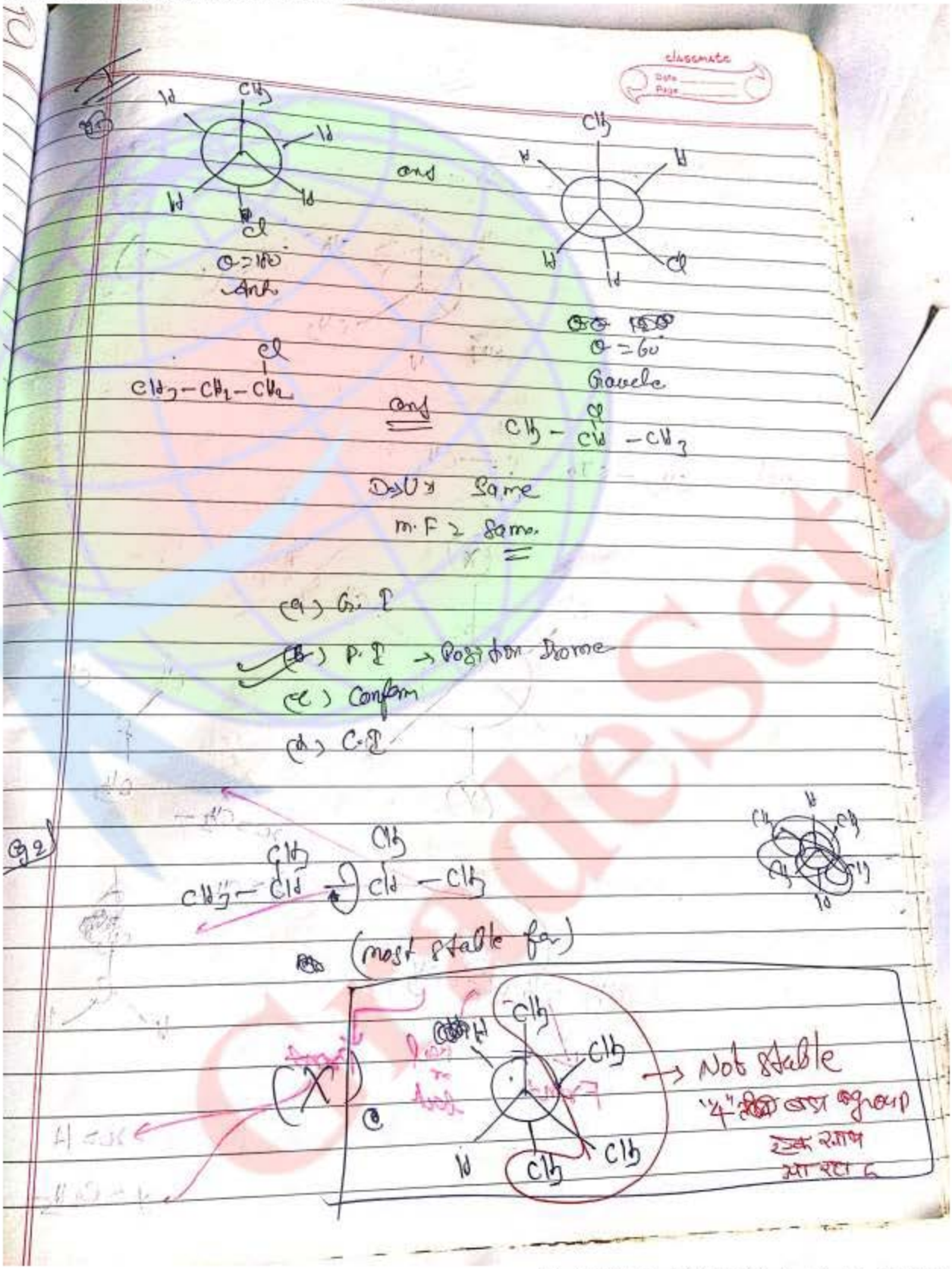
Anti > Gauche > Partial eclipse > fully eclipse

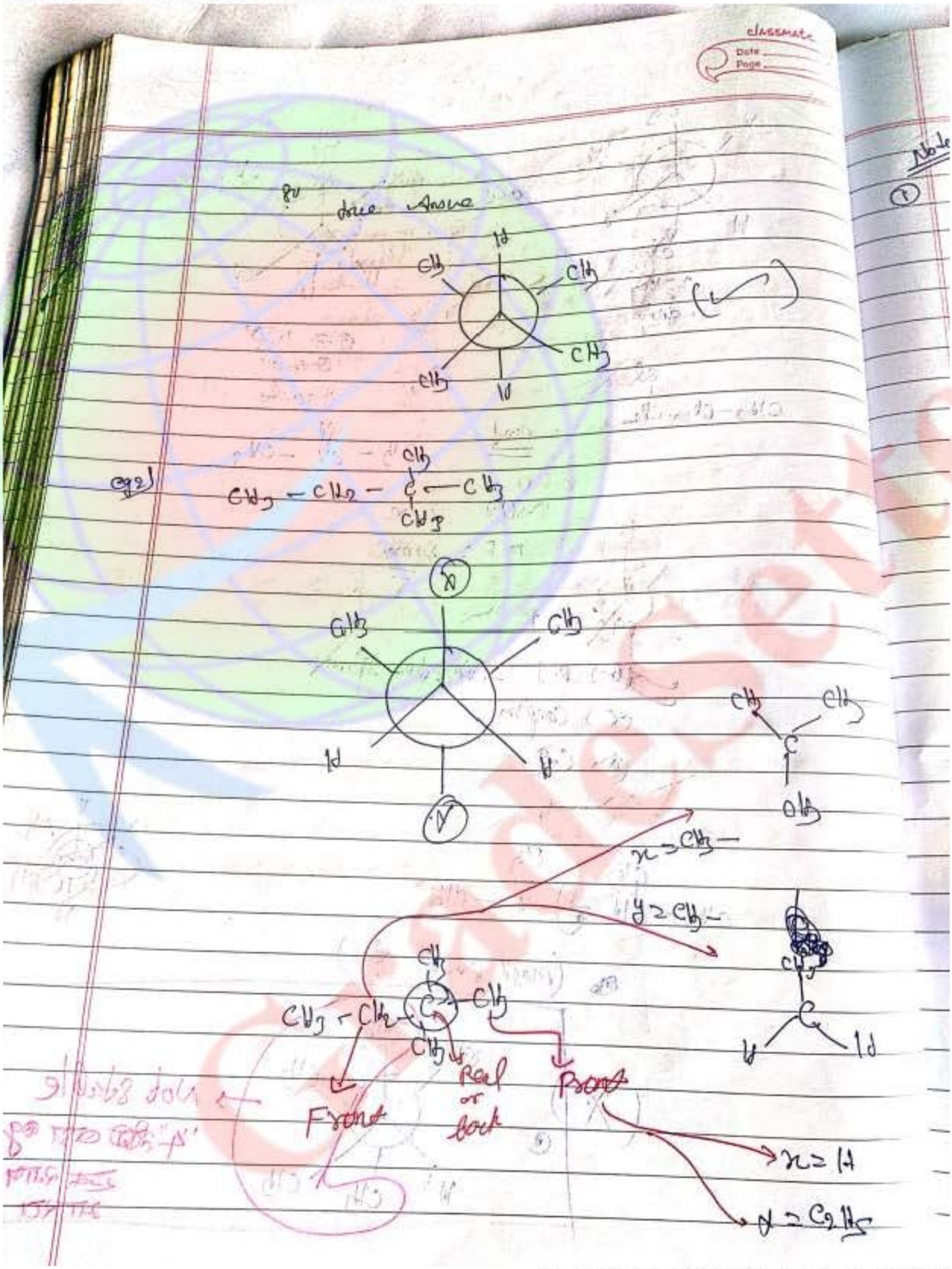
~~Anti > Partially eclipse > Gauche eclipse~~

Techand every strain will be minimum



$$\text{Stability} \propto \frac{1}{\text{Energy}}$$

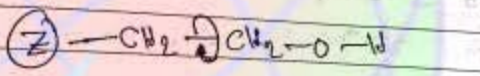




Note

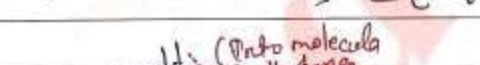
① Generally Anti conforme is more stable than Gauche.
but due to the presence of H-bonding
i.e. (Intramolecular electrostatic attraction)
Gauche form is more stable than Anti.

eg:->

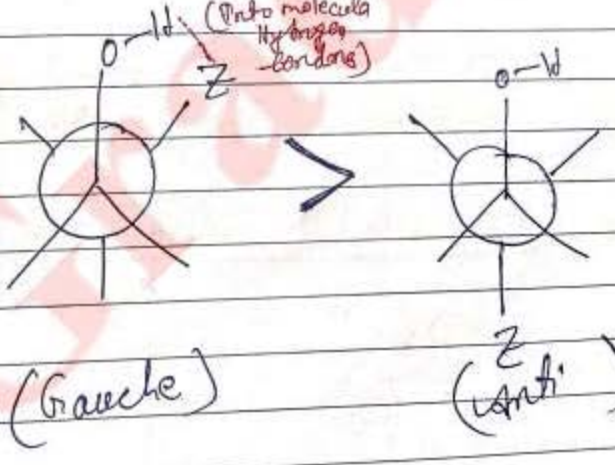


[Z -> OH (Glycol)
-> F
-> Cl (chloro-hydrate

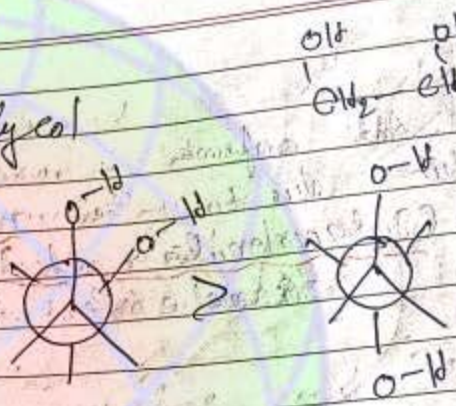
Note: Attraction of two electronegative atom via hydrogen.



-> NO2
-> -C(=O)-H] etc.



q) Ethylene glycol



q) 2-fluoro ethanol

☆ Conformers in cyclo alkanes :-

Baeyer-Strain theory (B.S.T)

less stable / more reactive

60° 109°28' sp³

90°

maximum deviation (angle deviation minimum)

108°

120°

more stable / less reactive

increases

decreases

109°28' sp³ ring

less stable

Real and finally more stable

VVI

deviation ∝ Angle strain ∝ Reactivity ∝ $\frac{1}{\text{Stability}}$

more reactive less stable → cyclo propane

more stable less reactive → cyclo pentane

But advanced experimental values and all types of strains it prove that except then cyclo "propan"

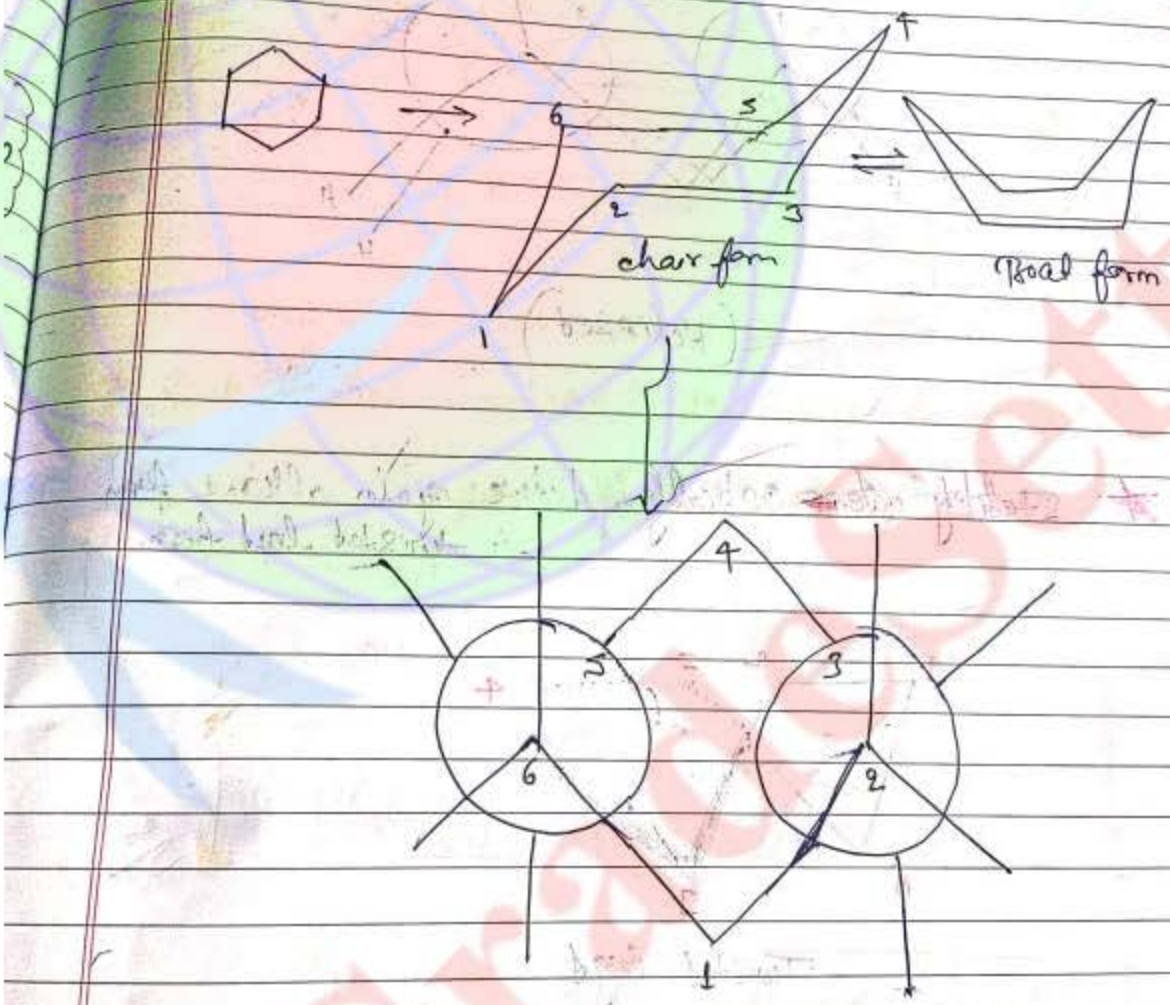
All cyclo alkanes are not planer all are present in folded (Packed) structure

So more reactive and less stable → cyclo propan

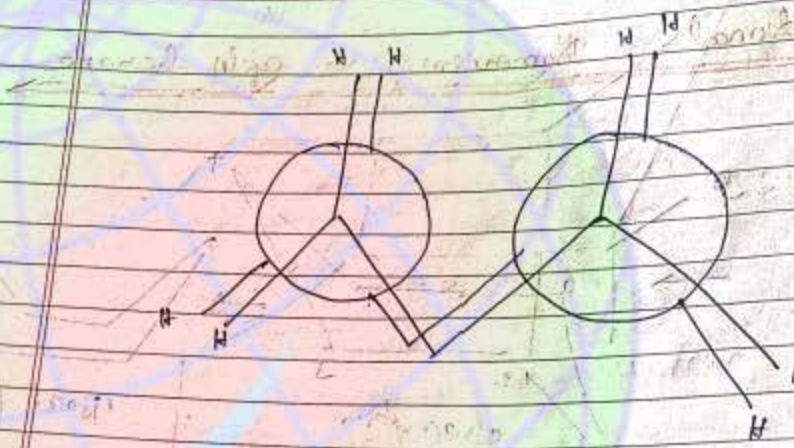
more stable less reactive → cyclo hexane

because orginally cyclopropan is present in this form.

Conformational Isomerism in cyclohexane

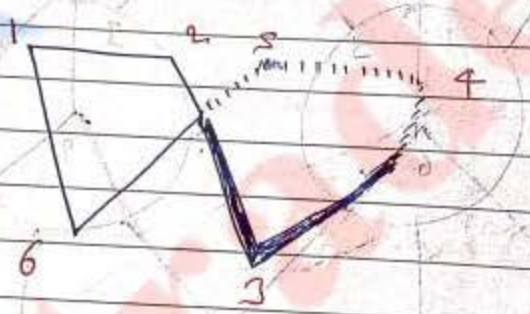


Staggered form.



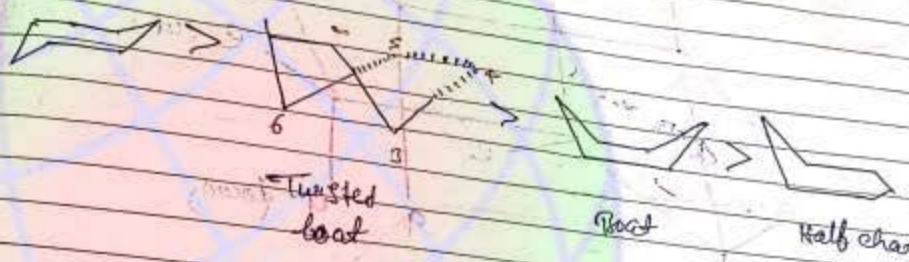
(Eclipsed)

★ ~~Stability of~~ Optically Active cyclo alkane form is twisted boat form.



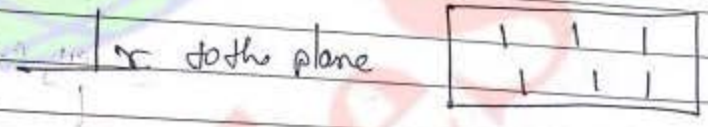
Twisted boat
(Non-planar)
(Op. active)

* Stability order

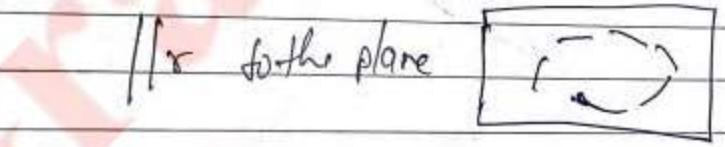


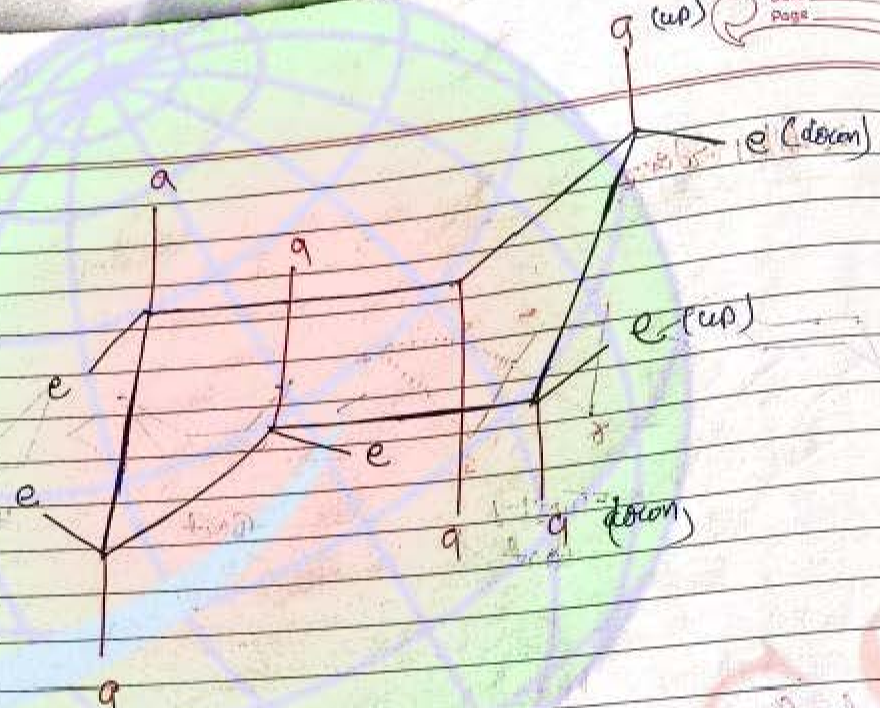
* Cyclohexane contains 12 hydrogens out of which

(a) Axial hydrogens (a) ⇒ 6 H

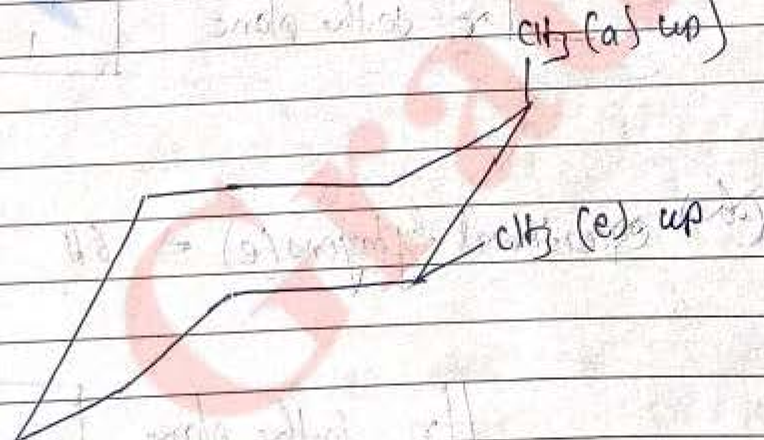


(b) equatorial hydrogens (e) ⇒ 6H





Cis 4 form – (Same group are at axial (a) (down or up) and equatorial (e) (down & up)



Trans family same ground a (down or up) and e (up or down)

G.O.C

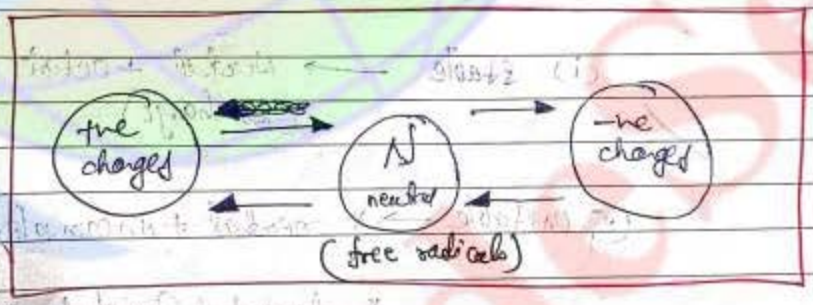
Ra1

(A) Basic concepts (helping hands) :-

(1) charge species :-

+ve charge
↳ [electron deficient species]
↳ [gain e⊖ from e⊖ rich species]

-ve charge
↳ [electron rich species]
↳ [Donate e⊖ to e⊖ deficient species].



(2) Octate :→ "8 e⊖'s in outermost shell

Ra1 →

$$\text{Octate} = 2x\left[1 \cdot P + 1 \cdot P + \ominus\right]$$

eg 1 — O:

octate = (1+2+1)x2
= 8
(so Complete octate)

eg) $-\overset{|}{\underset{|}{C}}^{\oplus}$

octate = $(2+0+0)\times 2$
= 6

→ octate incomplete

(5) stability → Determination of stability of species based upon charge and octate

(i) stable ⟶ Neutral + octate complete (No charge)

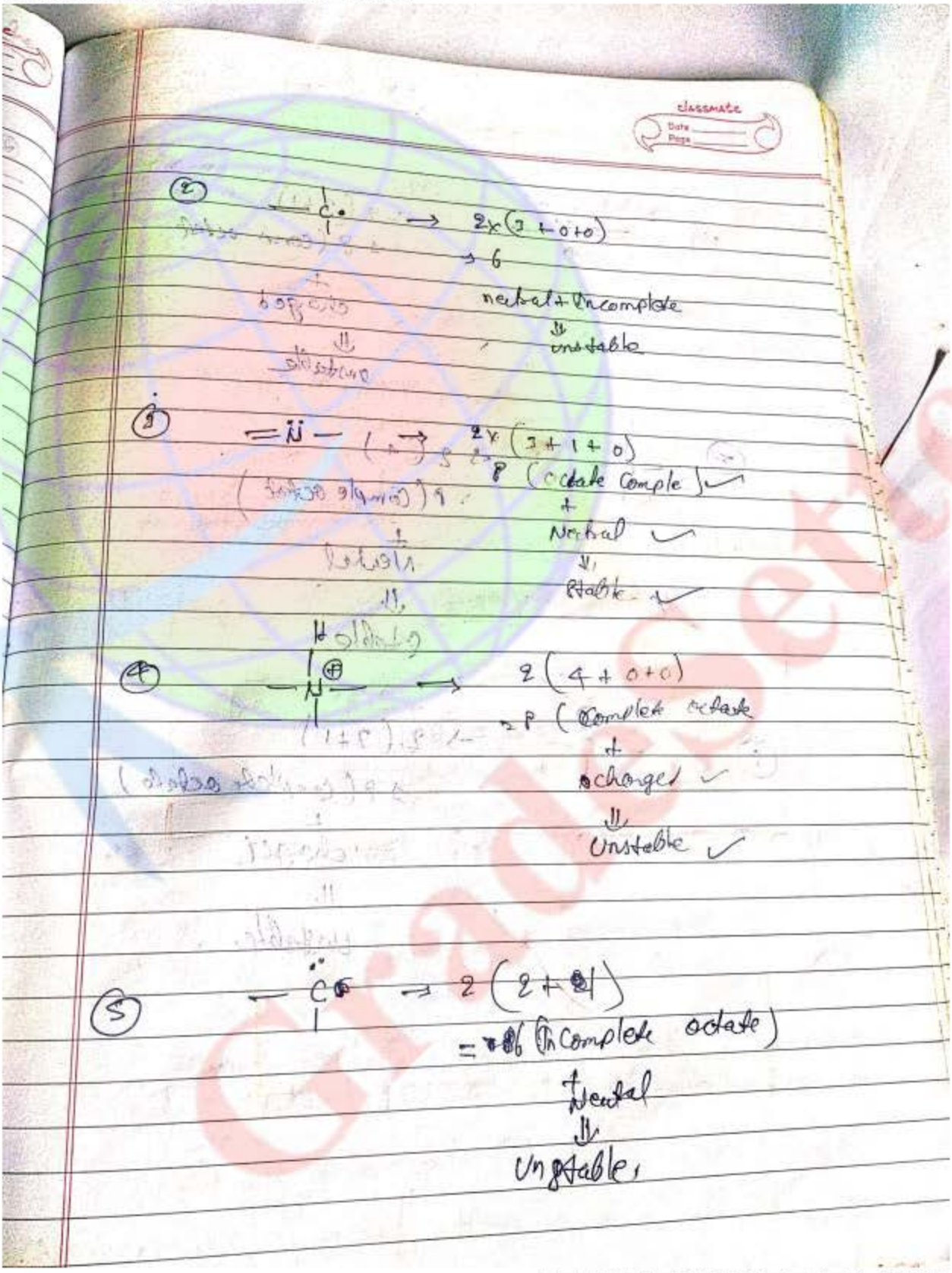
(2) unstable ⟶ * neutral + incomplete octate

* charged + Complete octate

* charged + incomplete octate

eg (1) $-\ddot{\underset{..}{O}}:^{\ominus}$

octate → 8 → complete octate
↓
unstable.



(2) $\cdot\overset{\cdot}{C}\cdot$ → 2x(2+0+0) → 6 → neutral + Incomplete → unstable

(3) $-\ddot{N}-$ → 2x(3+1+0) → 8 (Octate Comple) + Neutral → Stable

(4) $-\overset{\oplus}{N}-$ → 2(4+0+0) → 8 (Complete octate + charge) → Unstable

(5) $-\ddot{C}-$ → 2(2+2) → 8 (Incomplete octate) → Neutral → Unstable

Date ____
Page ____

⑥ $=\dot{O}-$ (with ⊕) → 2 (3+1)
→ 8 (Comp octate)
+
charged
⇓
unstable

⑦ $-\overset{|}{\underset{|}{C}}-$ → 2 (4)
→ 8 (Complete octate)
+
Neutral
⇓
stable

⑧ $-\overset{\ominus}{\underset{|}{C}}-$ → 2 (3+1)
→ 8 (complete octate)
+
charged
⇓
unstable.

Organic Reagents → (Attacking species) :

(1) Electrophiles :- [Electro = $e^{\oplus}$ / philic = to love] ⇒ i) e⁻ deficient species / ii) Incomplete octate / iii) e⁻ pair from e⁻ rich species

Electrophiles work as a lewis Acids (e⁻ pair acceptor)

classification ⇒

① charged electrophile (E^+) :

Central atom contains the charges

X^+ ($Cl^{\oplus}$ / $Br^{\oplus}$), $NO_2^{\oplus}$, $N{\equiv}O^{\oplus}$, $R^{\oplus}$ (CH_3^+), $H^{\oplus}$ etc

(b) Neutral electrophiles

› Neutral Central atom's behave as a electrophile Centre, when it is neutral / i) contains empty d or p orbitals or

ii) Central atom contains "δ+" due to

bonded with two or more than two electronegative atoms.

(i)

eg (1) CH_3 ($H-\dot{C}-H$)
|
H

(free radicals)

eg 2) $H-\ddot{C}:$ (Carbine)
|
H

eg 3) $-\ddot{N}:$

(Nitrene)

eg 4) $R-\overset{\overset{O}{\|}}{C}-\ddot{O}:$

(ii) BF_3, $AlCl_3$, $ZnCl_2$, $SbCl_5$, $SnCl_4$, PCl_5 etc.

B $\Rightarrow 1s^2\ 2s^2\ 2p^1$

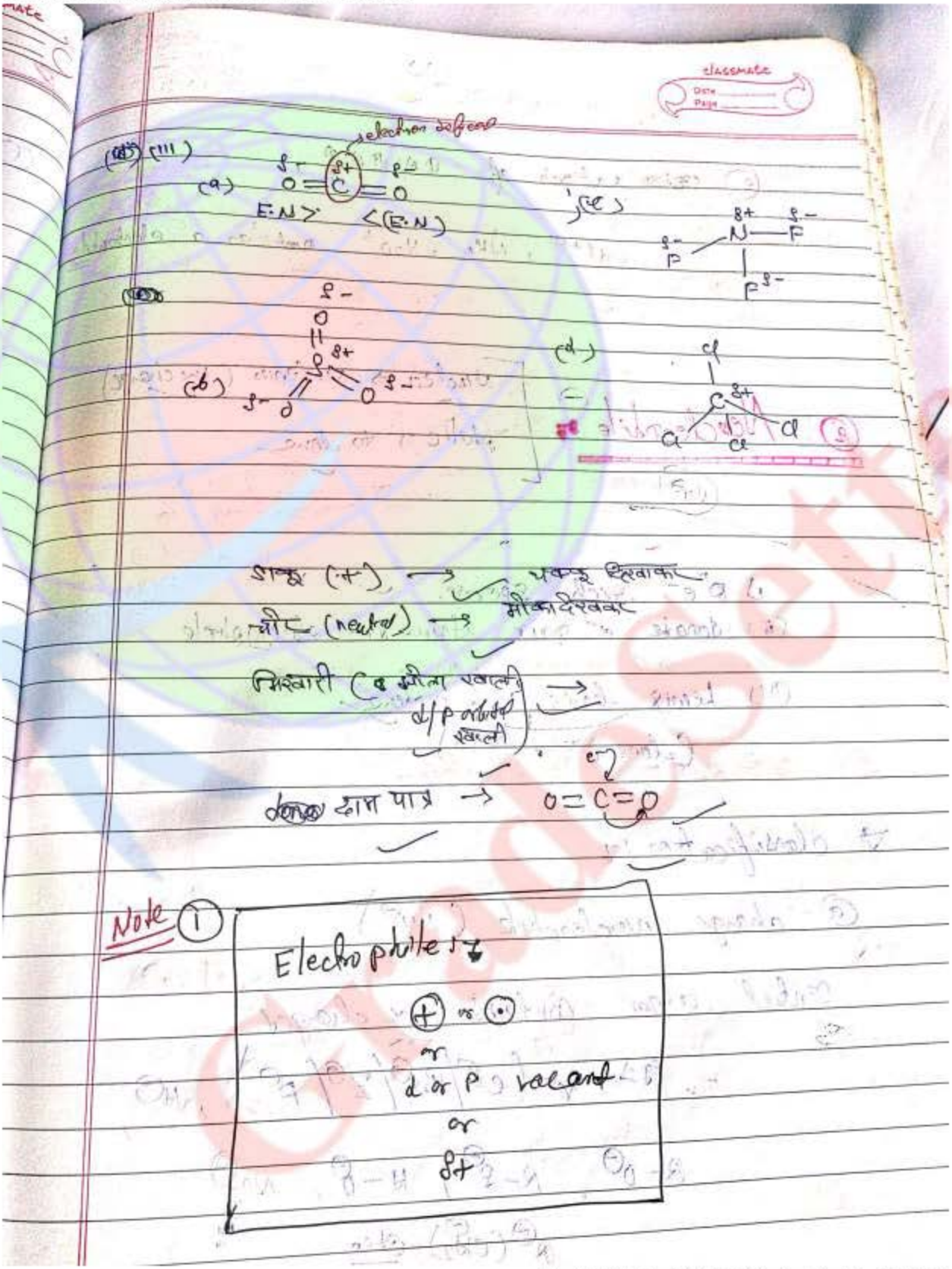
2s	2px	2py	2pz
↑↓	↑		

B (excited state) $\Rightarrow 1s^2\ 2s^1\ 2p^2$

2s	2px	2py	2pz
↑	↑	↑	

BF_3

↑	↑	↑	
sp²	sp²	sp²	pz is vacant.



(d) Neutral

(i) electro...

(ii)

② cation cations of IIIA/IIIA, ... act as a electrophile

Al^{+++}, $\overset{+}{N}H_4$, H_3O^+

② **Nucleophile** $\ominus$ — [Nucleo ⇒ Nucleous (+ve charge); phile ⇒ to love]

($Nu^\ominus$)

(i) $\bar{e}$ rich species

(ii) donate $\bar{e}$ pair towards electrophile

(iii) Lewis basic in nature (lone pair donor)

✪ classification :-

ⓐ charge nucleophile ($Nu^\ominus$)

central atom contains -ve charged

eg:- X^- ($Cl^\ominus$/$Br^\ominus$/$I^\ominus$/$F^\ominus$), $H^\ominus$,

$R-O^\ominus$, $R-S^\ominus$, $H-O^\ominus$, $NO_3^\ominus$

$R^\ominus$ ($\overset{\ominus}{C}N$) etc.

(b) Neutral nucleophiles:-

(i) electron negative atom behave as a nucleophile centre if it contains lone pair

eg:- $-\ddot{O}-$, $-\ddot{N}-$, $-\ddot{S}-$ etc.

eg:- $H_2\ddot{O}$: , $R-\ddot{O}-H$, $R-\ddot{O}-R$,

$R-\overset{O}{\overset{\|}{C}}-\ddot{O}-H$, $\ddot{N}H_3$, $R-\ddot{N}H_2$,

$R_2\ddot{N}H$ etc.

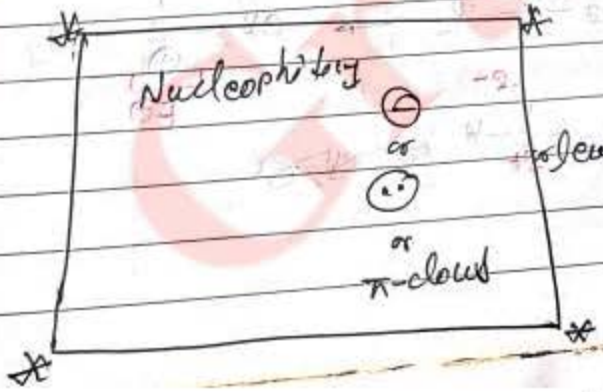
(ii) multiple bond:- (for ease of study)

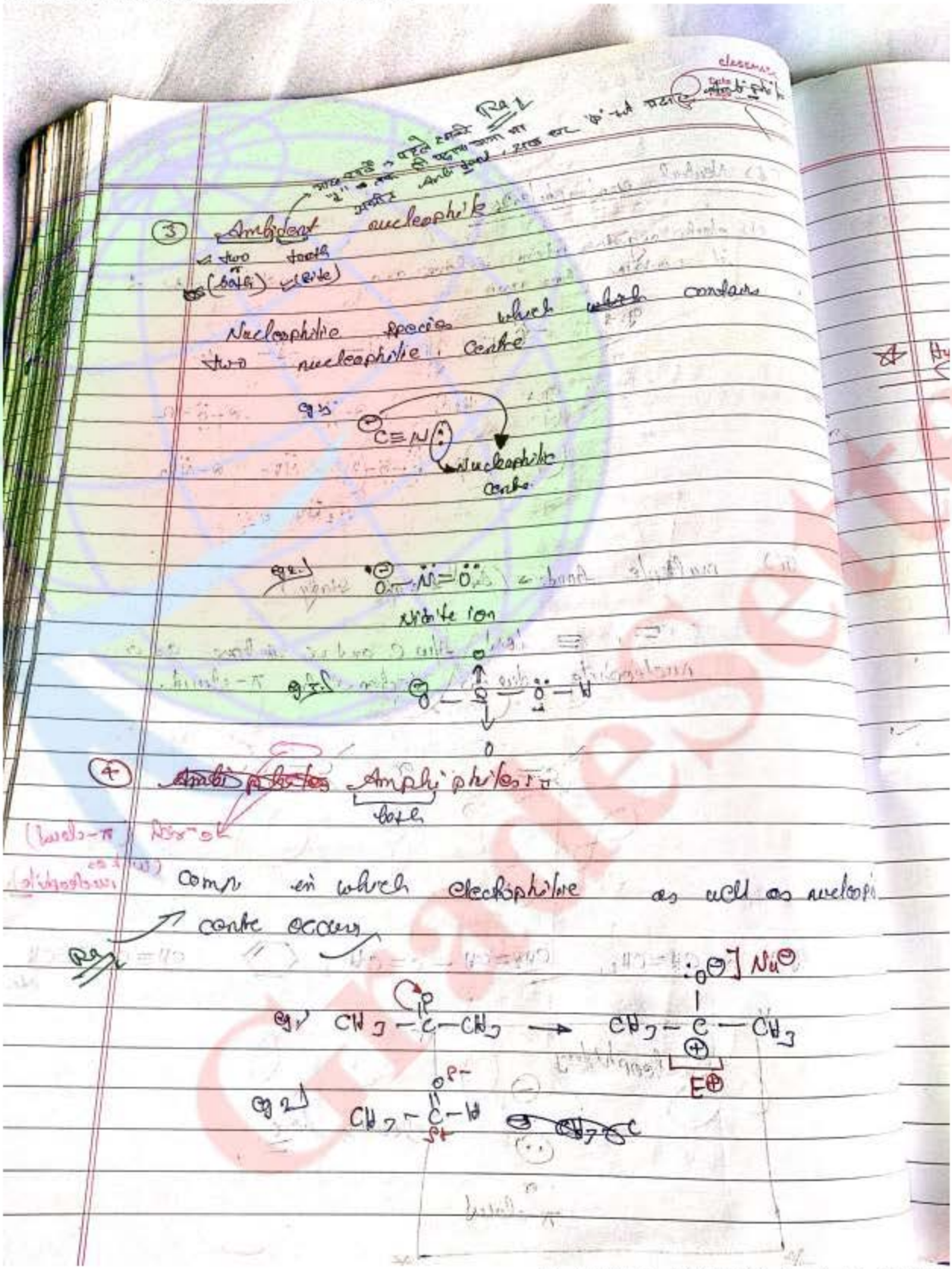
$=$, $\equiv$ bond b/w C and C behave as a nucleophile due to electron rich π-cloud.

$C=C$ or 

e⁻ rich (π-cloud) (work as nucleophile).

eg:- $R-CH=CH_2$, $CH_2=CH-C\equiv CH$,  , $CH\equiv C-C\equiv CH$ etc.





③ Ambident nucleophile
two two
(both) (site)

Nucleophile species which which contains two nucleophilic centre

eg:- $C\equiv N:^{\ominus}$ → nucleophilic centre

eg:- $O=\ddot{N}-\ddot{O}:^{\ominus}$
nitrite ion

eg:- $H-\ddot{O}-\underset{\underset{O}{\|}}{S}-O^{\ominus}$

④ Amphiphiles
both

com. in which electrophile as well as nucleophilic centre occurs

eg:- $CH_3-\overset{\oplus}{C}-CH_3 \rightarrow CH_3-\overset{\oplus}{C}-CH_3$ ($E^{\oplus}$)

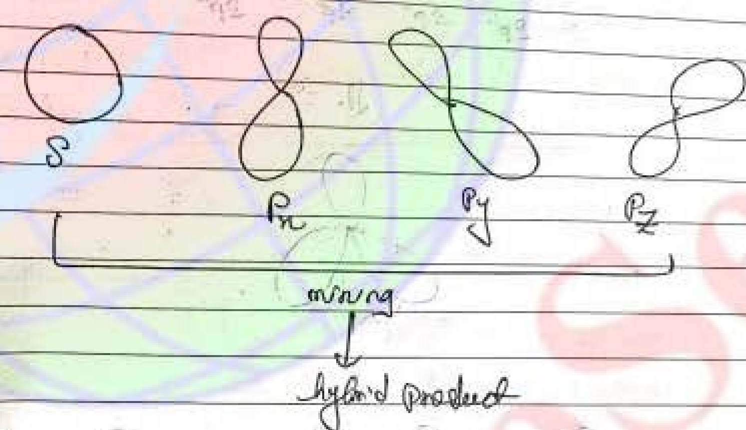
eg 2] $CH_2=\overset{\delta+}{C}-H$

eg 7-) $CH_3-\overset{\delta+}{C}(=\overset{\delta-}{O})-Cl$ ← $Nu^{\ominus}$ (e^- देगा)

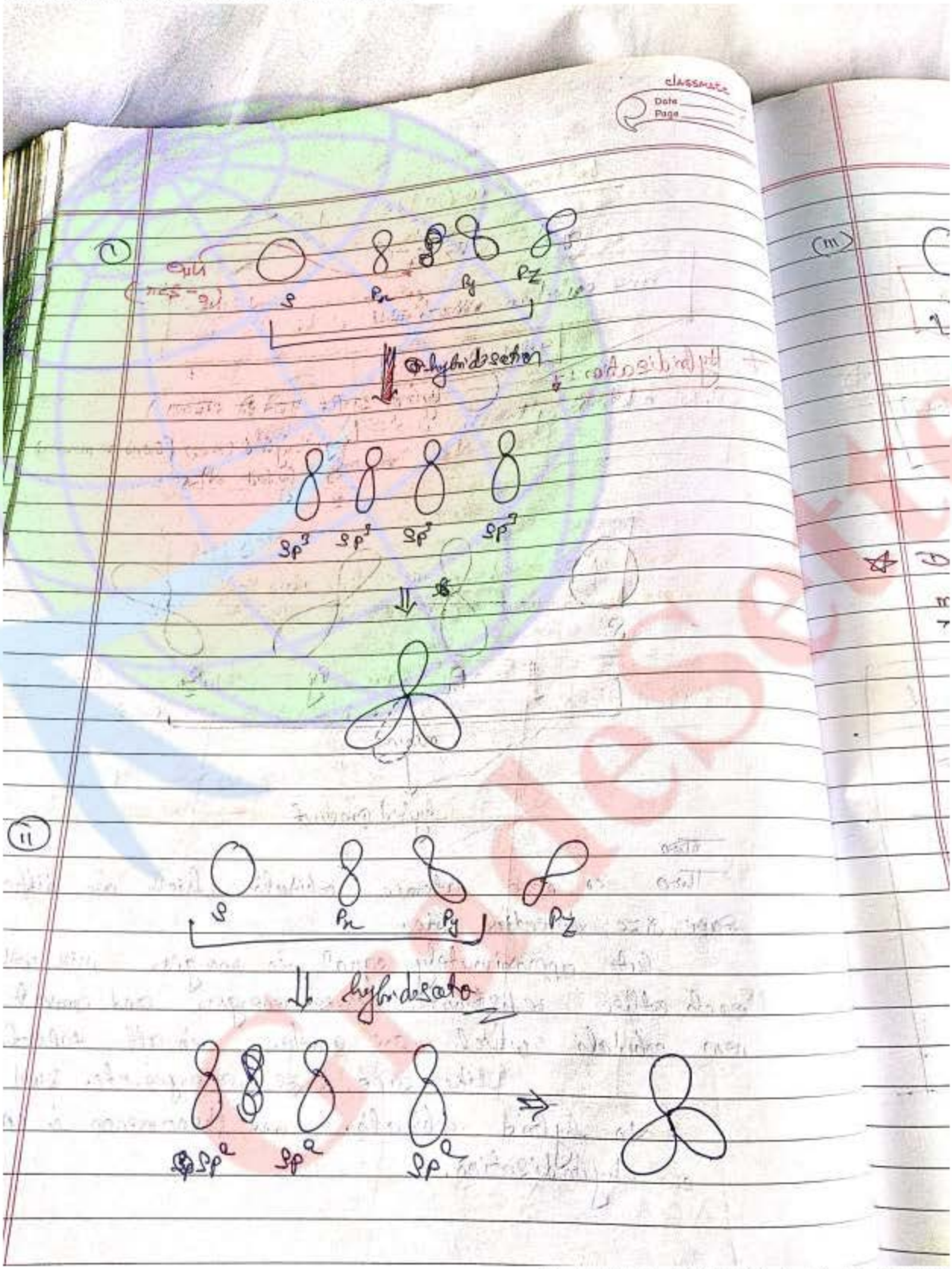
eg 8-) $CH_3-\overset{\delta+}{C}\equiv\overset{\delta-}{N}$

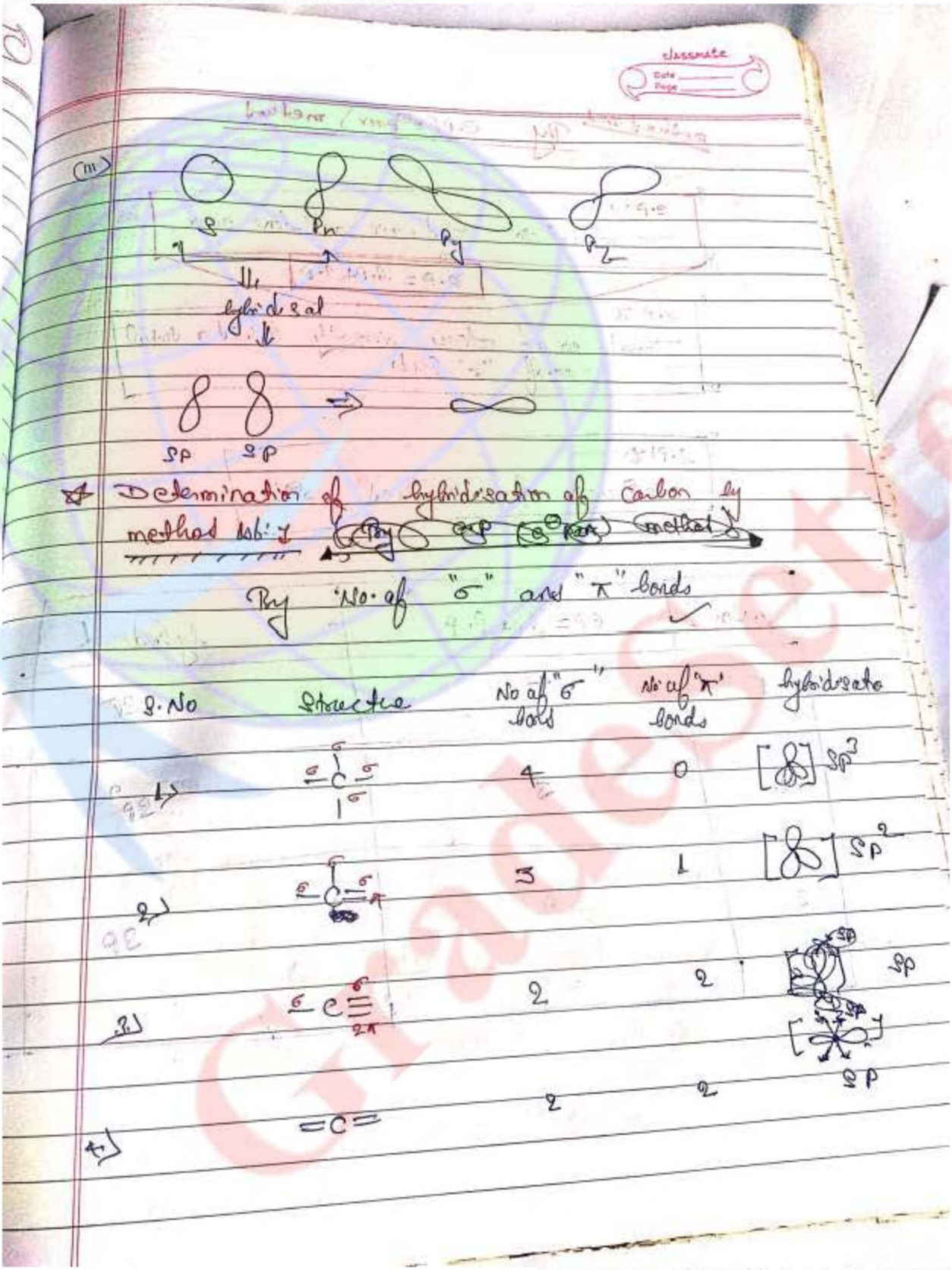
☆ Hybridisation :-

(Hybrid अर्थात् मिश्रित से उत्पन्न)
- eg - hybrid cows (breeds का mixing)
- eg - hybrid बीज



Two or more atomic orbitals which are differ in shape, size, direction etc. but approximately equal in energies mix with each other redistribute their energies and convert into new orbitals which are similar in all aspects like shape, size, energies etc. said to be hybrid orbitals. and phenomenon is known as hybridisation.



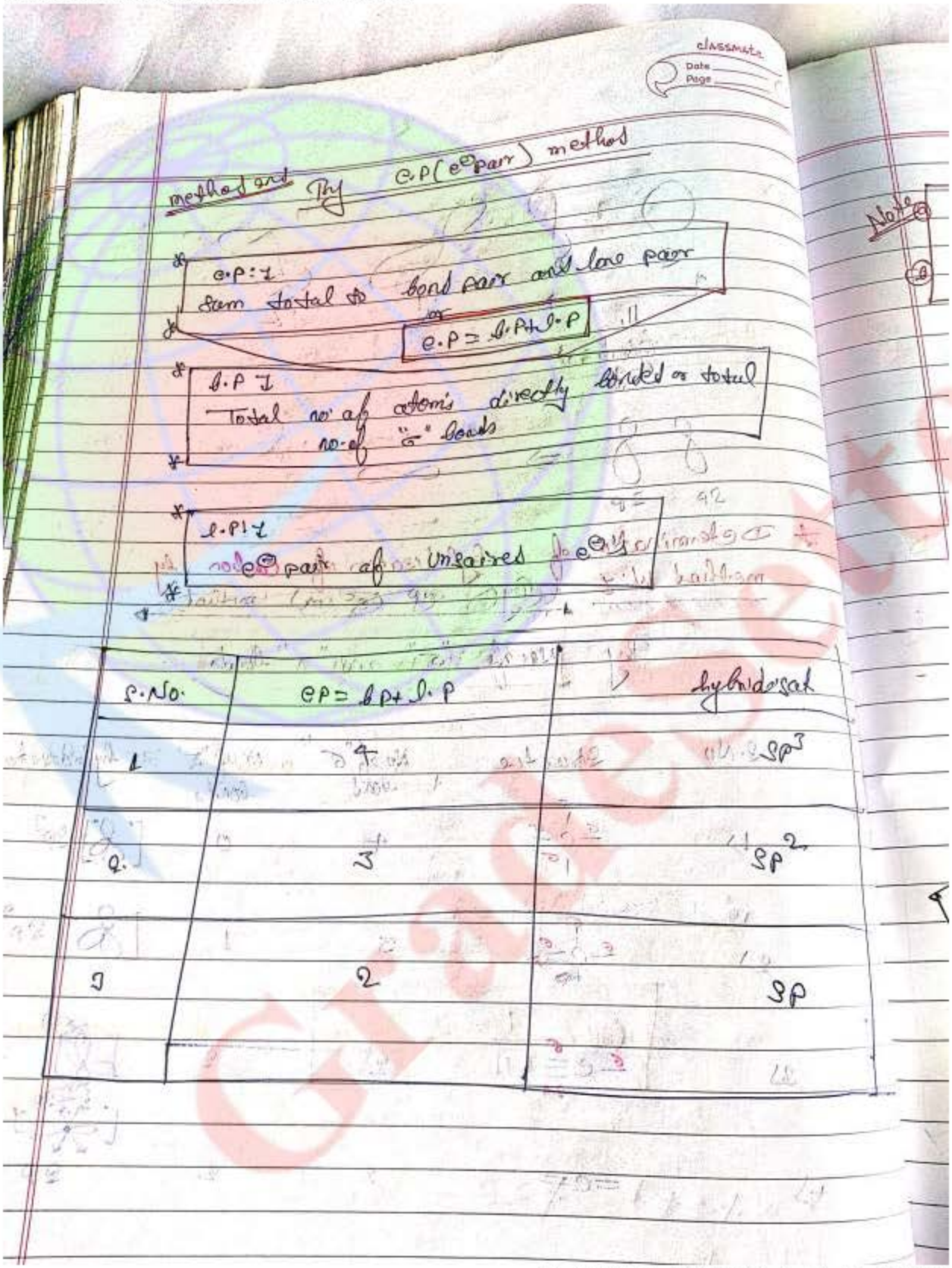


Determination of hybridisation of carbon by

~~method ability~~ ~~By sp sp² sp³ method~~

By 'No. of "σ" and "π" bonds

S.No	Structure	No of "σ" bonds	No of "π" bonds	hybridisation
1)	$=\overset{\sigma}{\underset{\sigma}{\underset{|}{\overset{|}{C}}}}=$	4	0	sp^3
2)	$=\overset{\sigma}{\underset{\sigma}{\underset{|}{\overset{|}{C}}}}-$	3	1	sp^2
3)	$-C\equiv$	2	2	sp
4)	$=C=$	2	2	sp



method and By C.P (core pair) method

Note

C.P : Sum total of bond pair and lone pair
or
C.P = B.P + L.P

B.P :
Total no of atoms directly linked or total no of "σ" bonds

L.P :
no of pair of unpaired electrons

S.No.	CP = BP + LP	hybridisat
1	4	sp^3
2	3	sp^2
3	2	sp

Note

⊖ or ⊙ ⇒ l.p = 1

⊕ or ⊙ ⇒ l.p = 0

eg ①

$CH_3 - \overset{H}{\underset{H}{C}} - H$

1st method = 4 + 0 = 4 ⇒ sp^3

2nd method = 4 + 0 = 4 ⇒ sp^3

eg ②

$CH_3 - \overset{H}{C}\oplus$

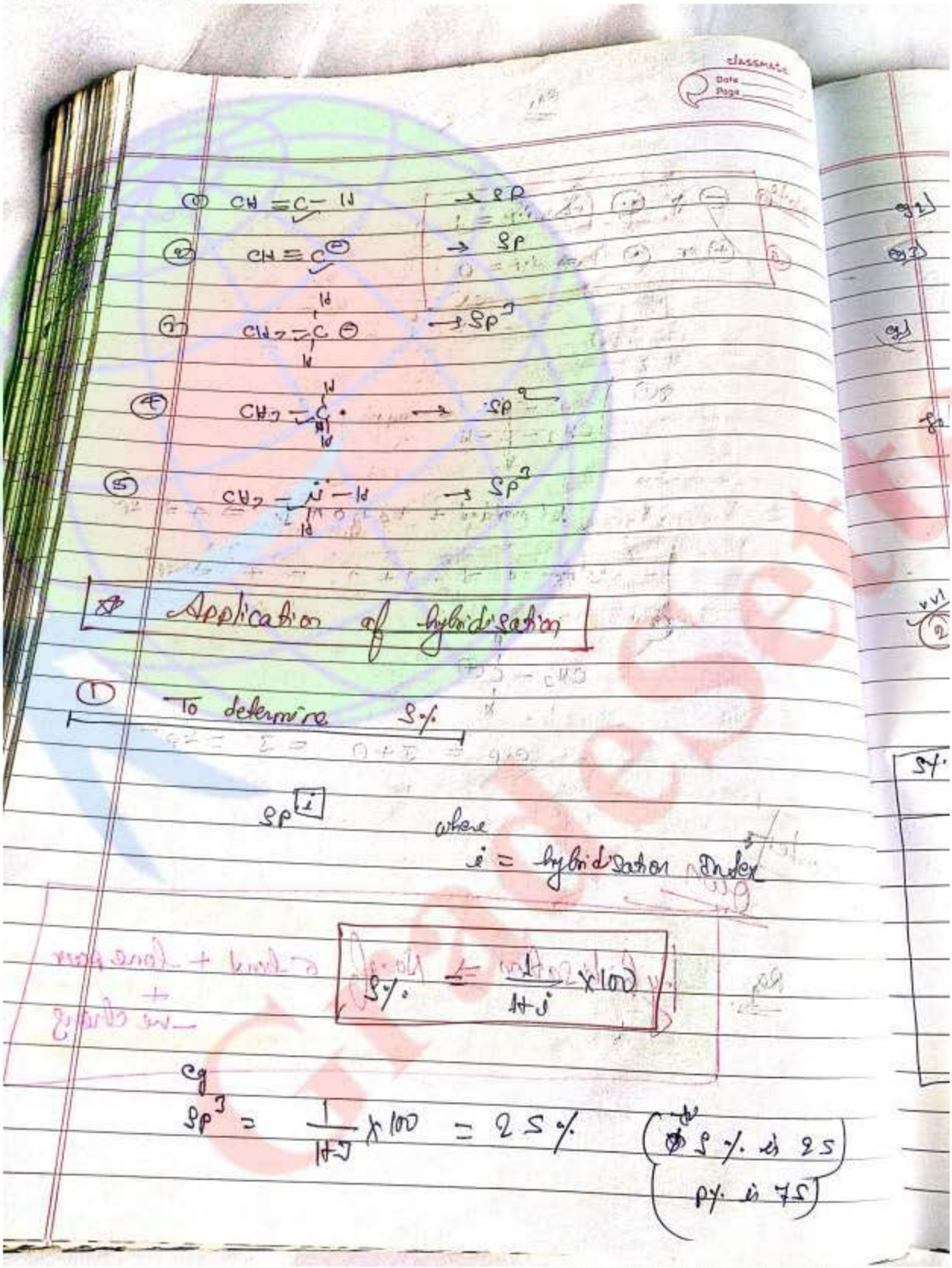
c.p = 3 + 0 = 3 ⇒ sp^2

Note

Q1 on

Rq

hybridisation ⇒ No. of σ bond + lone pair + −ve charge



Application of hybridisation

1. To determine s%

sp^i

where

i = hybridisation Index

$$s\% = \frac{1}{i+1} \times 100 \%$$

eg

$sp^3 = \frac{1}{3+1} \times 100 = 25\%$

(s% is 25
p% is 75)

Ra)

classmate
Date
Page

(a) sp^2 → 33.3%

(b) sp → 50%

(c) Arrang in "↓" order of s% :

(a) sp^2 (b) sp^3 (c) p (d) sp (e) s

33.3% 25% 0% 50% 100%

$s > sp > sp^2 > sp^3 > p$

vvi (2)

s% ∝ E.N ∝ Bond energy ∝ $\frac{1}{\text{Bond length}}$

Data:-

s%		E.N	B.E	B.L
25%	C—C (sp^3)	2.25	80-83 kal	1.54 A°
33.3%	C=C (sp^2)	2.75	146 kcal	1.34 A°
50%	C≡C (sp)	3.3	200.6 kcal	1.20 A°

⇒ Ra)

③ To determine type of overlaping :-

$CH_2 = CH - CH_3$

$sp^2 \quad sp^2 \quad sp^3$

overlaping type → $sp^2 - sp^3$

eg. $CH \equiv C - CH = CH_2$

$sp \quad sp \quad sp^2$

Single bond overlaping → $sp - sp^2$

Application based Questo

Type of hybridisation

$CH_3 - \overset{2}{C}H = \overset{3}{C}H - \overset{4}{C}H = \overset{5}{C}H - \overset{6}{C}H_2$

sp^3 sp^2 sp^2 sp^2 sp sp^2

$sp^3 \Rightarrow 1$

$sp^2 \Rightarrow 2, 3, 4, 6$

$sp \Rightarrow 5$

Q. overlaping type of sigma bond in benzene is —

Single bond

$sp^2 - sp^2$

(3) order of E.N in decreasing order :-

(A) C_{sp^2} (2.75) (B) N (3.0) (C) C_{sp} (3.1) (D) O (3.5) (E) C_{sp^3} (2.25)

F O N C , B

$C_{sp} > C_{sp^2} > C_{sp^3}$

Q7) Arrange in Acidic hydrogen :-

(a) CH_3-CH_2-H (sp^3)

(b) $CH_2=CH-H$ (sp^2)

(c) $CH\equiv C-H$ (sp)

E.N

Sol^n

Ra Acidic strength ∝ Acidic H ∝ E.N

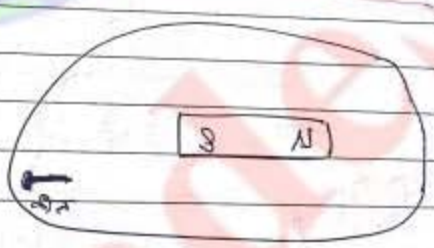
Ra ⟹ C > B > A

☆ Electronic effects in co-valent bond

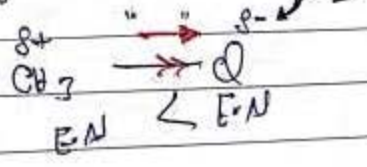
- Permanent effect
  - (1) Inductive → (I)
  - (2) Hyperconjugation (H)
  - (3) Resonance (R) / mesomeric effect (m)
- Temporary effect
  - (1) Electromeric effect (E)

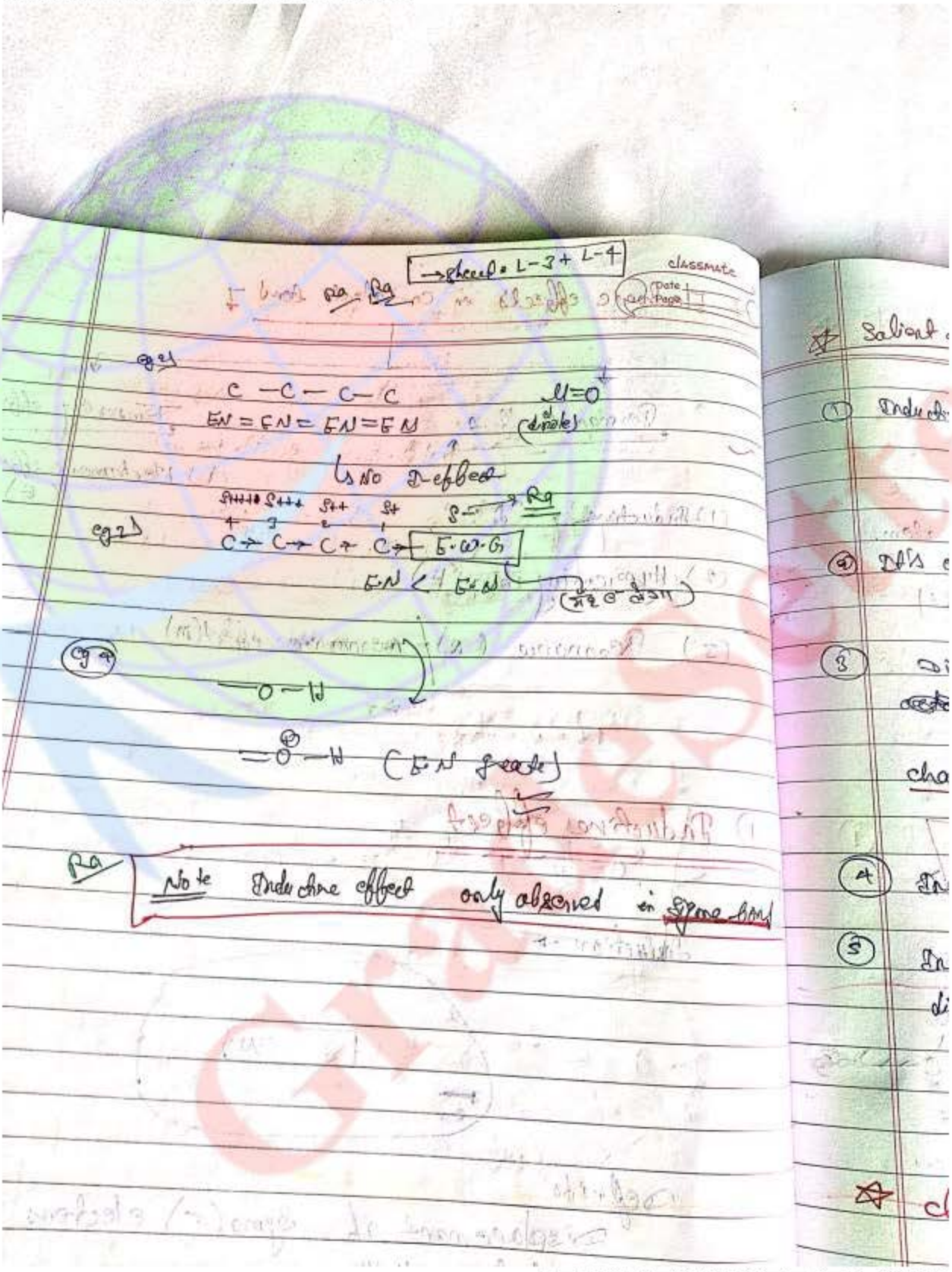
(1) Inductive effect

Induction: →



Defn'd to
Displacement of Sigma (σ) electrons due to Electronegativity.
or
Polerisation of σ e⊖'s





☆ Salient or specific features of I-effect

(1) Inductive effect represented by I/T (transmission)

Note
Inductive effect or transmission effect

(2) It's occurs only in [σ e's]
Ra↑

(3) displacement of Sigma e's does not leave their atomic orbitals.
So Inductive effect represented by partial charges- therefore I-effect is weak effect

(4) Inductive effect is uni-directional

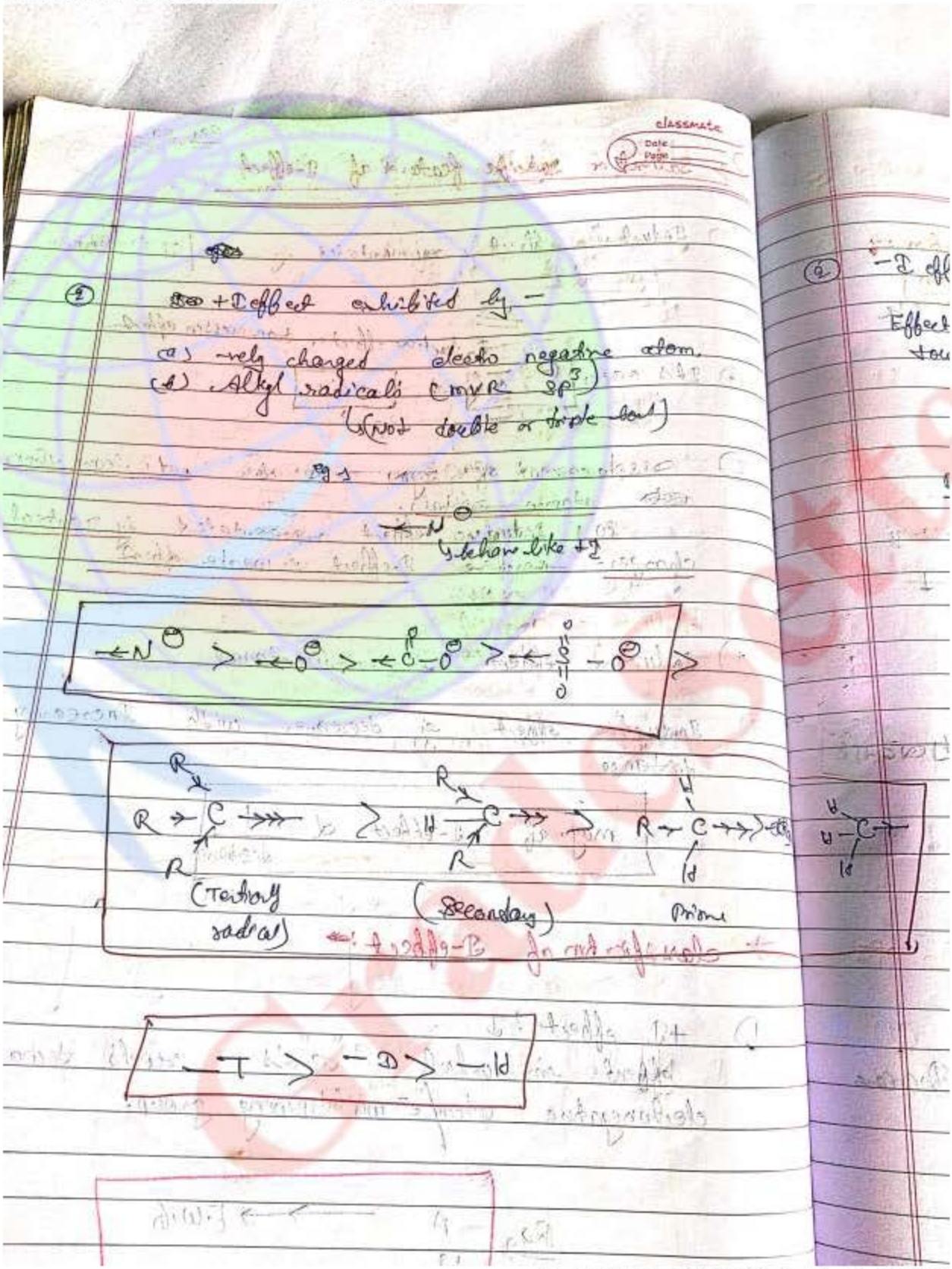
(5) Inductive effect is decrease with increasing of distance.

[mag. of I-effect ∝ 1/distance]

☆ classification of I-effect :➡

(1) +I effect : I effect in which "σ" e's repels towards more electronegative atom/e⁻ withdrawing group.

Ra→ [A ⟶ E.W.G
+I]



Raj

-I effect →

Effect exerted by groups which attract "σ" e's towards itself or
effect exerted by E.W.G

Raj →

E.W.G
(-I group)
E.D

Eg:

$CH_3 - Cl$

E.R.G E.W.G

↳ (e⁻ withdrawing ability)

$\rightarrow \overset{\oplus}{N}F_3 > \rightarrow \overset{\oplus}{N}R_3 > \rightarrow N\rightarrow O > \rightarrow C\equiv N >$

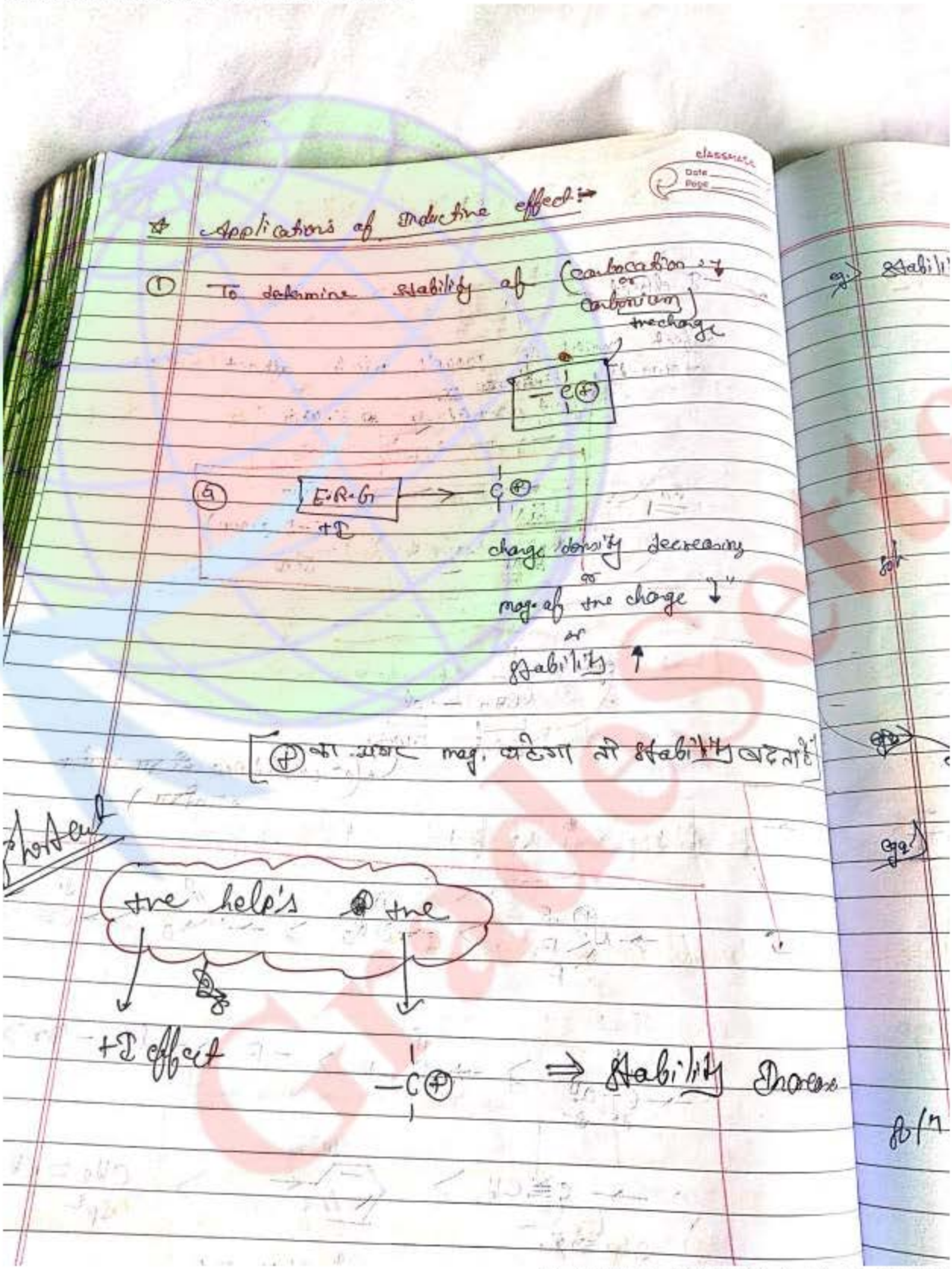
$\rightarrow C(=O)-OH > \rightarrow C(=O)-H > -F > -Cl > -Br > -I$

$\rightarrow C\equiv CH > \text{C}_6\text{H}_6 > CH_2=CH- > H$

sp sp^2 sp^2

sp character = 50%.

$sp^2 = 1/3 \Rightarrow 33.33\%$.



* Applications of Inductive effect :-

(1) To determine stability of (carbocation or carbonium) +ve charge

$-\overset{|}{C}\overset{|}{\underset{|}{\oplus}}$

(a) E.R.G $\xrightarrow{+I}$ $-\overset{|}{C}\overset{|}{\underset{|}{\oplus}}$

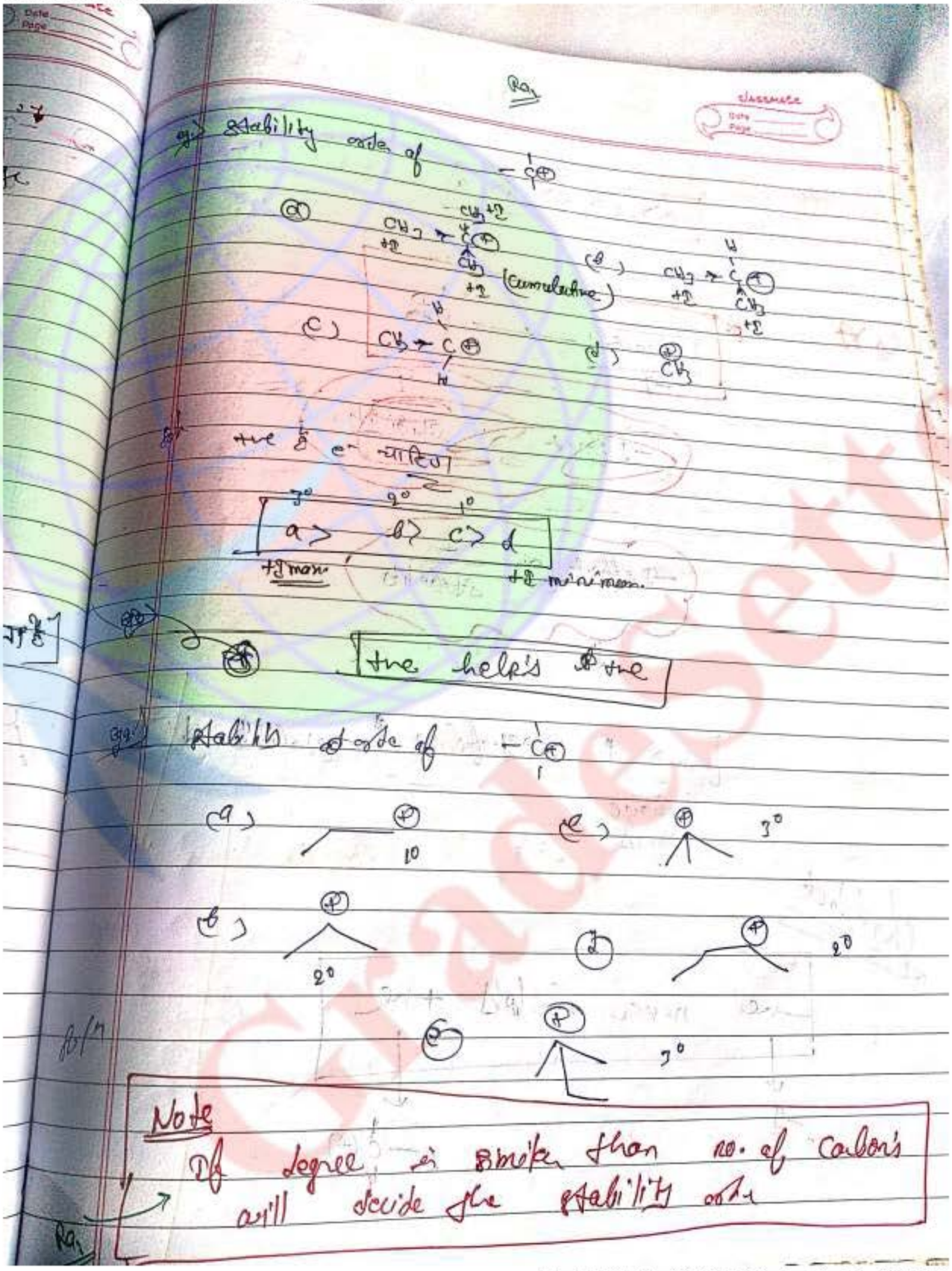
charge density decreasing
or
mag. of the charge ↓
or
Stability ↑

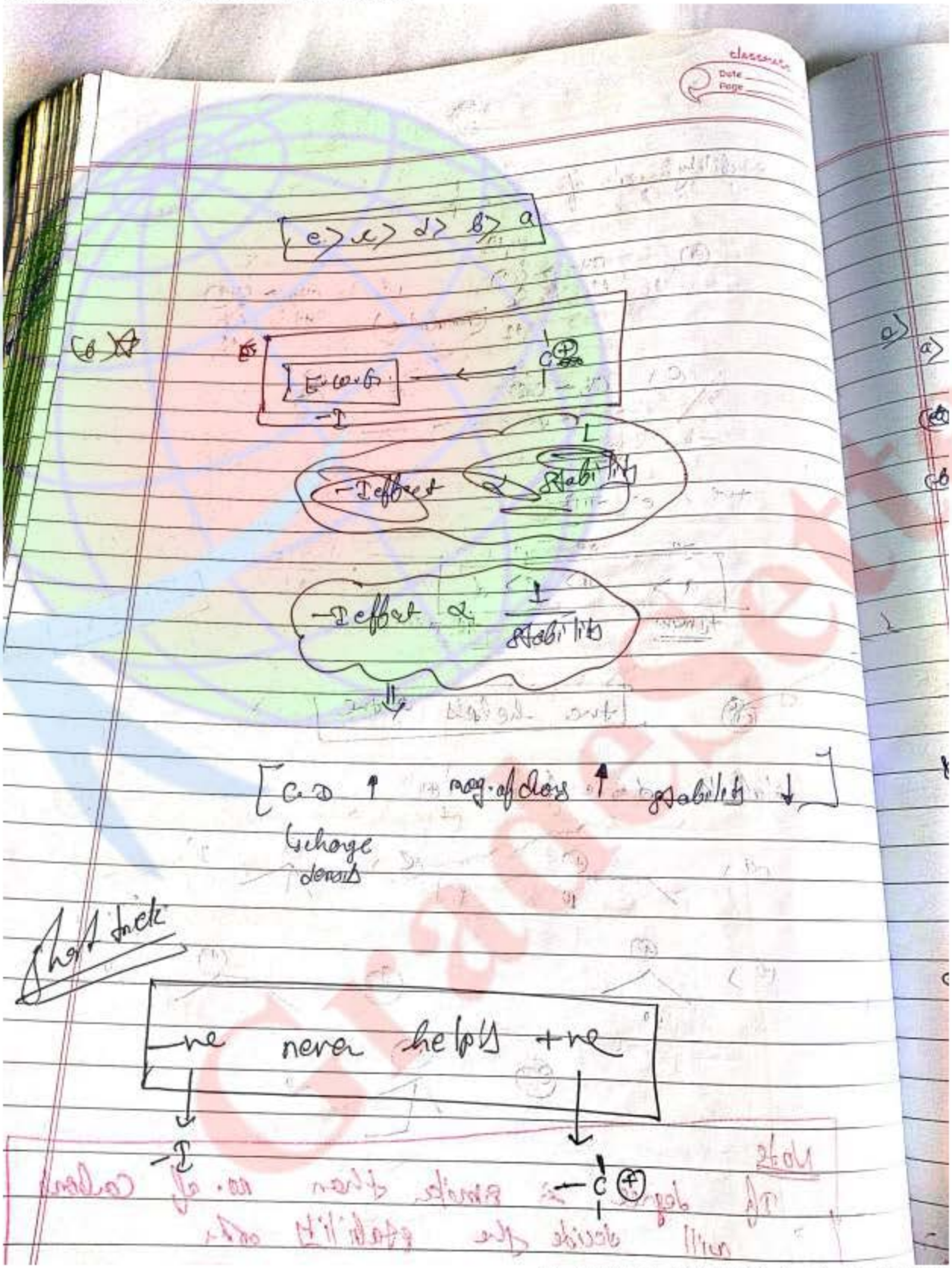
[⊕ का मान mag. घटेगा तो Stability बढ़ेगी]

Short cut

the help's ⊕ the

+I effect $\Rightarrow$ $-\overset{|}{C}\overset{|}{\underset{|}{\oplus}}$ $\Rightarrow$ Stability Decrease





Note: Inductive effect (I)

E.R.G → E.W.G

+I → −I

⊖ E.N, O⊖, N⊖

or

sp^2 → I > sp

⊕ $E^{\oplus}$, $N^{\oplus}$, $O^{\oplus}$, $P^{\oplus}$

or

E.N

or

$sp > sp^2 > sp^3$

C≡C > C=

(1) E.R.G → C⊕

+I

$s\uparrow$

the help's +ve

(applicable for

+I,

+H,

+Mc

(2) E.W.G ← C⊕

−I

$s\downarrow$

② To determine stability order of carb-free radicals → [$-\dot{C}\cdot$]

Same as carbocation $-\overset{+}{C}$

Stability of $-\dot{C}\cdot$ α +I $\alpha \frac{1}{-I}$

③ To determine stability order of carbanion → [$-C\ominus$]

(a) [E·R·G] (+I) → $C\ominus$

(b) [E·W·G] (−I) ← $C\ominus$

charge density ↑ mag. of charge (−) ↑ stability ↓

[+ve never helps −ve]

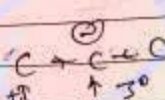
stability $-C\ominus \alpha \frac{1}{+I}$

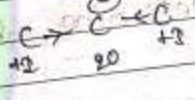
charge density ↓ mag. of charge ↓ stability ↑

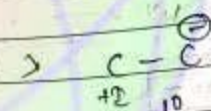
[−ve helps −ve]

stability of $-C\ominus \alpha -I$

Q) Arrange in decreasing order of carbanions

(a) 

(b) 

(c) 

so/n

(i) 2° > 3°

c > b > a

min +I effect more stability

(2)

(a) $NO_2 - C - \overset{\ominus}{C}$ (-I)

(b) $\overset{\oplus}{N}R_3 - C - \overset{\ominus}{C}$ (-I)

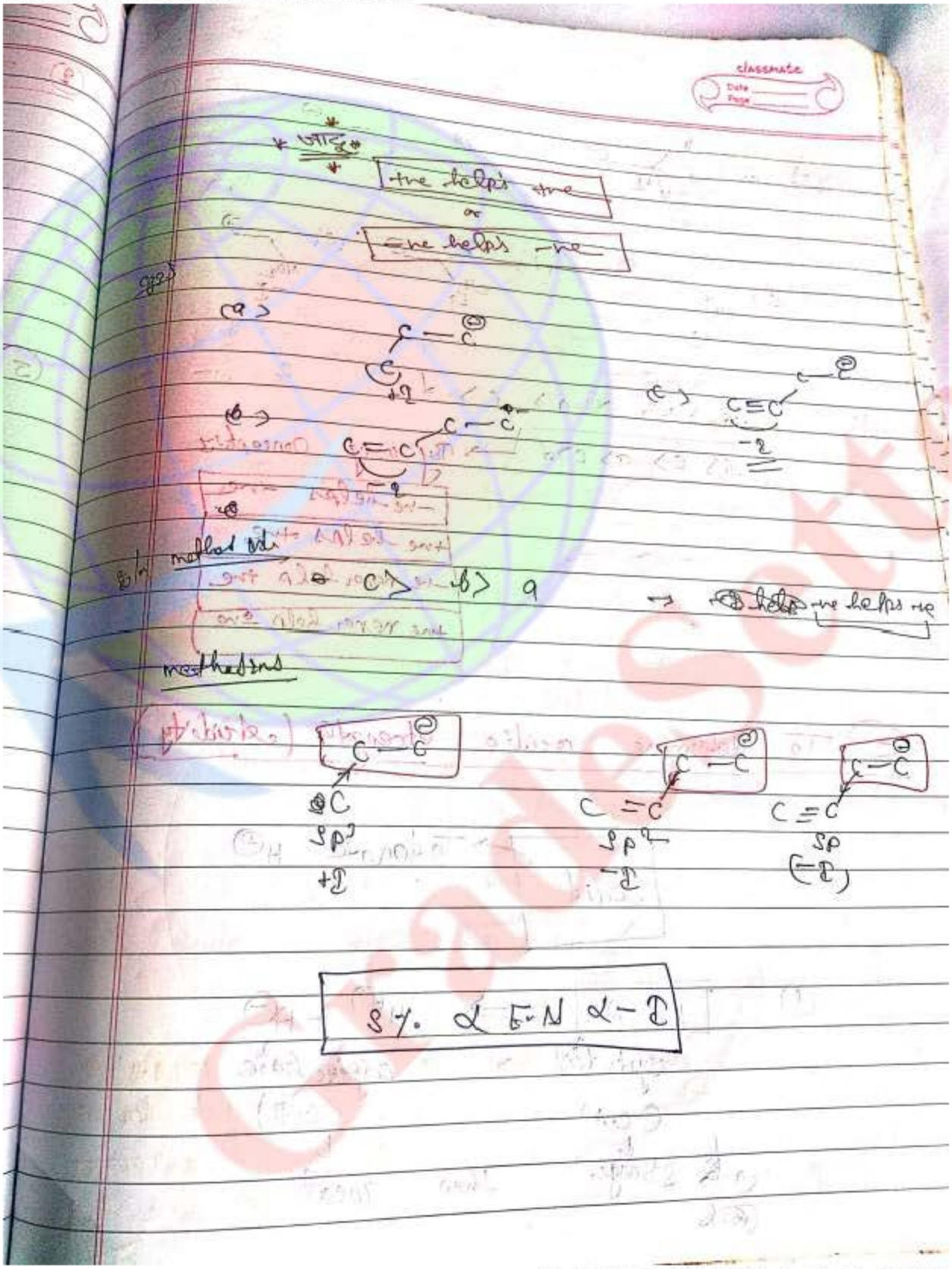
(c) $F - C - \overset{\ominus}{C}$ (-I)

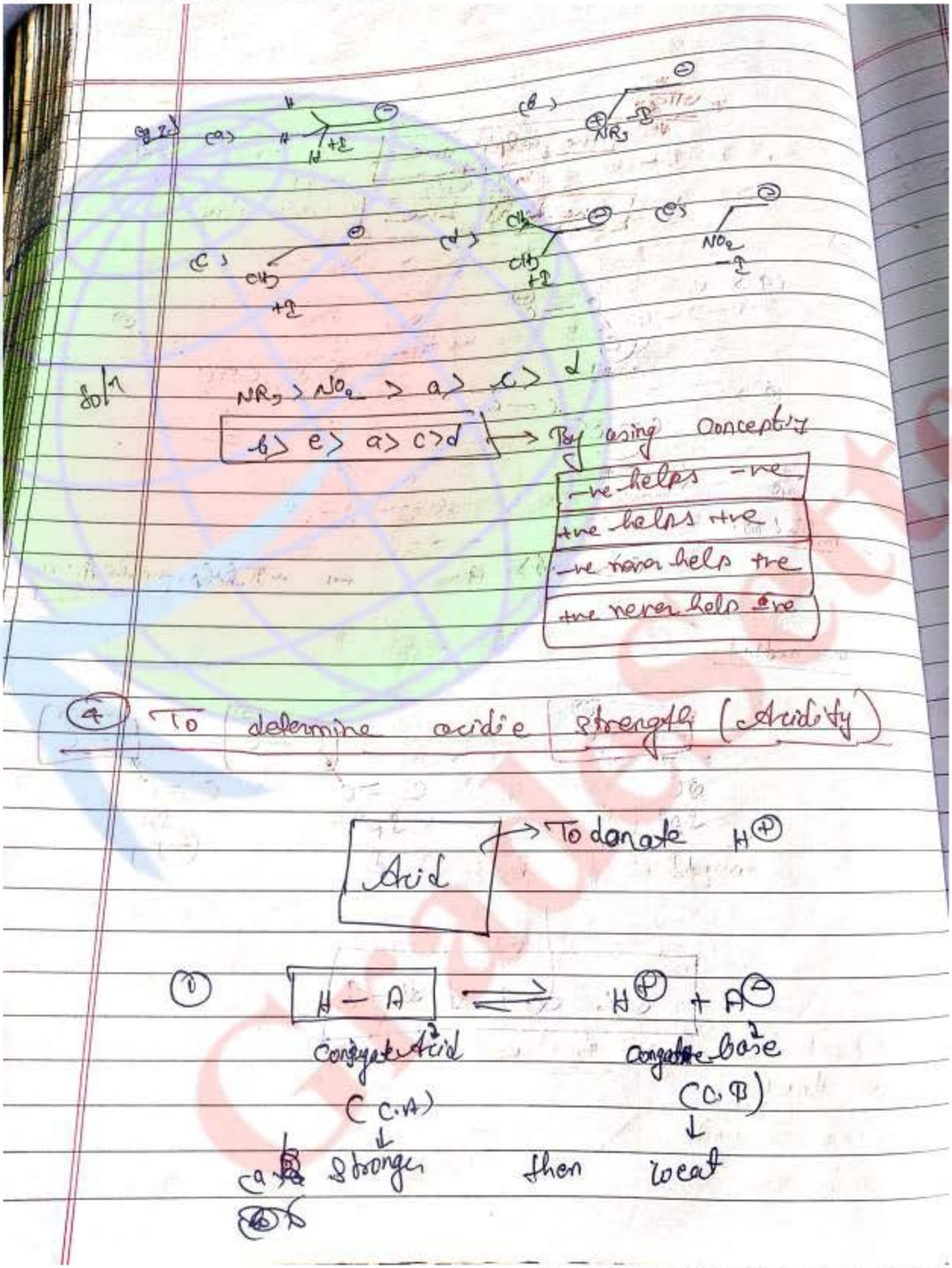
so/n

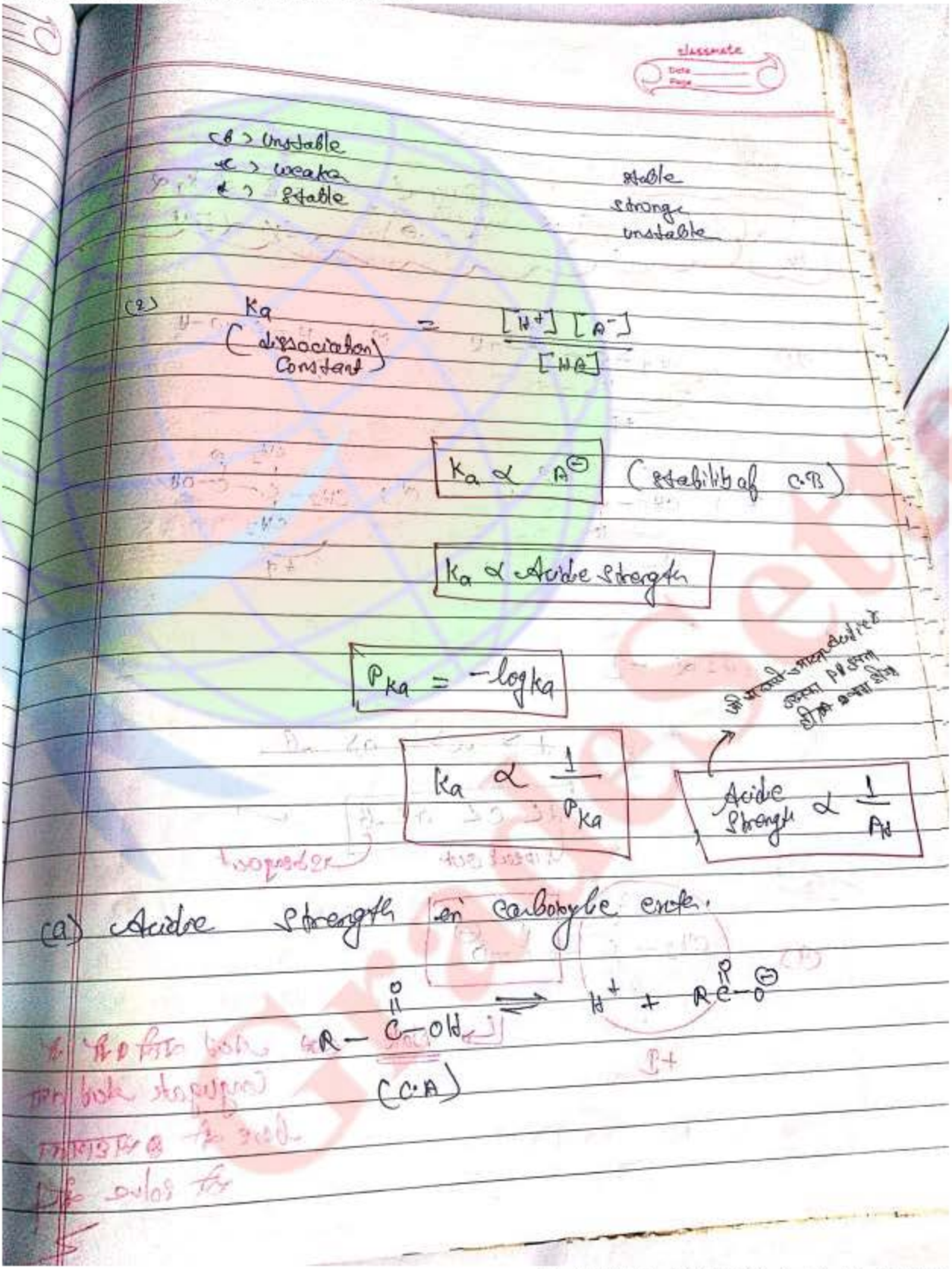
$NR_3 > NO_2 > F$

b > a > c

-ve helps -ve







(B) > Unstable
(C) > weaker
(A) > Stable

stable
strong
unstable

(2) K_a (dissociation Constant) $= \frac{[H^+][A^-]}{[HA]}$

$K_a \propto A^{\ominus}$ (stability of C.B)

$K_a \propto$ Acidic strength

$P_{Ka} = -\log Ka$

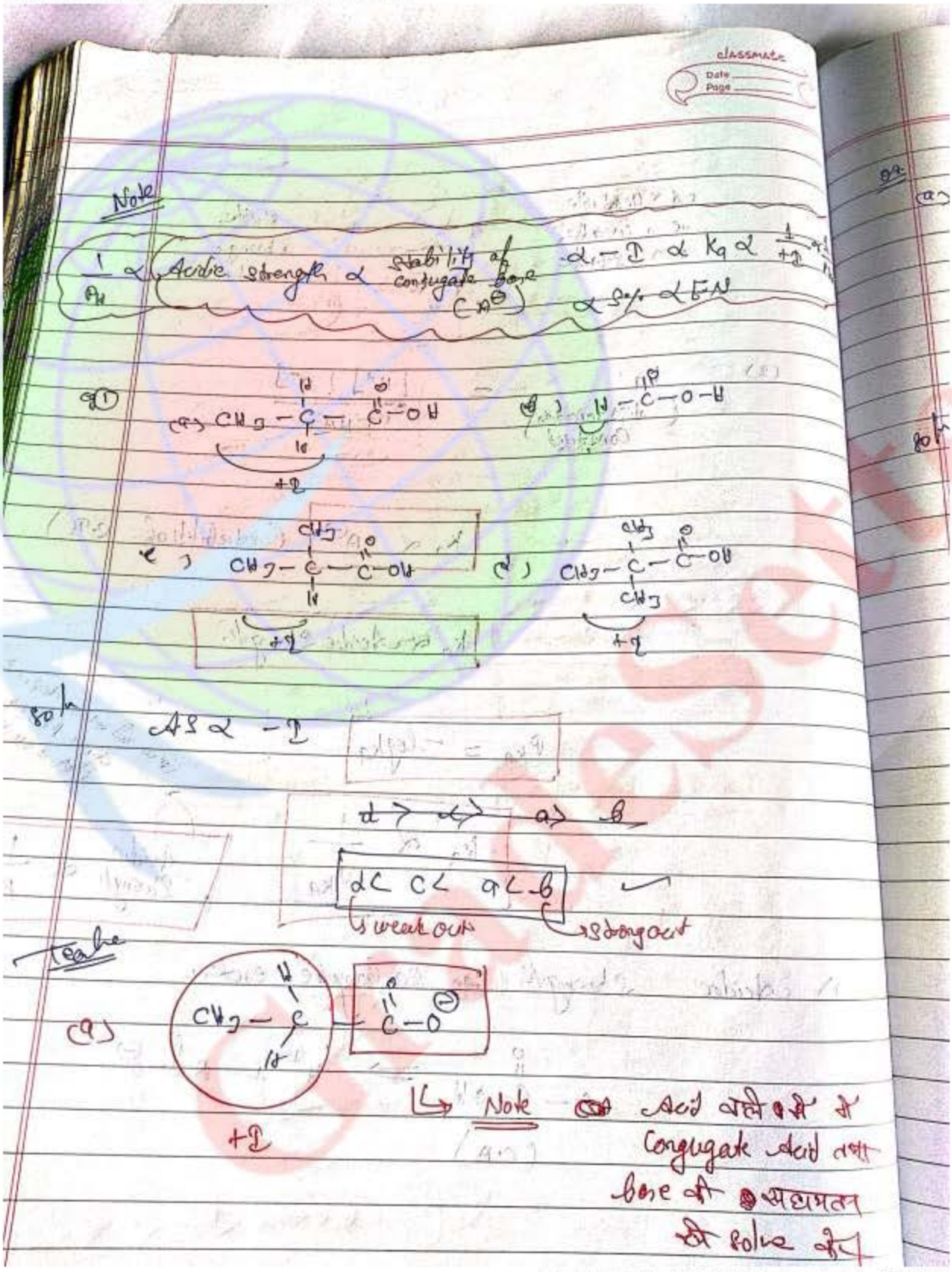
$K_a \propto \frac{1}{P_{Ka}}$

Acidic Strength $\propto \frac{1}{P_{Ka}}$

(a) Acidic strength in carboxylic acid.

$R-\overset{O}{\overset{\|}{C}}-OH \rightleftharpoons H^+ + R-\overset{O}{\overset{\|}{C}}-O^{\ominus}$

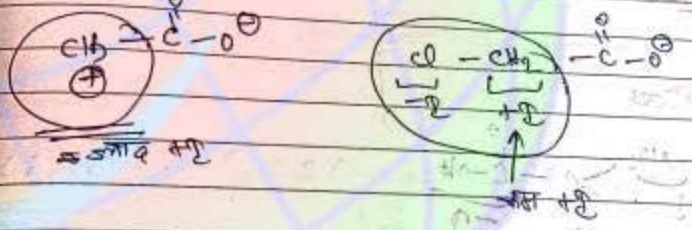
(C.A)



(a) $CH_3-\overset{O}{\overset{\|}{C}}-OH$ (b) $Cl-\underset{N}{\overset{H}{C}}-\overset{O}{\overset{\|}{C}}-OH$

(i) Ka value
(ii) Pka value
(iii) Acidic strength
(iv) pH

$\frac{1}{+I} \propto \frac{1}{Pka}$



(i) $a < b$ or $b > a$
(ii) $a > b$ or $a > b$
(iii) $a < b$ or $b > a$
(iv) or $a > b$

(a) $\underbrace{CH_3-CH_2}_{+I}-\overset{O}{\overset{\|}{C}}-OH$ (Propionic acid)

(b) $CH_2=CH-\overset{O}{\overset{\|}{C}}-OH$ (Acrylic acid)

(c) $CH\equiv C-\overset{O}{\overset{\|}{C}}-OH$ (Propenzylic acid)

$-I$

$c > b > a$

Note :- मात्र याद रखें → Number तथा Distance में से dominant कौन power.

Specific Point for only "-I" effect →

(1) Number always dominant over power.

eg.

(i) $O_2N-CH_2-CH_2-COOH$ (ii) $Cl-CH_2-CH_2-COOH$

$-I^{NO_2} > -I^{Cl}$ → According to order

but

$-I^{Cl\ (not)} > -I^{NO_2\ (not)}$

II > I → Acidic strength

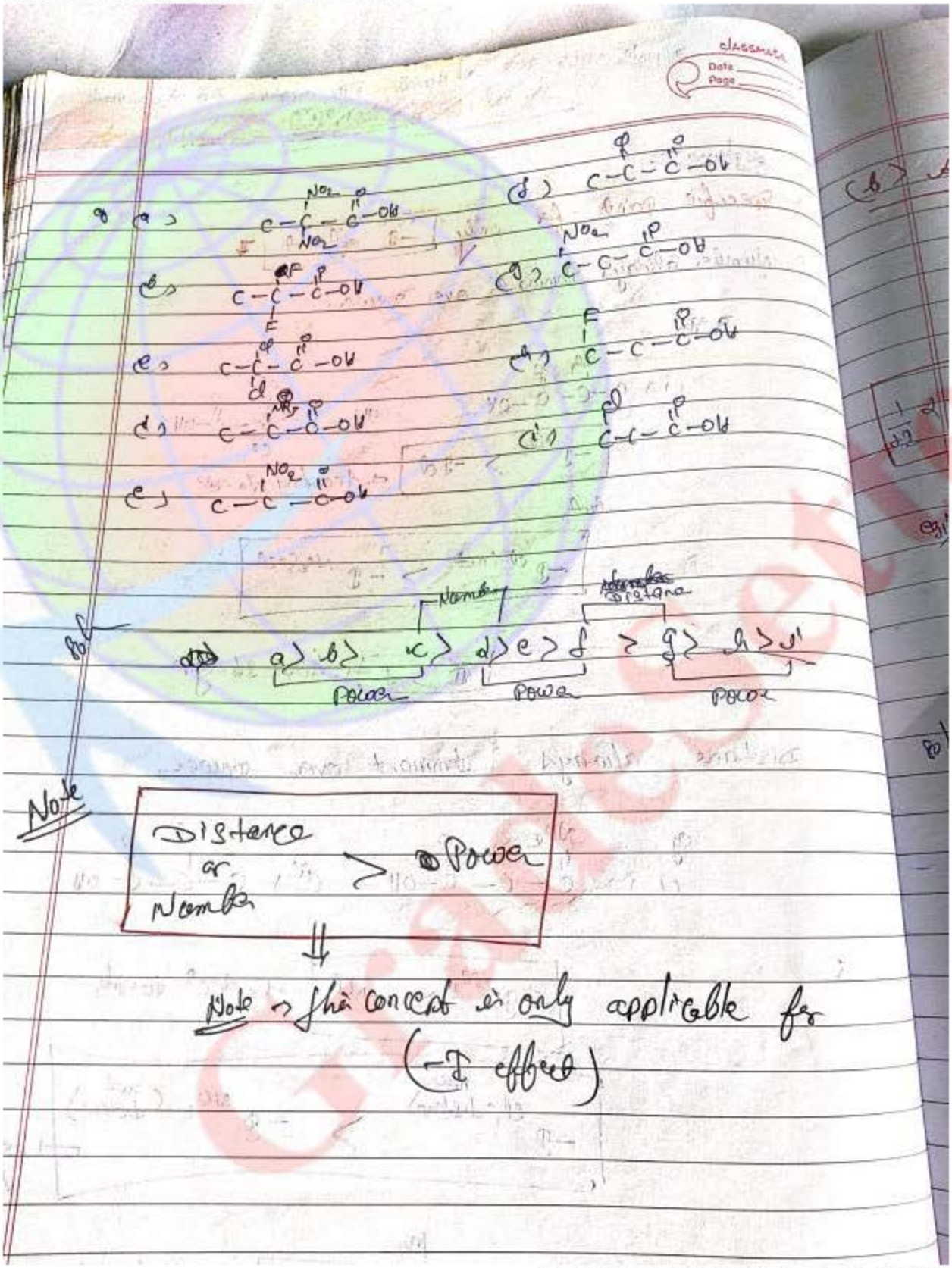
(2) Distance always dominant over power

eg. (i) $O_2N-CH_2-CH_2-COOH$ (ii) $Cl-CH_2-CH_2-COOH$

$-I^{NO_2} > -I^{Cl}$ → Acc^n to order

$-I^{Cl\ (not\ distance)} > -I^{NO_2\ (not\ distance)}$ → According Distance.

Ans. I > (ii) → Acidic strength



(6) Acidic strength in alcohols :-

E.N > E.N

$R-O\overset{(C.A)}{-}H \rightleftharpoons R-O^{\ominus}$ (alkoxide, C.B) $+ H^{\oplus}$

$\frac{1}{\text{Acidic strength}} \propto \frac{1}{pH} \propto \frac{1}{pKa} \propto$ Acidic strength $\propto -I \propto EN \propto K_a$

(a) $C-\overset{NO_2}{\overset{|}{C}}-C-OH$ (b) $C-\overset{CH_3}{\overset{|}{C}}-C-OH$ (c) $C=C-C-OH$

$-I$ of $NO_2 >$ ~~OH > H~~

NO_2 ($-I$): $C-C-C-O^{\ominus}$

a > c > b

$-I_{NO_2} > -I\ C=C$

$C=C-C-O^{\ominus}$ ($-I$)

CH_3 ($+I$): $C-C-C-O^{\ominus}$

-ve helps -ve

+ve helps +ve

(b) Acidic strength of alcohols :-

$$R-\overset{\overset{EN}{\longrightarrow}}{O}-H \rightleftharpoons R-O^{\ominus} + H^{\oplus}$$

(C.A) alkoxide (C.B)

$\frac{1}{EN} \propto \frac{1}{pH} \propto \frac{1}{pKa} \propto$ Acidic strength $\propto -I$ effect $\propto EN \propto K_a$

Eg:-

(a) $C-\overset{NO_2}{\overset{|}{C}}-C-OH$ (c) $C=C-C-OH$

(b) $C-\overset{CH_3}{\overset{|}{C}}-C-OH$

Ans:-

$-I \Rightarrow NO_2 > OH > \cancel{OR}$

NO_2 (-I)

$C-C-C-O^{\ominus}$

a > c > b

$-I_{NO_2} > -I\ C=C$

$C=C$ (-I) $-C-O^{\ominus}$

-ve helps -ve

+ve helps +ve

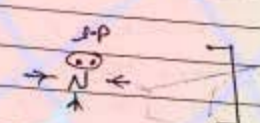
CH_3 (+I)

$C-C-C-O^{\ominus}$

Base strength in Amines

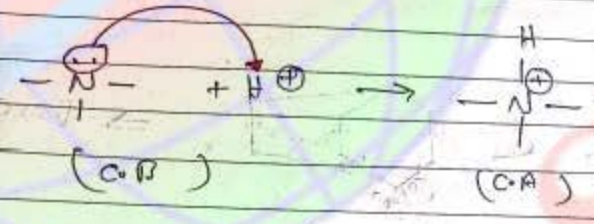
Base → l.p donor (Lewis base)
Proton acceptor or H^+ acceptor

(a) Base strength will be decided by e⁻ density at nitrogen



+I ∝ B.S
−I

(b)



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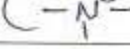
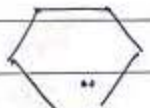
Base strength ∝ stability of C.A



eg)

(a)  ↓ e⁻ density min.

(b)  ↓ e⁻ density medium

(c)  ↓ e⁻ density max

so

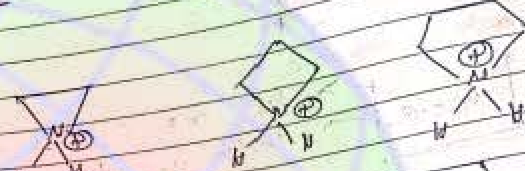
→ ~~Acidic~~ Basic strength

Basic strength ∝ +I

Qa)

Qa) → Methodand

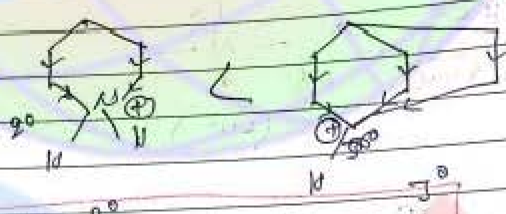
C.A



+ve belos +ve

Q2)

S/n



⇒ Base order

Note

i) σ e^-

ii) weak effect ([illegible] due to δ^+ and δ^-)

Hyperconjugation [H]

or

σ – p Resonance

or

No-bond Resonance

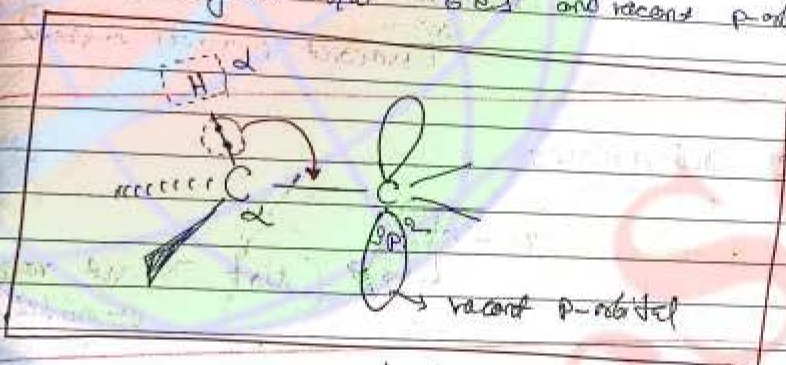
or

Bakka- Nathan's effect

Defn
De-localisation of σ e⁻'s towards vacant p-orbital

or

Conjugation b/w σ e⁻'s and vacant p-orbital



↳ hyperconjugation में σ e's भी है वह vacant p-orbital की ओर आता है

Note how to find vacant p-orbital ↓
जिसका hybridisation sp^2 होगा उसके पास vacant p-orbital होगा

Conditions to show hyperconjugation

① Compound (or Species) should have sp^2 hybridised carbon (vacant p-orbital)

classmate
Date
Page

(2)

g.1

$CH_3 - \overset{+}{C} <^{H}_{H}$

$H+O = 3 (sp^2)$
↳ vacant p-orbital is present

(ii) ~~carb~~ Carb - free radicals :-

$CH_3 - \dot{C}H_2$
sp^2 ↳ vacant p-orbital is present

Note: Carb-anions :-

$CH_3 - \overset{-}{C}H_2$
↳ sp^3 (Not Present vacant p-orbital)

(iii) Alkene

$CH_3 - CH = CH_2$
sp^2 ↳ vacant p-orbital present

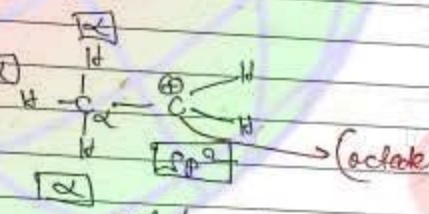
(2) Species or compound should have at least one α-H

eg:- $CH_3-\overset{\oplus}{C}H_2$ (α, sp^2)

eg:- $CH_3-\dot{C}H_2$ (α, sp^2)

* Mechanism of H-effect :-

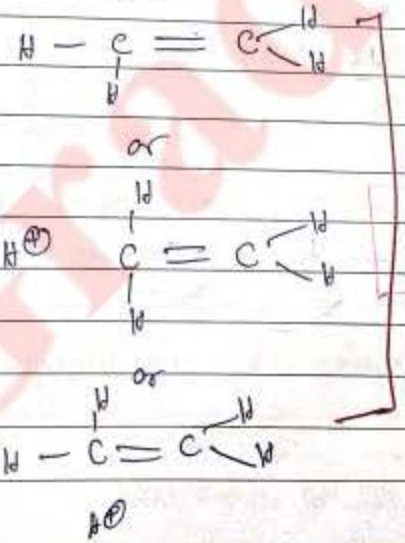
eg:-



(octet Incomplete) (less stable)

ethyl carbocation

(mechanism)



(more stable)

Hyperconjugative structure

(Here 3 α-H so 3 structure is formed)

Note:- जितना ज्यादा α-H होगा उतना ज्यादा hyperconjugate structure होगा।

Ans)

Intermediate structure occurs during hyperconjugation

No. of Hyperconjugation structure = No. of α-H + 1

eg) $CH_3-\overset{\oplus}{C}H_2$ (α, sp^2) — No. of α-H = 2 — No. of hybrid atom 2+1 = 3

eg) $(CH_3)_2-\overset{\oplus}{C}H$ (α, sp^2) — 9 — 9+1 = 10

Ans) eg) $CH_3-CH=CH_2$ (α, sp^2, sp^2) — 3 — 3+1 = 4

eg) $CH_3-\overset{\oplus}{C}H-CH_3$ (α, sp^2, α) — 6 — 6+1 = 7

eg) $CH_3-\underset{\alpha}{C}(CH_3)=\underset{sp^2}{C}H-\underset{\alpha}{CH_3}$ (α, sp^2, α) — 9 — 9+1 = 10

R_a, R_a → $\overset{\oplus}{C} < \overset{\oplus}{C} < \overset{\oplus}{C} < C-H$

H-effect :-

Based upon no. of α-H

* Application of H-effect :-

(1) To determine stability of carbocation :-

Stability of $-\overset{|}{C}\overset{\oplus}{}$ ∝ No. of α H

(a) $CH_3 - \overset{\alpha}{CH_2} - \overset{\oplus}{CH_2}$ (sp^2) → α H = 2

(b) $CH_3 - \overset{\alpha}{\underset{\alpha}{\overset{|}{C}}}\overset{\oplus}{} - \overset{\alpha}{CH_3}$ (CH_3 on α) → α H = 9

(c) $\overset{\oplus}{C}H_3$ (sp^2) → α H = 0

(d) $CH_3 - \overset{\alpha}{\underset{sp^2}{CH}}\overset{\oplus}{} - \overset{\alpha}{CH_3}$ → α H = 6

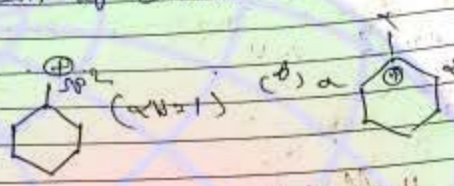
b > d > a > c

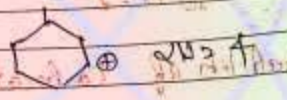
Note: No. of hyperconjugative structure ∝ Stability

↳ जितना बार एक 'σ' bond shift होगा उतना energy मिलेगा और stability बढ़ेगा।

Q1)

Q1) Stabⁿ of carbocation on the basis of +H-effect

(a)  (b) α-H = 7

(c)  α-H = 4

Sol^n b > c > a

(2) To determine stability of carbo-free radical :-

Q1) Stabⁿ of carbocation or Stabⁿ of carb-free radical

Stability of $-\dot{C}\cdot$ $\propto$ No of α-H

(3) To determine Stability of Alkenes :-

Stabⁿ of alkene $\propto$ No of α-H

(No of hyperconjugated structure

Ra1

(a) $\underset{sp^2\ sp^2}{\boxed{CH_2 = CH_2}}$ α-H = 0

(b) $CH_2 = CH_2 - \underset{sp^2\ sp^2}{\boxed{CH = CH_2}}$ α-H = 2

(c) $CH_3 - \underset{sp^2\ sp^2}{\boxed{CH = CH}} - CH_3$ α-H = 6

c > b > a

Note

Raj ↑ If alkene contains same no. of α-H then always :

Unsymmetrical alkene is greater stable than symmetrical alkene

or

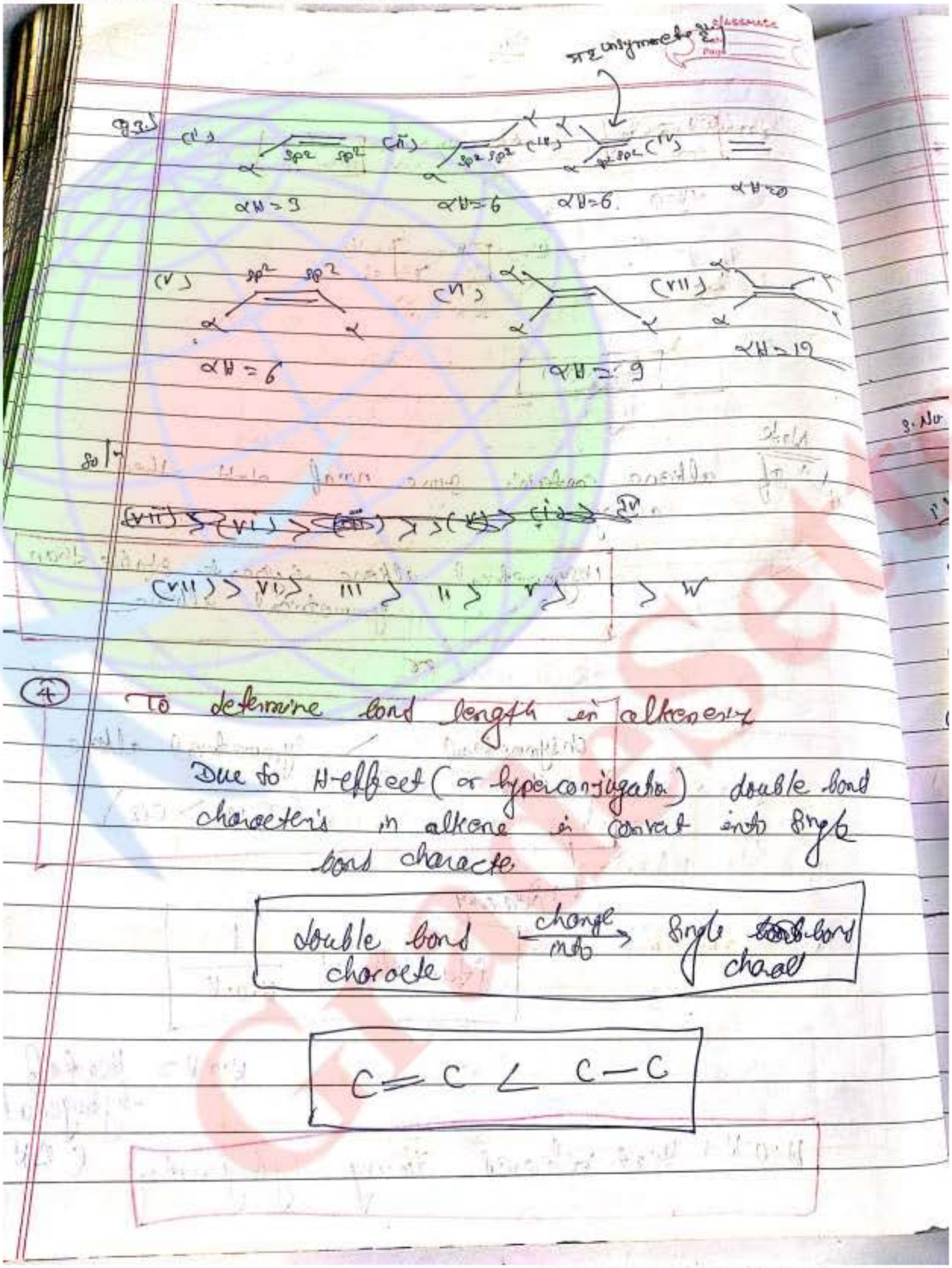
Unsymmetrical alkene > Symmetrical alkene (Trans > Cis)

↳ Reason

Stability $\propto \frac{1}{H.O.H}$

H.O.H = Heat of hydrogenation ($C \Delta H$)

H.O.H = Heat released during hydrogenation



(4) To determine bond length in alkenes:-

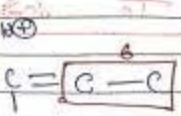
Due to H-effect (or hyperconjugation) double bond character in alkene is convert into single bond character

Double bond character	change into	Single bond character

$C=C < C-C$

eg.

(B. length less)

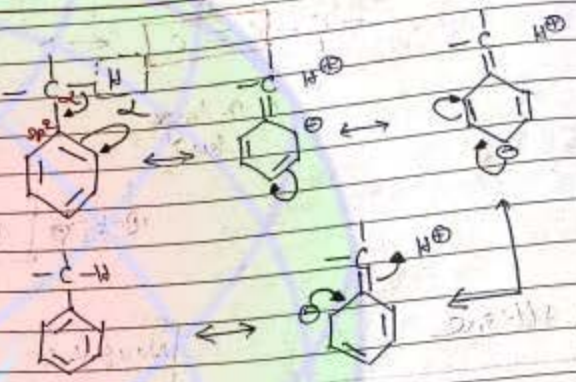


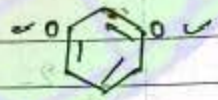
(B. length is high)

B.l → b > a

S.No	Alkene	No of α-H	Bond length
1)	$CH_2=CH_2$	0	1.34 A°
2)	$CH_3-CH=CH_2$	3	1.39 A°
3)	$CH_3-CH_2-CH=CH_2$	2	1.37 A°
4)	$CH_3-CH(CH_3)-CH=CH_2$	1	1.35 A°
5)	$CH_3-C(CH_3)(CH_3)-CH=CH_2$	0	1.34 A°

⑤ To determine Activation of benzene Ring:-



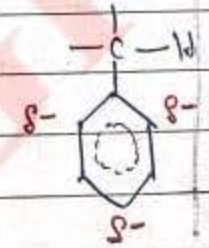


P ✓

✓ Due to +H-effect in alkyl benzene :-

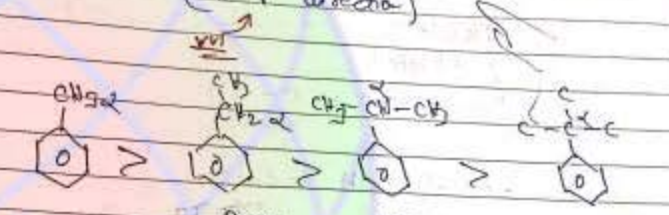
(i) e^- density Increases in Ring which is Responsible for activation of Ring.

(ii) e^- density occurs at ortho and Para Positions



Ans)

(iii) In aromatic electrophilic substitution reaction Electrophile (E^+) attack at ortho and para position (o-p directing)



Note

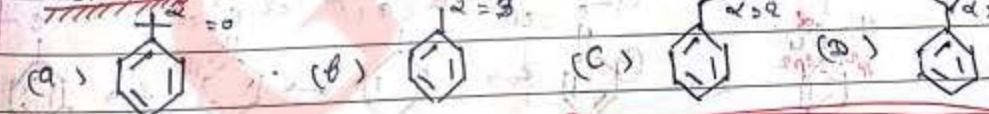
$\Rightarrow$ Stability $\propto$ No. of α-H

Ring activation ↑ "α-H" ↑ ⇒ stability ↑

Ans

☆ Application

Q) Arrange following alkyl benzene comp. in decreasing order of ring activation.



No. of α-H ∝ Ring activation energy

B) > C > D > A

Ans H-effect

C–H > C–D

↳ H-atom का mass बड़ा है इसलिए easily हट जाएगा।

White
+I effect
C–H < C–D

Ans +H and +I

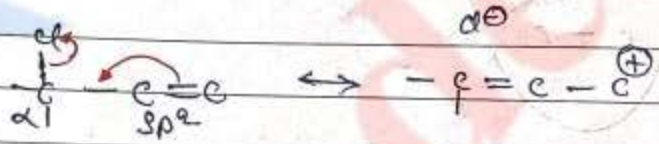
(a) (b)

+H → a > b

+I → b > a

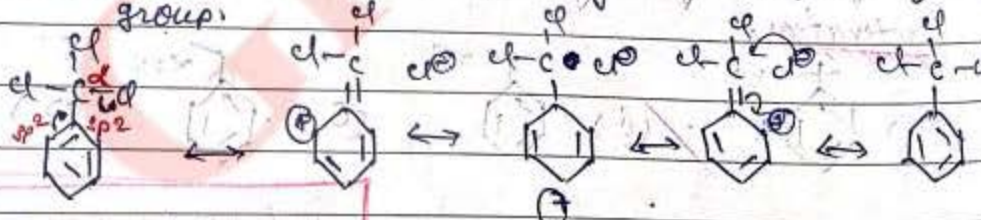
Extra point

b) Reverse H-effect ∝ –H effect
(–H)

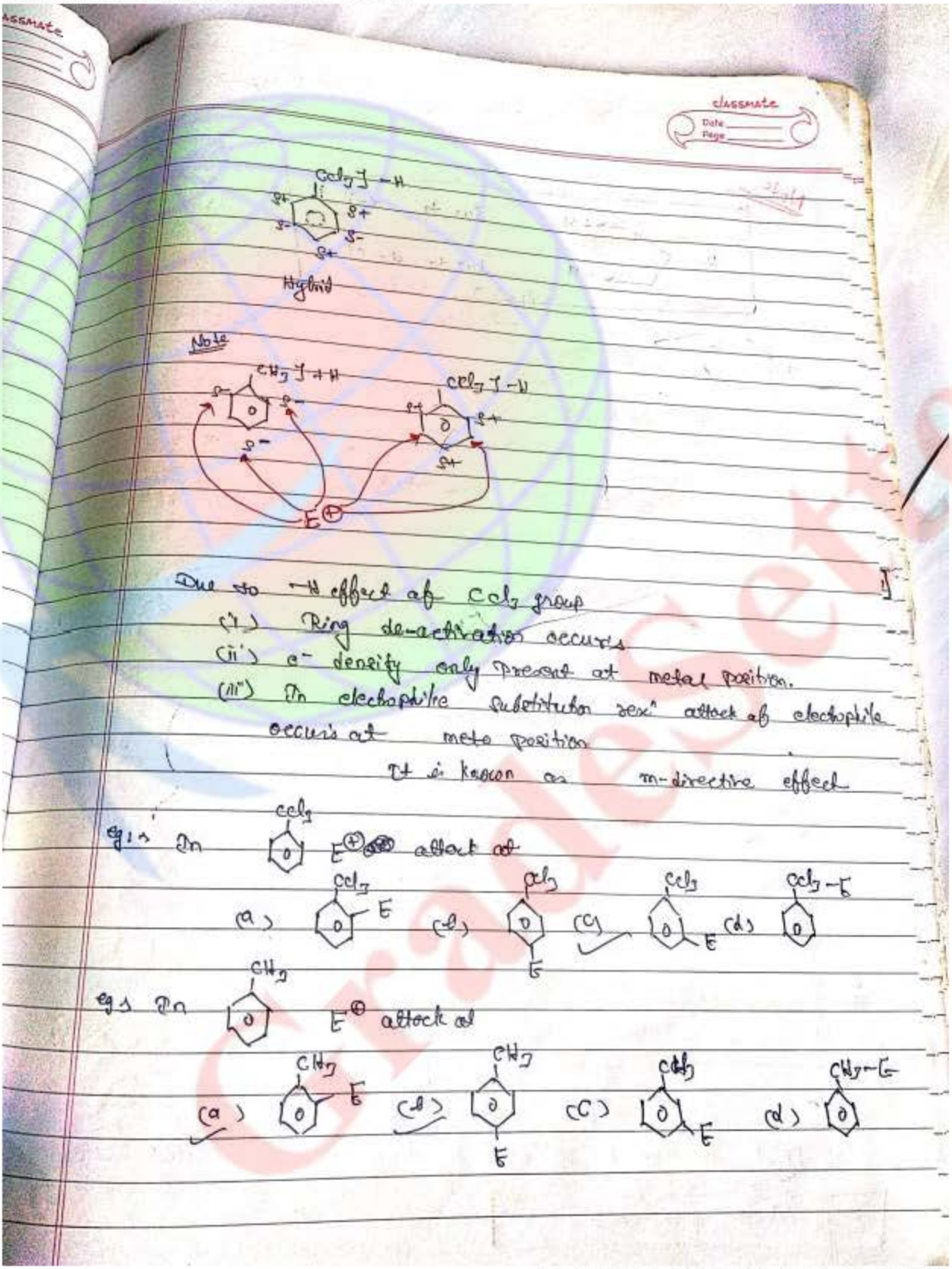


Applications

(1) To explain de-activation of ring by –H-effect of CCl_3 group.



Benzotrichloride



Hybrid

Note

Due to −M effect of CCl_3 group

(i) Ring de-activation occurs

(ii) e⁻ density only present at meta position.

(iii) In electrophilic substitution rxn attack of electrophile occurs at meta position

It is known as m-directive effect

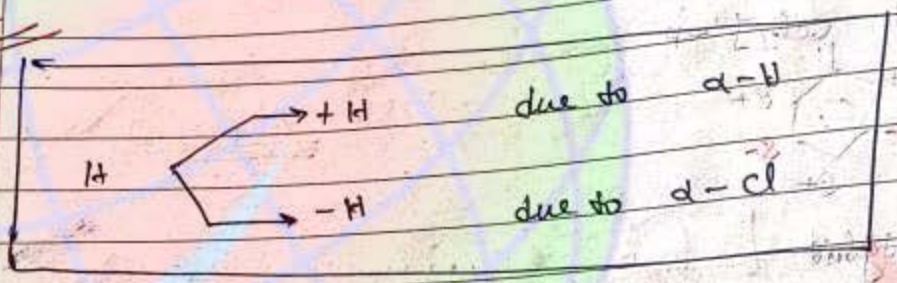
eg: In attack at

(a) (b) (c) (d)

eg: In $E^{\oplus}$ attack at

(a) (b) (c) (d)

Note



Ra

③ Electromeric effect (E)

→ only capital 'E' is used

→ applicable only in $>C=C<$, $-C\equiv C-$, aldehyde, ketone, $>C=O$

Electromeric effect occurs only π-bonded system in which due to the presence of attacking reagents ($E^{\oplus}$/$Nu^{\ominus}$) complete shifting of π-electrons towards any bonded atom is known as said to be electromeric effect.

$>C=C<$ + $E^{\oplus}$ → $>\overset{\oplus}{C}-\overset{\ominus}{C}<$ (+E effect)

alkene / Benzene

$-C\equiv C-$ + $E^{\oplus}$ → $-\overset{\oplus}{C}=\overset{\ominus}{C}-$ (+E effect)

(Alkyne)

$>C=O$ + $Nu^{\ominus}$ → $>\overset{\oplus}{C}-\overset{\ominus}{O}$ (−E effect)

Ra

eg:

$CH_3-CH=CH_2 + Cl-Cl \rightarrow CH_3-\overset{\oplus}{C}H-CH_2-Cl$

$CH_3-\underset{Cl}{C}H-CH_2-Cl$

④ Mesomeric effect / Resonance (R) effect
(M)

Basic concepts

★ C.P (Conjugated position)

$C=C-\overset{\oplus}{C}$

In any system or compound $\overset{\oplus}{\text{charge}}$ / $\overset{\ominus}{\text{charge}}$ / free radical / π-bond / lone pair .. are present alternate with π-bond then it is said to be conjugated position

eg:- $CH=\overset{\pi}{CH}-CH_2-\overset{\ominus}{CH_2}$ C.P(X)

eg:- $CH_2=CH-\dot{C}H-CH_3$ C.P (✓)

eg:- (I) (✓) (II) (✓) (III) (✓)

(IV) (✓) (V) (✓) (VI) (✓)

↳ So all six are Conjugate position.

④ Mesomeric effect / Resonance (R) effect

(M)

Basic concepts

★ C.P (Conjugated position)

$C=C-\overset{\oplus}{C}$

In any system or compound the $\oplus$ / $\ominus$ / free radical / π-bond / lone pair ($\ddot{}$) are present alternate with π-bond then it is said to be conjugated position

eg: $CH \overset{*}{=} CH - CH_2 - \overset{\ominus}{C}H_2$ C.P(X)

eg: $CH_2 = CH - \dot{C}H - CH_3$ C.P (✓)

eg: (I) (✓) (II) (✓) (III) (✓)

(IV) (✓) (V) (✓) (VI) (✓)

∴ So all six are conjugate position.

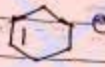
Number of conjugate position :-

eg.) 

⇒ (C.P = 3)

eg.)

eg.)



(C.P = 0)

* Conjugated system :-

compound / species / system said to be conjugated in which at least two conjugate position should be present.

* Type of conjugated system :-

(1) π - π conjugation → C=C-C=C

(2) π - ⊕ conjugation → C=C-⊕

(3) π - ⊖ conjugation → C=C-⊖

(4) π - ⊙ conjugation → C=C-⊙

(5) π - ⊙ conjugation → C=C-⊙

Note :- A may be any compound.

(6) 

(7) 

(pπ - pπ back bonding)

Rar, Rar

Important points about conjugation :-

① If two or more than two conjugated position present at same position then only one will take part in conjugation.

eg. $C=\overset{*}{C}-C\equiv\overset{*}{C}$ → de-localized (π-e⁻ की संख्या ज्यादा है)
→ localized (π-e⁻ की संख्या कम है)
दोनों में से जिसमें ज्यादा π-e⁻ की संख्या होती है

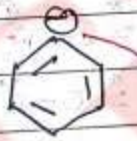
eg. $CH_2=\overset{*}{C}H-\overset{\oplus}{\underset{\cdot\cdot}{\underset{\cdot\cdot}{Cl}}}$ → de-localized
→ localized (lone pair पर charge होता है)
दोनों में से जिसमें lone pair count होता है

② If π-π conjugation present in system then no charge, +ve charge, lone pair, or free radical never participate in conjugation.

eg.

→ localized (Not Participate in Resonance because Here π-π bond is in conjugate

eg.

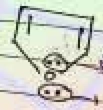


eg 3.

localized (Not Participate) so not affect the compound

$R_{a_1} > R_{a_2}$)

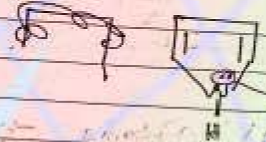
eg.)



→ de-localised → यह lone pair (••) ही in conjugation with π-bond
→ localised → नाम पहले → आवश्यक है मानी जाए एक-दूसरे कान्वकता है
→ This l.p. is not in conjugation with π-bond

① If −ve charges or lone pair participate in conjugation then R_{a} always equal to $2\pi e^{\ominus}$

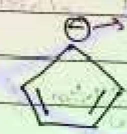
eg.)



→ delocalised ($2\pi e^{\ominus}$)

$6\pi e^{\ominus}$ system (मानी एक bond में $2e^{\ominus}$ होते हैं)

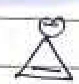
eg.)



⊖ → delocalised ($2\pi e^{\ominus}$)

⇒ $6\pi e^{\ominus}$ system

eg.)



⇒ $4\pi e^{\ominus}$ system.

④ If −ve (⊖) or lone pair (••) participate in conjugation then

$R_{a} \uparrow$, R_{b}

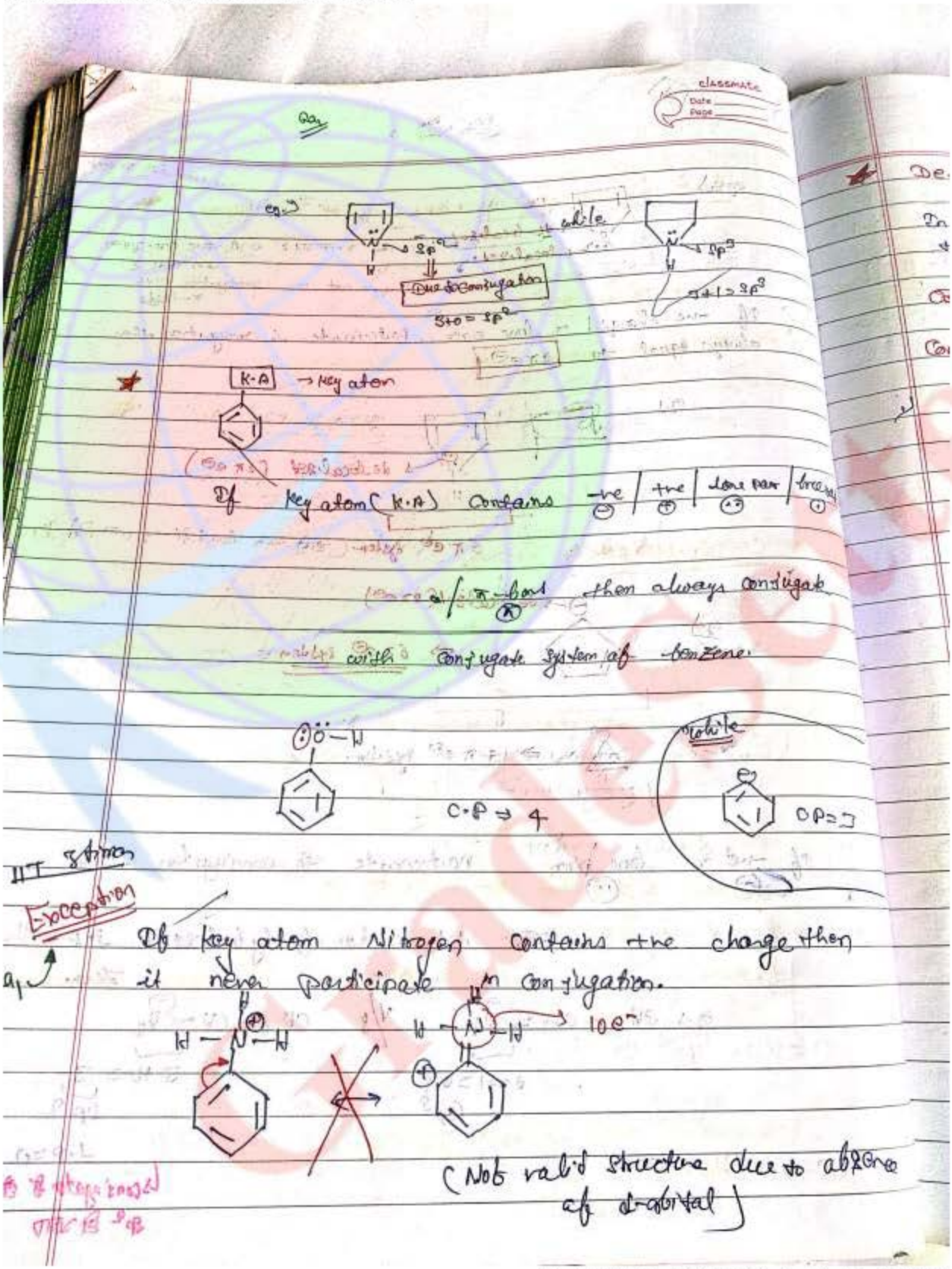
~~most~~ determination of hybridisation l.p will be zero.

eg.) $CH_3-CH_2-\overset{\ominus}{C}H_2$ v/s $CH_2=CH-\overset{\ominus}{C}H_2$

$3+1 = 4$ (sp^3) — $3+0 = 3$ (sp^2)

l.p = 0

↳ conjugation में होने की वजह से sp^2 हो जाता



Ref

De-localisation of electron (e^-)

In conjugated system transfer of e^- from one C.P (conjugated position) to another said to be de-localization.

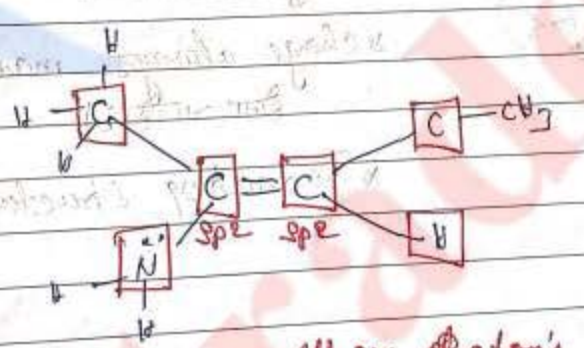
~~Condition / de-localisation~~

Condition for De-localisation / Resonance

Compound / system / species must be plane or near to be planar.

All p-orbital lie in same plane.

Ref [sp, sp^2 carbon's and directly attached atom always attached in same plane.]



All six atom's at same plane.

यदि N carbon sp^2 या sp होगा तो वह planar form show करेगा।

(2) Compound must be conjugated.

π — π
π — ⊙
π — ⊖
π — ⊕
π — ⊙

★ De-localization in system →

(1) π — ⊖ delocalization

↳ ["–ve" move towards π-bond]
↳ [l.P ⇌ B.P]

$CH_2 = CH - \overset{\ominus}{A} \longleftrightarrow \overset{\ominus}{C}H_2 - CH = A$

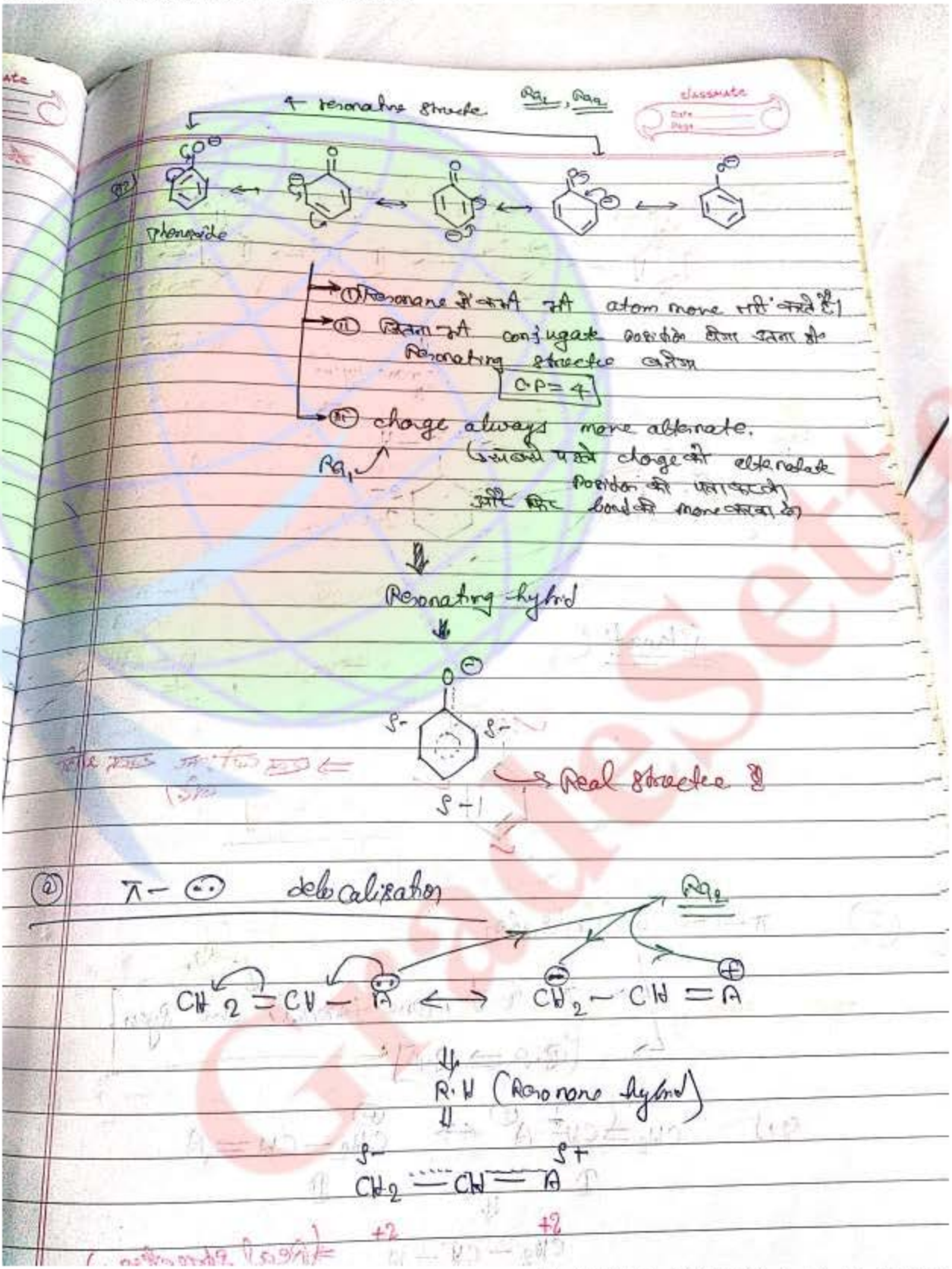
⇓

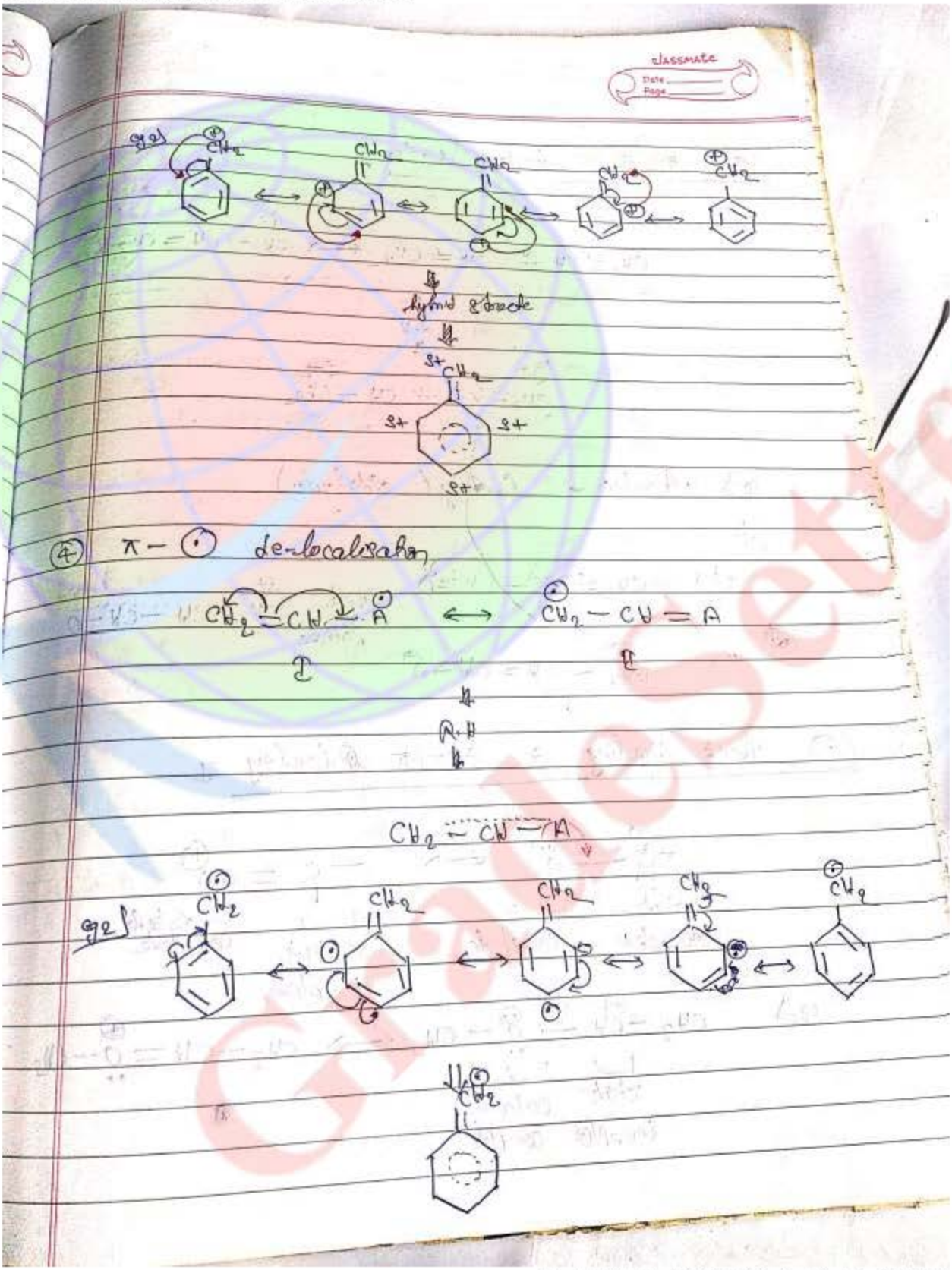
* charge always maintained होना चाहिए।
* Resonating structure

eg: $CH_2 = CH - CH = CH - \overset{\ominus}{O} \longleftrightarrow CH_2 = CH - \overset{\ominus}{C}H - CH = O$

⇕

$\overset{\ominus}{C}H_2 - CH = CH - CH = O$





(5) $\pi - \pi$ de-localisation

$CH_2 = CH - CH = CH_2 \longleftrightarrow CH_2^{\oplus} - CH = CH - CH_2^{\ominus}$

R.H

$CH_2^{\delta+} \cdots CH \cdots CH \cdots CH_2^{\delta-}$

eg.) Acrolein → (Acryl aldehyde)

Sol'n

(i) $CH_2 = CH - CH = O$ Resonance Structure $CH_2^{\delta+} \cdots CH \cdots CH \cdots O^{\delta-}$

(ii) $CH_2^{\oplus} - CH = CH - O^{\ominus}$

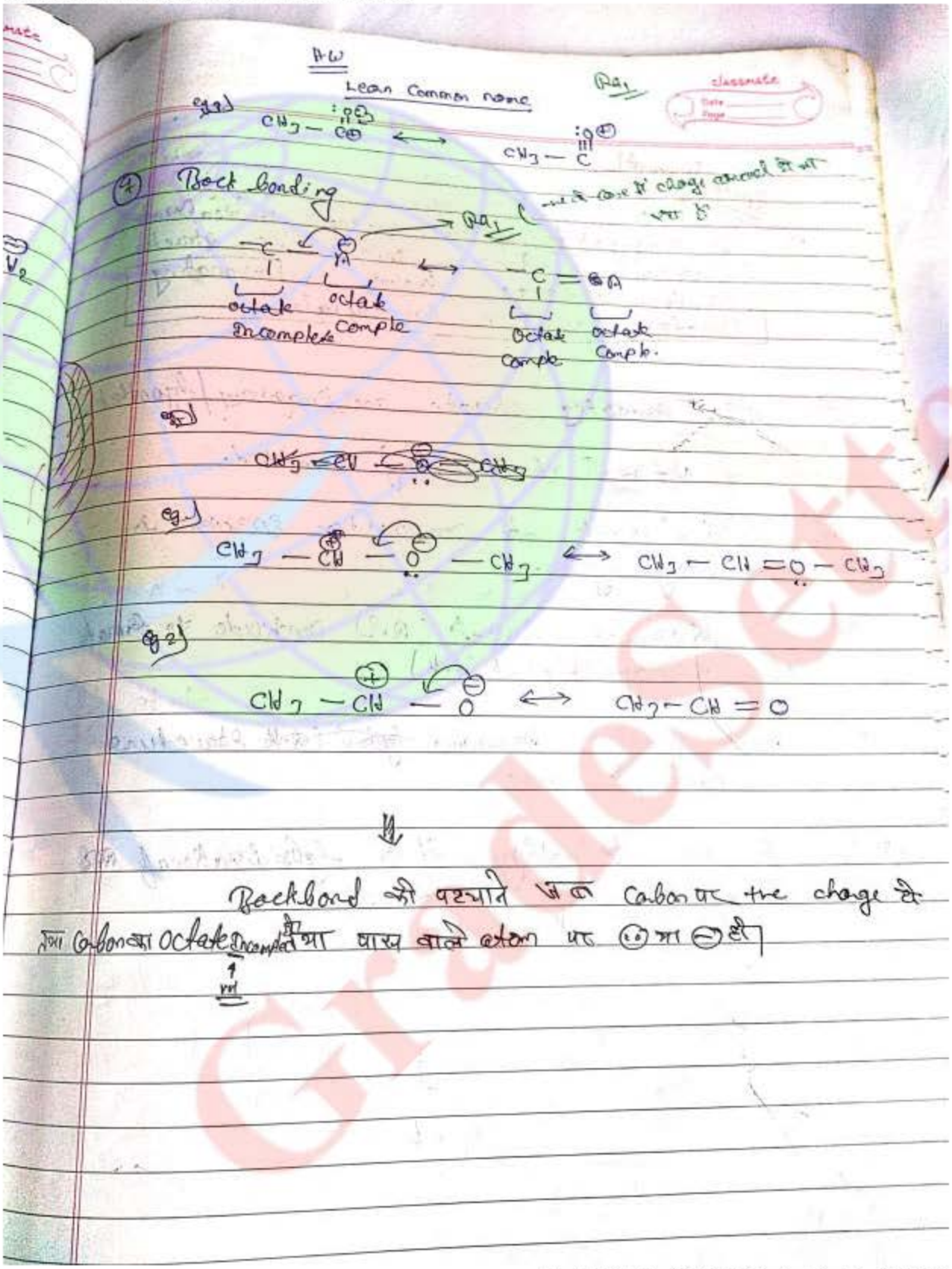
(6) Back bonding or $p\pi - p\pi$ bonding

$-\overset{\oplus}{C} - \overset{\cdot\cdot}{A} \longleftrightarrow -C = A^{\oplus}$

octet incomplete — octet complete. — octet complete. — ~~octet~~ complete

eg.) $CH_3 - \overset{\oplus}{C}H - \overset{\cdot\cdot}{O} - CH_3 \longleftrightarrow CH_3 - CH = \overset{\oplus}{O} - CH_3$

octet Incomplete — octet complete



Backbond की पहचान जब Cabon पर the charge के या Cabon का Octak Incomplete है या पास वाले atom पर ⊕ या ⊖ हो।

Special points

(i) In conjugated system during de-localization formation of electronic intermediate structure occurs which are known as resonating structure. (R.S) or Canonicals.

(ii) All resonating structure are imaginary / hypothetical Not real structures of compound.

(iii) Real structure of compounds or species is resonating hybrid.

(iv) All Resonating structure (R.S) contribute to formation of Resonance hybrid (R.H)

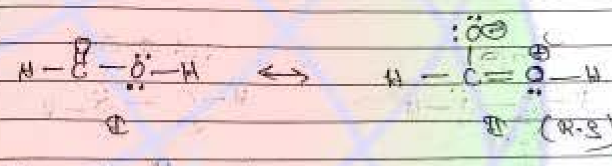
(v) Most stable Resonance ~~hybrid (R.H~~ structure contribute more.

(vi) Resonance is nothing it is hybridization of Resonating structure.

* Stability of Resonating structure

1. Neutral Resonating structure (with complete octate) always more stable than bipolar Resonating structure (Incomple octate) ↳ (or incomplete)

eg.

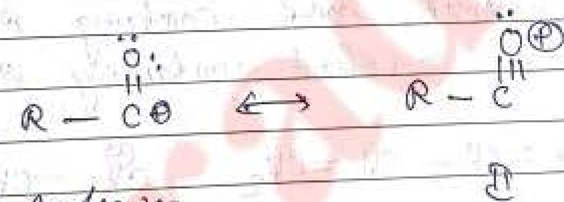


I — [octate complet]

II (R.S) ↳ octate सिर्फ +ve का check किया जाता है।
Ra, [octate comple]

I > II

2. octate complete bipolar R.S (Resonating structure) more stable than octate in complete bipolar R.S

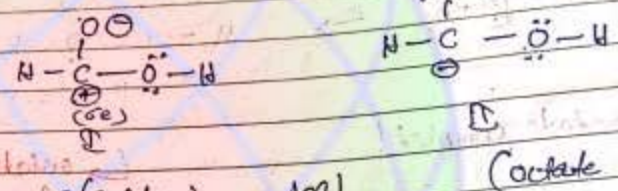


Acylium ion
I
(octete incomplete)
↳ +ve वाला check करें

II
(octate comple

I < II

(3) If both R.S are containing incomplete octate than that R.S is more stable in which "-ve" charge at more E.N atom and "+ve" charge at more electropositive atom.



(octate incomplete) (octate incomplete)

I > II

(5) For stability

Ist step → to see octate

2nd step → see charge on an atom.

(4) more covalent bond containg R.S is more stable than less covalent containing R.S

eg → $CH_2=CH-CH=CH_2$ $CH_2-CH=CH-CH_2$

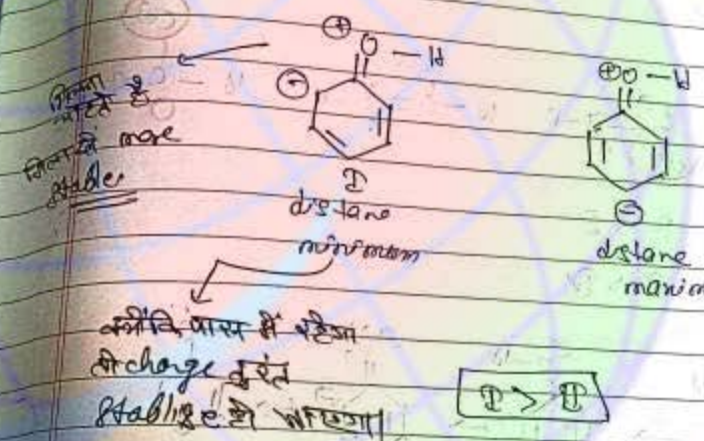
II I

(incomplete octate)

I > II

charge seperation →

(a) charge seperation में opp. charges develop unstability



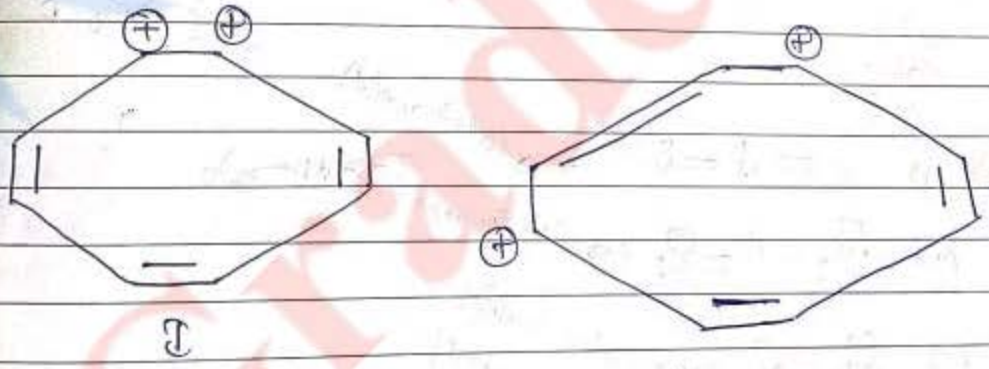
I
distance minimum

II
distance maximum

क्योंकि पास में रहेंगे तो charge दूर रहने से stable हो जाएगा।

I > II

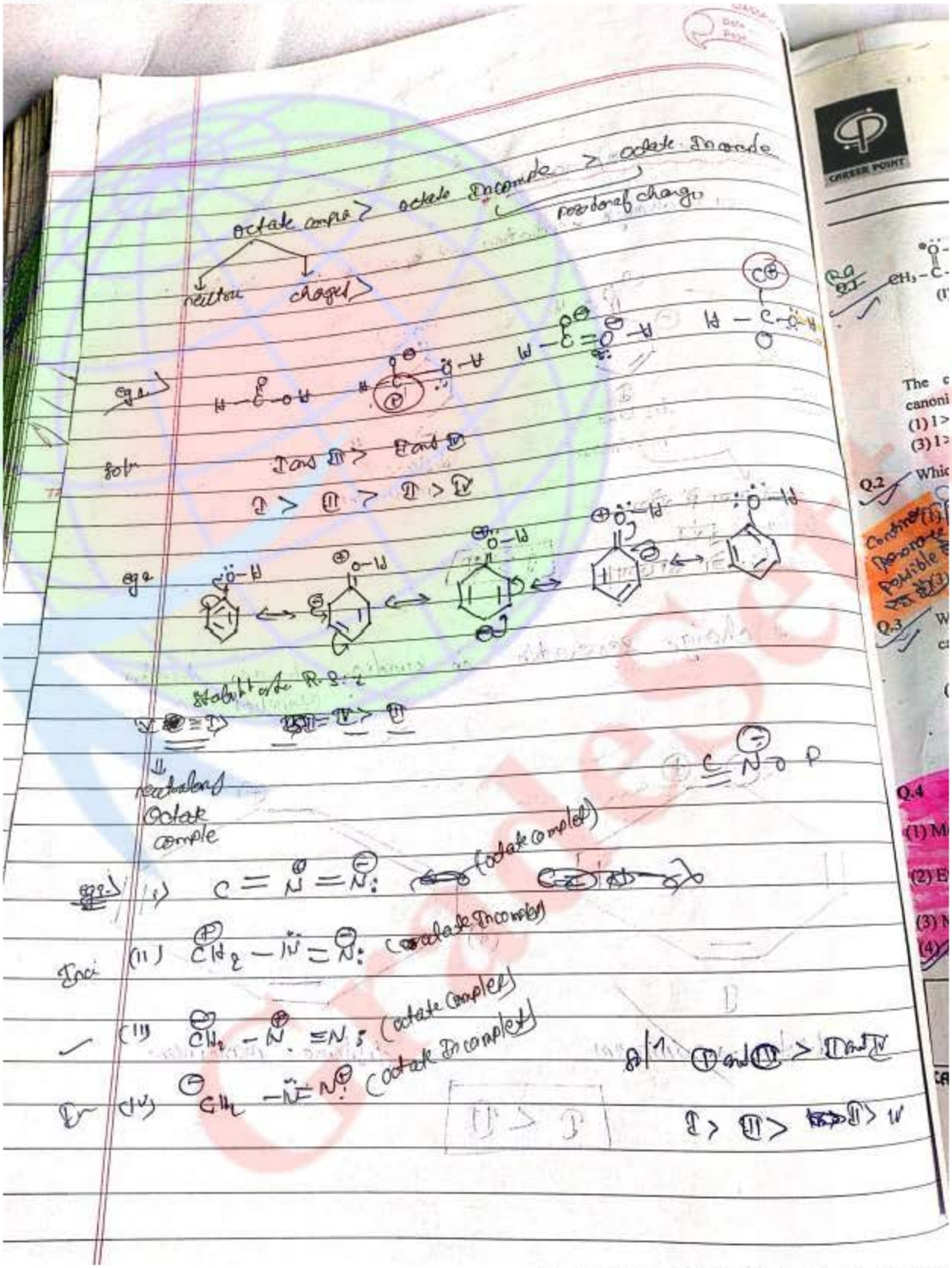
(b) charge seperation में similar charges develop stability.



I
distance → minimum

distance maximum

I < II

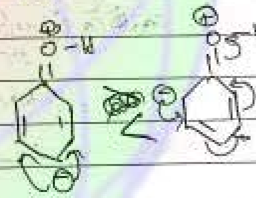


Ra, Rac Adv

(6) Contnous conjugation in R.S is more stable than cross conjugation R.S

R.S – I (Contnous conjugation) > R.S – II (Cross conjugation)

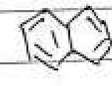
Note.



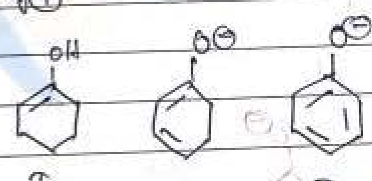
(7) No. of R.S ∝ stability

Adv

No. of C.P = No. of R.S
↳ Not valid for benzene and fused ring



Q(1)



I II III

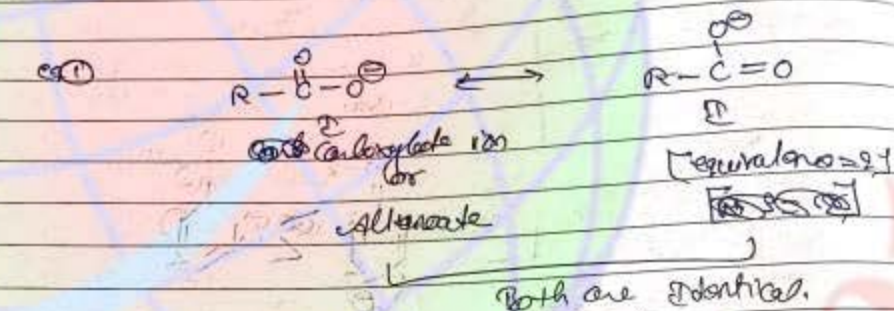
Q. 2

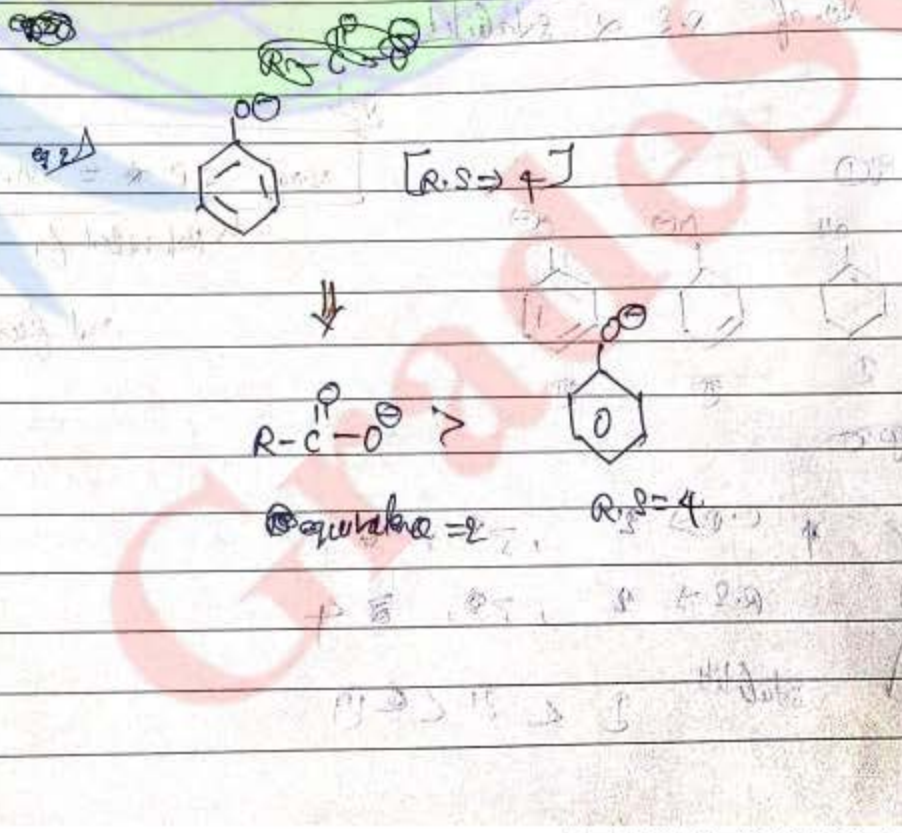
Ra₂
C.P → 2 , 3, 4
R.S → 2 , 3, 4
Stability I < II < III

Q.8 Equivalent (Energyers) structure is more stable than R...

Equivalent structure > No. of R.S

Equivalent structure = Identical Resonating structure.



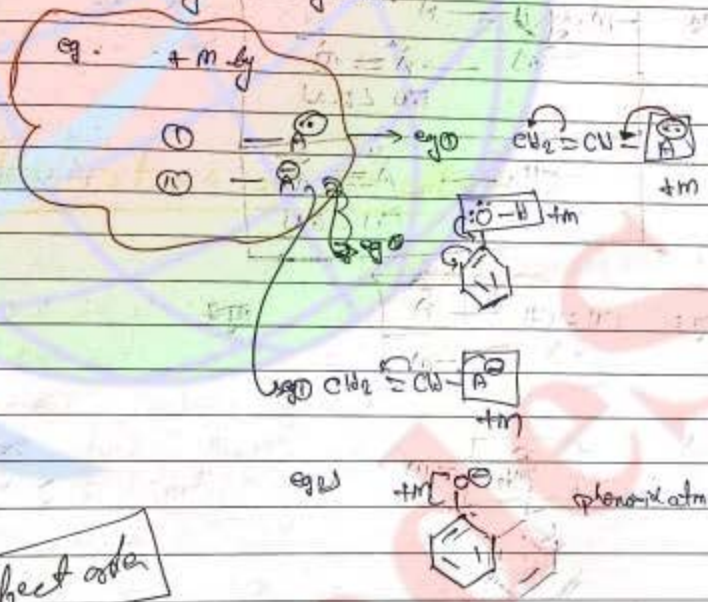


Mesomeric effect / Resonance effect

① Production of polarity in conjugated system. +m effect

② +m effect created by group or atom which produce e⁻ richness in system or group which donate e⁻'s towards conjugated system.

eg. +m by



+m effect order

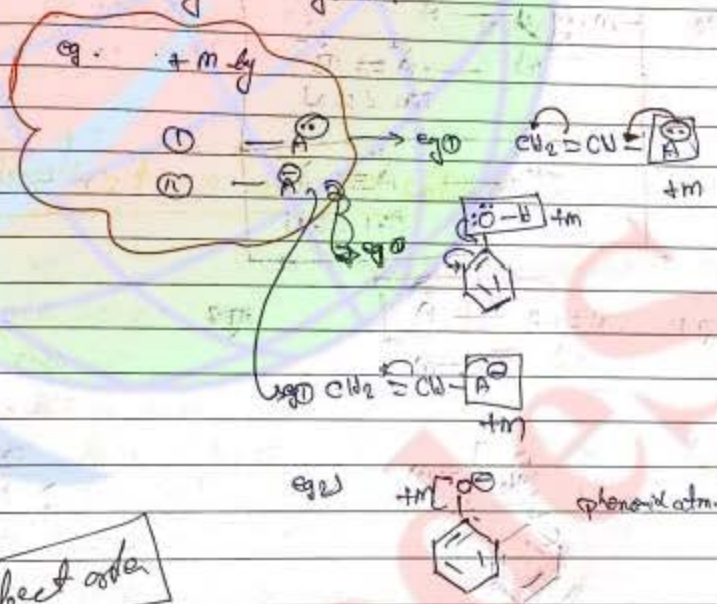
$-\ddot{N}H_2$, $-\ddot{N}HR$, $-\ddot{N}R_2$, $-NH-\overset{O}{\overset{\|}{C}}-R$

$-\ddot{O}H$, $-\ddot{O}Id$, $-O\ddot{C}H_3$, $-\ddot{O}-\overset{O}{\overset{\|}{C}}-R$, $-\ddot{O}^{\ominus}$

Mesomeric effect / Resonance effect

① Production of polarity in conjugated system. +m effect

② +m effect created by group or atom which reduce e^- richness in system or group which donate e^-'s towards conjugated system.



+m effect order

$-\ddot{N}:\ ,\ -\ddot{N}H_2\ ,\ -\ddot{N}HR\ ,\ -\ddot{N}R_2\ ,\ -NH-\overset{O}{\overset{\|}{C}}-R$

$-\ddot{O}:\ ,\ -\ddot{O}H\ ,\ -OCH_3\ ,\ -\ddot{O}-\overset{O}{\overset{\|}{C}}-R\ ,\ -O^{\ominus}$

(2) -M effect

Group or atom which withdraws e⁻'s from system

eg -M

EN < EN

EN < EN

eg CH=CH -M

eg -M

eg -M

Aldehyde eg

-M

eg -M

eg: -m effect

$-\overset{\oplus}{N}R_3$, $-\overset{\oplus}{N}H_3$, $-\overset{O}{\overset{\|}{C}}-OH$, $-N\overset{O}{\rightarrow}O$, $-\overset{O}{\overset{\|}{C}}-OR$,

$-\overset{O}{\overset{\|}{C}}-Cl$, $-\overset{O}{\overset{\|}{C}}-$, $-C\equiv N$, etc.

Note

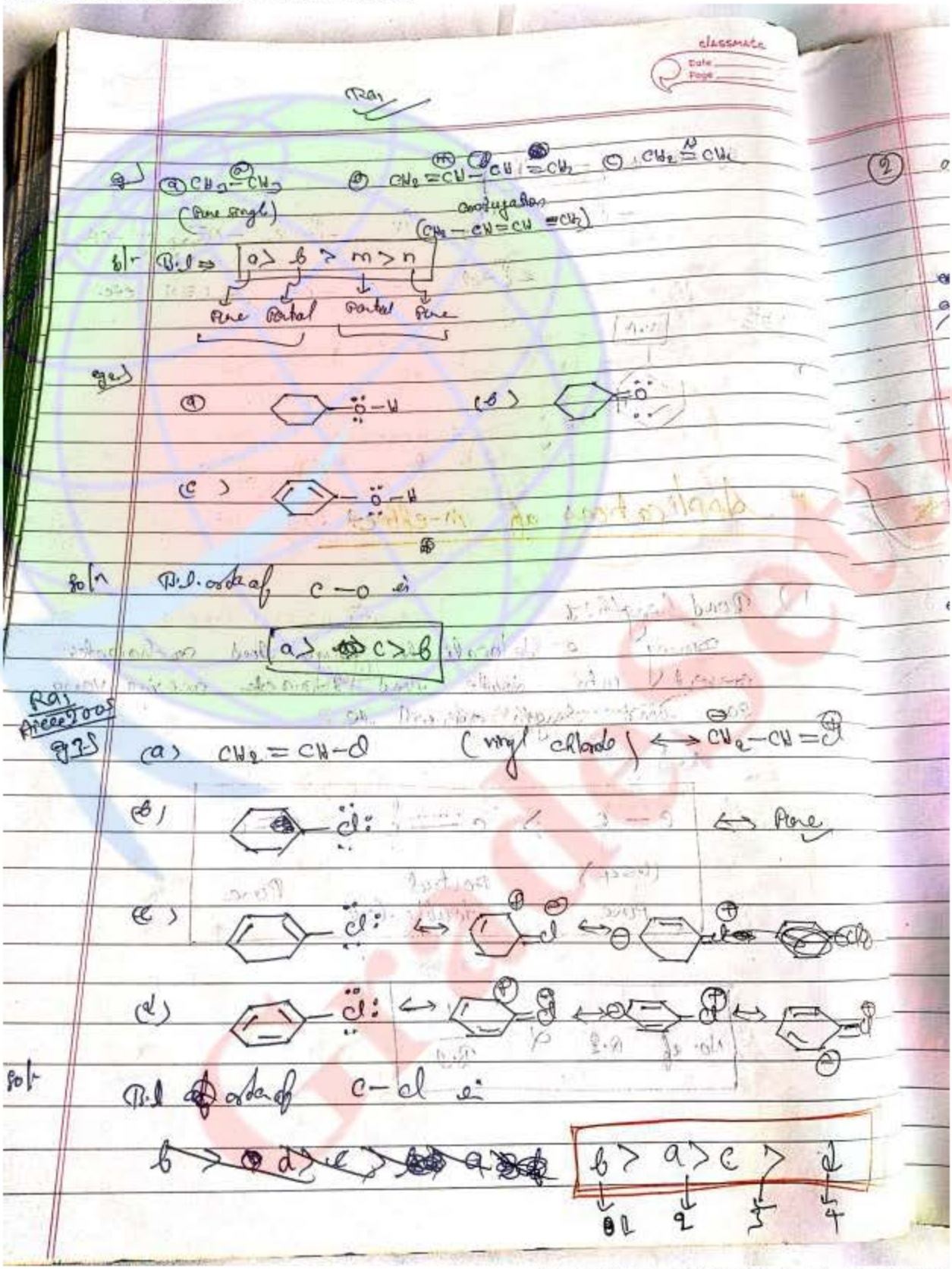
★ Applications of m-effect

(1) Bond length:-

During e⁻ delocalization single bond changes convert into double bond character and vice versa so bond length order will be

C – C	>	C ····· C	>	C = C
(1.54) Pure		Partial double bond		Pure

No. of R.I $\propto \frac{1}{\text{B.I}}$



Q1 (a) CH_3-CH_3 (One single) (b) $CH_2=CH-CH=CH_2$ (Conjugation $CH_2-CH=CH=CH_2$) (c) $CH_2=CH_2$

Sol: B.I ⇒ a > b > m > n

a: One, b: Partial, m: Partial, n: One

Q2 (a) (b) (c)

Sol: B.I. order of C–O is

a > c > b

Q3 (a) $CH_2=CH-Cl$ (vinyl chloride) $\leftrightarrow CH_2^{\ominus}-CH=Cl^{\oplus}$

(b) $\leftrightarrow$ One

(c) $\leftrightarrow$

(d) $\leftrightarrow$

Sol: B.I of C–Cl is

b > a > c > d

b: 1, a: 2, c: 3, d: 4

(2) order of effects :-

Mesomeric effect > H > I

(a) $\overset{\alpha}{C}H_3 - \overset{\oplus}{C}H_2$ ($\alpha H = 3$)
↳ stabilise by +H (S.B.H)

(b) $CH_2 = CH - \overset{\oplus}{C}H_2$
+m ↳ stabilise by Resonance + mero (S.B.R)

(c) $CH_2 = CH - \overset{\oplus}{C}H - CH_3$ ($\alpha H = 3$)
+m ↳ stabilise by mesomeric +H effect

Stability → c > b > a

Eg 2)

(a) (R.S → 2)

(b) (+H.) (c) (R.S → 3) (d) (R.S → 4)

d > c > a > b

No of R.S ∝ stability

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Eg 2.)

(a) (b)

(c) (d)

Sol^n

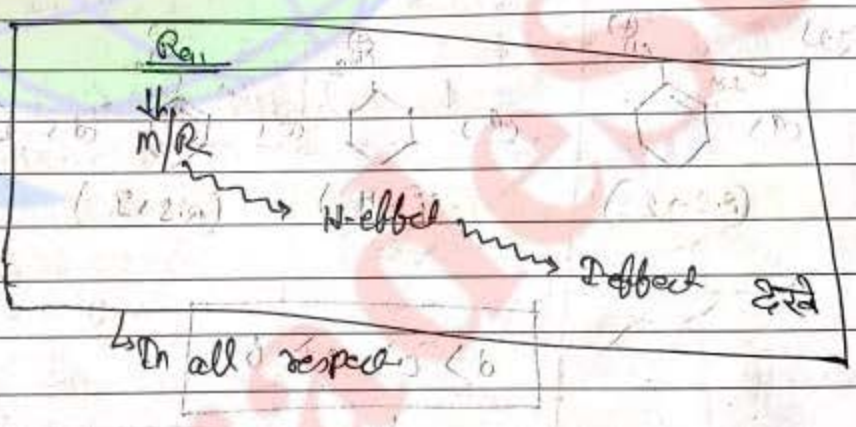
~~(a) > (b) > (c) > (d)~~

(c) > (a) > (b) > (d) → (H-effect = 1)

(c) → +R, +I, H-effect (α = 3)

(a) → Stabilise by Resonance + H-effect (α = 6)

(b) → H-effect (α = 6)



Ra1, Ra2

(3) Stability of carb-free radical

allyl > 3° > 2° > 1° > methyl

(a) 2°

(b) allyl

(c) 1°

(d) 3°

Resonance (R.S = 2)

Ra1

b > c > a > d

(4) Stability of carbanion ⇒ Generally order R > I because h-effect is not considered in the charge.

but when we come in ring (6θ) then consider the h-effect

(a) R.S = 2, α-H = 3 (I-effect) (X)

(b) R.S = 2, α-H = 6 → Ra2 (H-effect only)

(c) R.S = 2

a > c > b (A)

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(5) Aromaticity and Antiaromaticity and Non-Aromaticity

(1) Aromaticity →

Compound or a species said to be aromatic when it should have following characters

(i) C ⇒ cyclic
(ii) P ⇒ planar [should be sp or sp^2 or near to it]
(iii) R ⇒ Resonate (complete)
(iv) H ⇒ Hückel Rule $[4n+2\ \pi e^{\ominus}]$
(where $n = 0, 1, 2, 3, \ldots$)

n	$4n+2\ \pi e^{\ominus}$	π-bond
0	2π	1
1	6π	3
2	10π	5
3	14π	7

eg

cyc ✓
P ✓
R ✓
H ⇒ $6\pi e^{-}$ ⇒ ✓

} ⇒ Aromatic

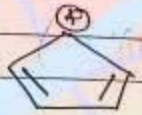
(3) 

cyclopropenyl cation

C → ✓
P → ✓
R → ✓
N → 2πe⁻ ✓
} So Aromatic.

(5) 

C → ✓
P → ✓
R → ✓
N → 6 ✓
} So Aromatic

(4) 

C ✓
P → ✓
R → ✗
N → 4πe⁻ (Not condition of Aromatic)

⇓

Anti Aromatic.

(II) Anti Aromatics

Compound or species flane : ↓

(I) C → cycle
(II) P → plana
(III) R → Complete Resonate
(IV) N → 4nπe⁻

	4nπe⁻	π-bond
0	0	0
1	4π	2
2	8π	4
3	12π	6

eg. (a) 4πe (Anti) (b) 4πe (Anti) (c) 4πe (Anti) (d)

(3) Non-aromatic → Compound or species which is neither Aromatic nor Anti aromatic is always non-aromatic.

eg. sp → C ✓, P ✗ (planar नहीं है), P ✗, ✗

Non-aromatic

eg. sp³ → C ✓, P ✗, ✗

(Non-Aromatic)

Stability Order

Aromatic > Non-Aromatic > Anti-Aromatic

Q) Comp. which is non-aromatic

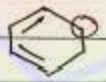
(a)  $6\pi e^-$ (Aromat)

(b)  $10\pi e^-$ (Aromat)

(c)  $4\pi e^-$ (Anti)

(d)  sp^3 (Non-Aromatic)

Q2) Which of the following molecule is unstable.

(a)  Is Non-Aro

(b)  $4\pi e^-$ (Anti)

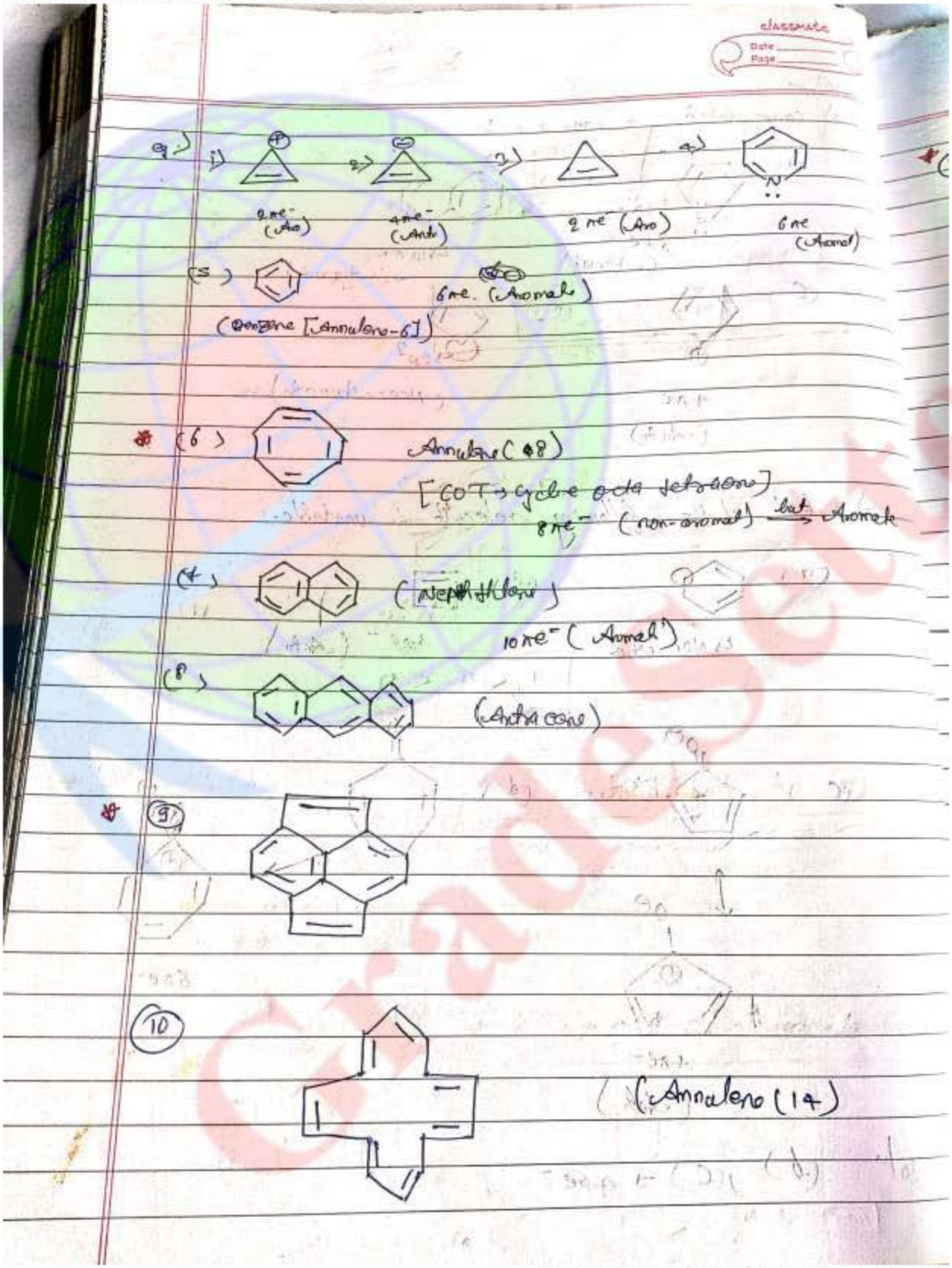
(c) 

(d) 

 $6\pi e^-$

 $4\pi e^-$ (Anti)

(b) & (c) $\Rightarrow 4\pi e^-$



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(10) 
(Annulene (10))

(12) 
Tropolium

Non examinal

(6) To compare stability order in substituted benzyle Intermediate.

Some Important points :-

(I) M-effect → only applicable & effective at ortho and para position. not at meta.

$$M_{ortho} = M_{para} \rightarrow Rg_{re}$$

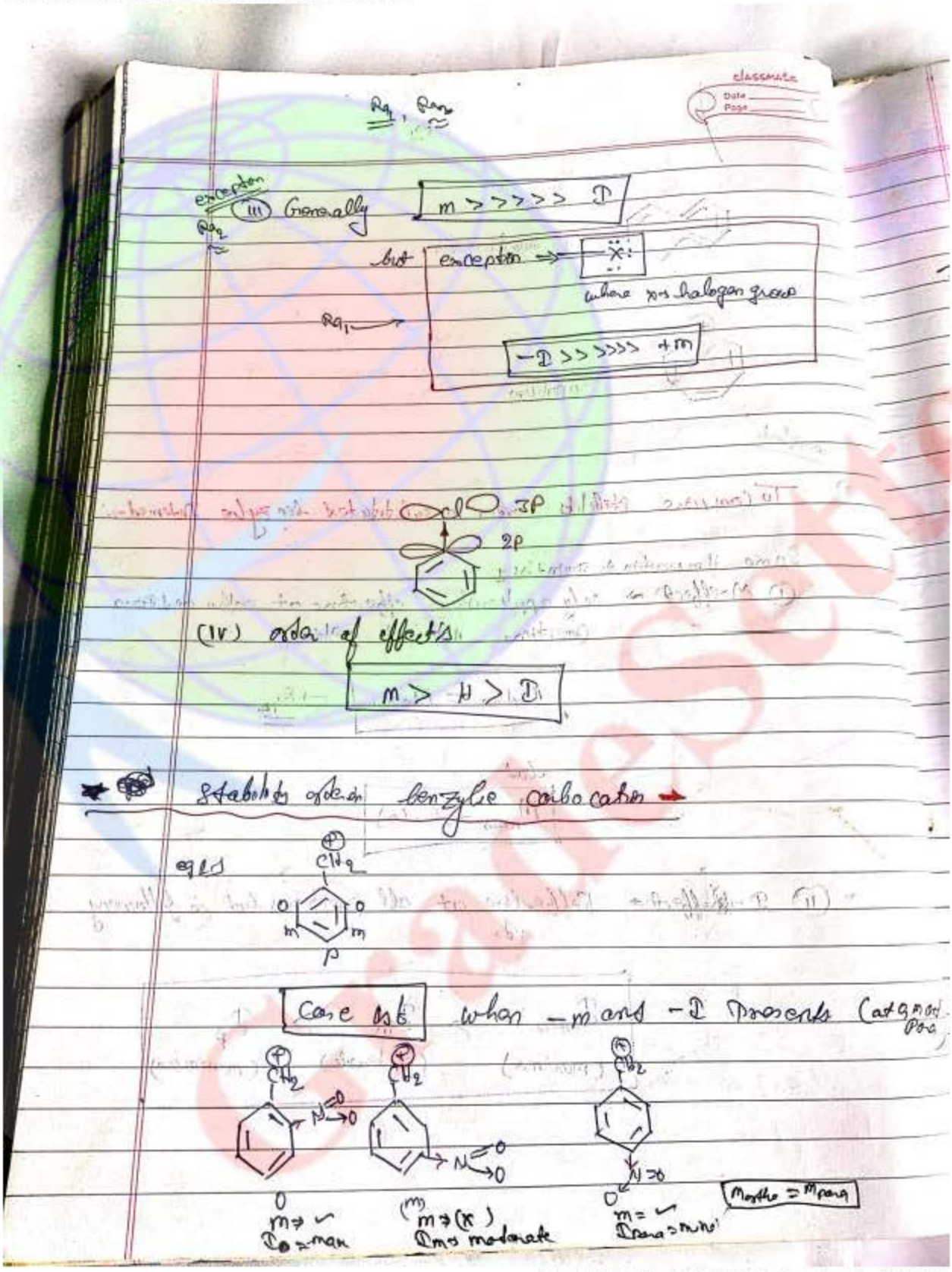
but

$$M_{meta} = Zero\ (0)$$

(II) I-effect → Effective at all positions but in following order

$$I_{ortho} > I_{m} > I_{p}$$

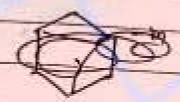
(maxima) (moderate) (minimum)

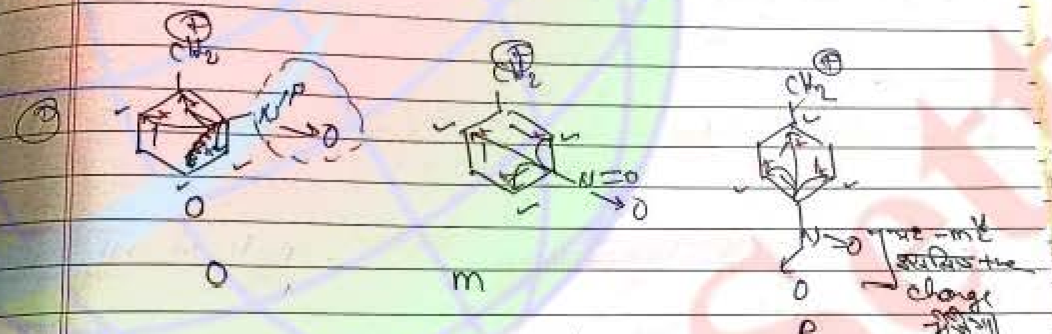


So, stability order :-
Meta > ortho > para

→ [Hindi text] charge [Hindi text] destablise [Hindi text] +ve help's +ve [Hindi text] -ve helps -ve [Hindi text] concept [Hindi text]

Reason
−m (+ve charge [Hindi text])
[Hindi text] concept [Hindi text] charge [Hindi text] stabilise [Hindi text]





O	m	P
$m_o \Rightarrow -100$	$m_m \Rightarrow 0$	$m_p \Rightarrow -100$
$I_o \Rightarrow -50$	$I_m \Rightarrow -30$	$I_p \Rightarrow -20$
-150	-30	-120

m > P > O

[Hindi text]
$M_{ortho} = M_{para} = 100$
$M_{meta} = 0$
$I_{ortho} > I_{meta} > I_{para}$
50 30 20

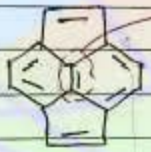
① cyclo octa tetra ene

COT (Tub) ⇒ Non aromatic

② Annulene [10]

(Non-planar) ⇒ Non-aromatic

③



localised

~~14 e⁻~~

12 e⁻ ⇒ Anti Aromatic

★ Benzyne

Consider

when -m and -I are applicable

		I	m	H
	$C=C-N(=O)\rightarrow O$	-I	-m	X
1)	$-N(=O)\rightarrow O$	-I	-m	X
2)	$-\ddot{O}-R$	-I	+m	X
3)	$-\ddot{O}-H$	-I	+m	X

		I	m	H
(4)	$-\overset{O}{\overset{\|}{C}}-OH$	-I	-m	X
(5)	$-\overset{O}{\overset{\|}{C}}-OH$	-I	-m	X
★ (6)	$-\ddot{X}:$	-I	+m	X
(7)	$-CH_3$	+I	X	+H
(8)	$-CCl_3$	-I	X	-H
(9)	$-O^-$	+I	+m	X
(10)	$-\ddot{N}H_2$	-I	+m	

Note

$m >>>> I$

or

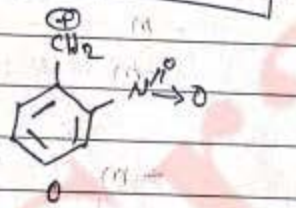
$H >>>> I$

while, for halogens

$-I >>> +m$

Case 1st (method 1st)

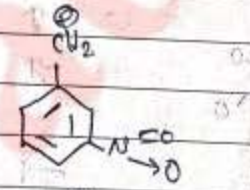
$-m$ and $-I$



$-m$

$-I$

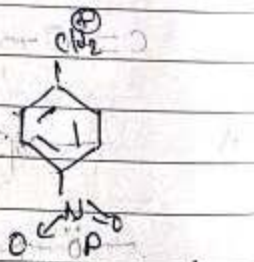
$[-m >>> -I]_{ortho}$



$m = X$

$-I$

[only $-I$ effect]



$[-m >>> -I]_{minimum}$

$m > 0$ and P $\Rightarrow$ $m > P > 0$

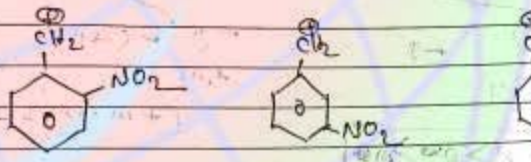
Case 2nd (method 2nd)

m_o 100 I_o 50

m_m 0 and I_m 30

m_p 100 I_p 10

for + (take +ve) for − take −



−100 −50 = −150

−30

−100 −10 = −110

for +ve

−30 > −120 > −150

m > p > o

Case 3rd (method 3rd)

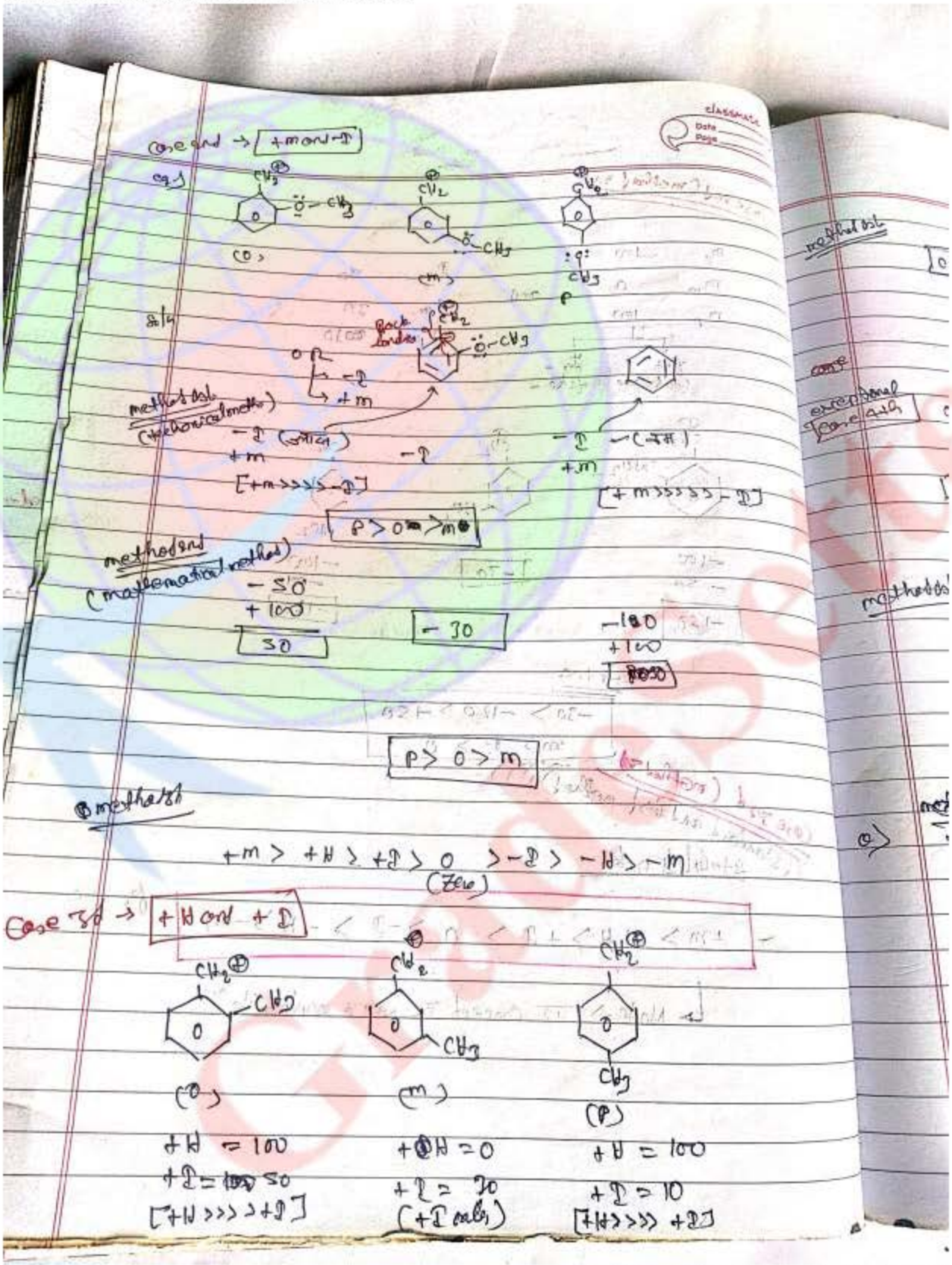
Standard and best method

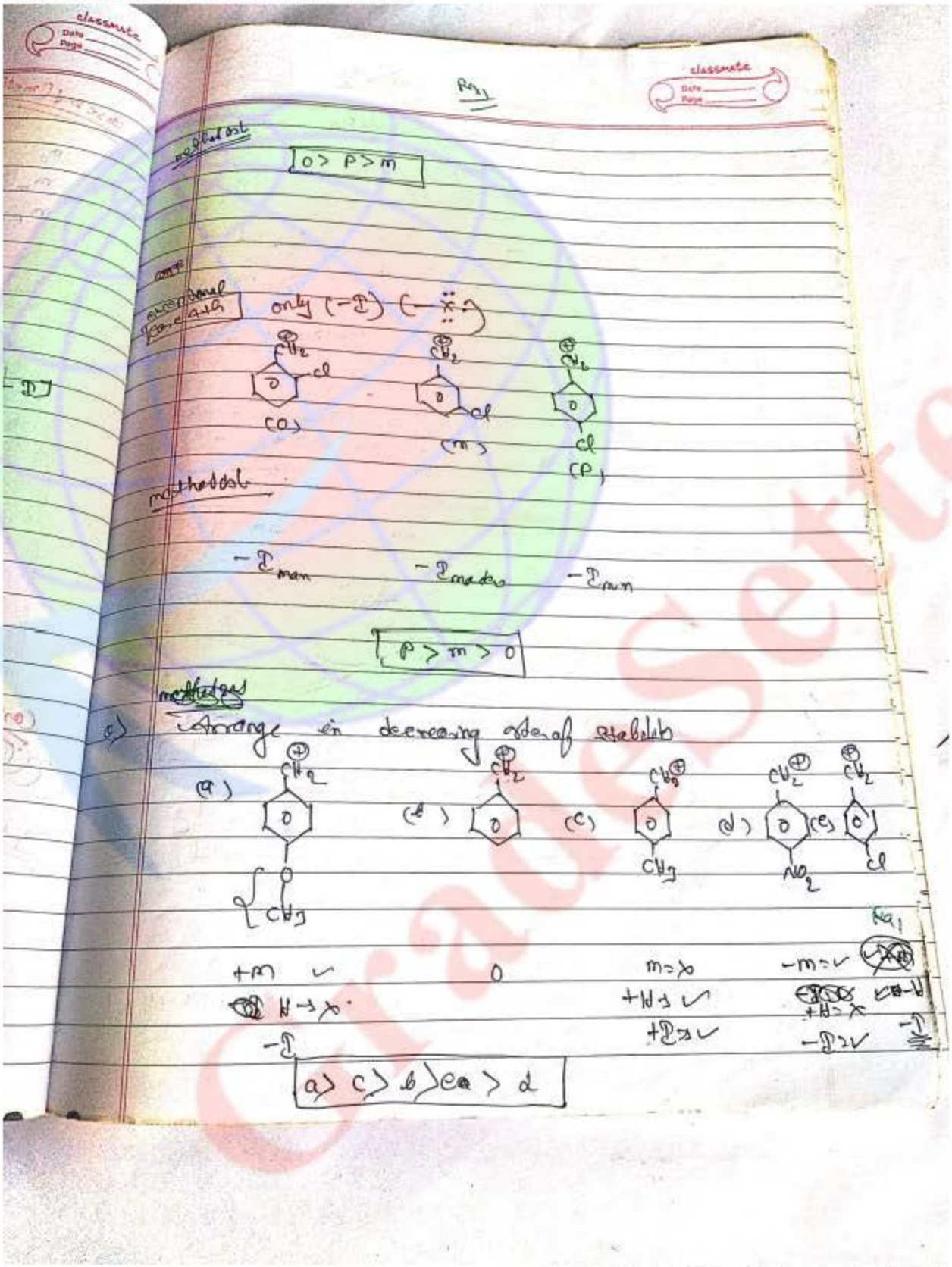
Stability order

for +ve

+m > +H > +I > 0 > −I > −H > −m

Note → यह concept हर जगह applicable है

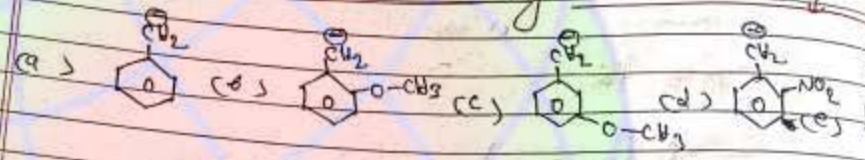




Stability order in benzyle free radicals

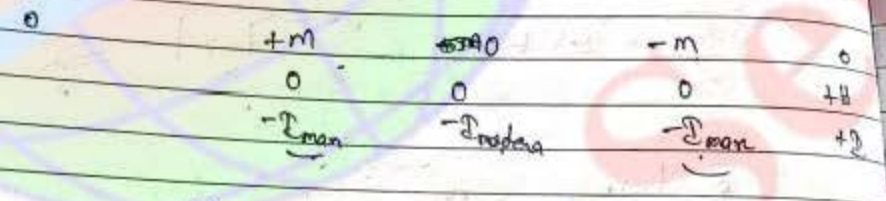
↳ same as carbocation.

Stability order in benzyle anions :-



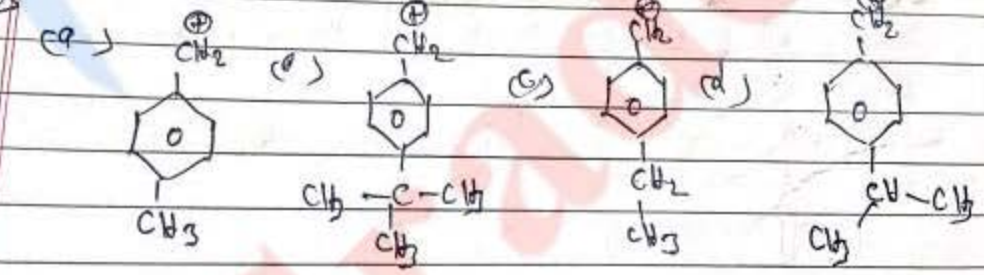
Stability order :-

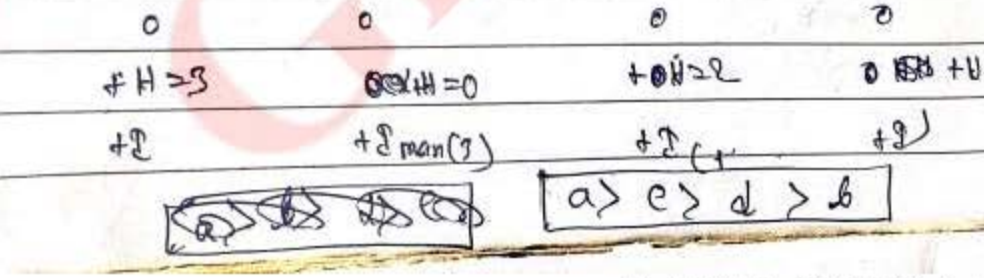
$-m > -H > -I > 0 > +I > +H > +m$



d > b > c > a > e

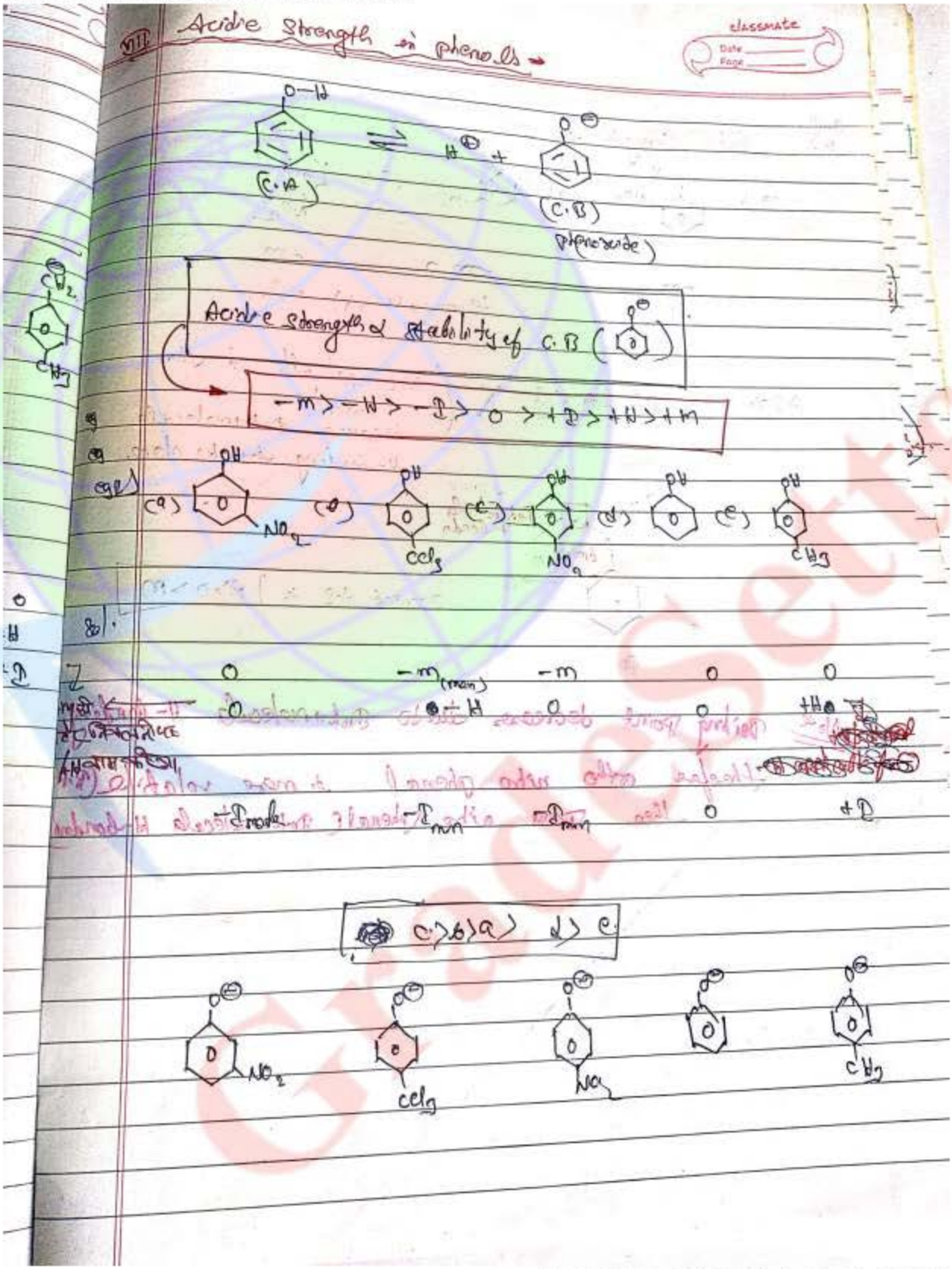
d > c > a > e > b



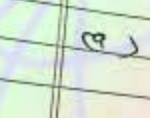


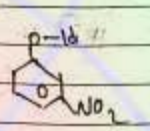
a > c > d > b

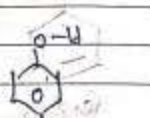
VII) Acidic Strength in phenols →



Acidic strength ∝ I.E.

(a) 

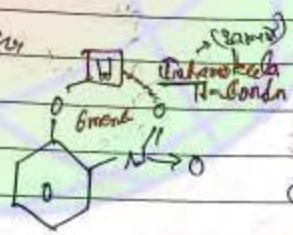
(e) 

(c) 

-m
-I_mes

-m
-I_mes

A.S ⇒ [a > c] × (Not applicable in this example - because Intramolecular H-bonding is take place.



Correct A.S ∝ [P > O > M]

Note Boiling point decreases due to Intramolecular H-bonding
Therefore ortho nitro phenol is more volatile (B.P.) than para nitro phenol (Intermolecular H-bonding)

Base strength determination →

1st step

B.S = Not participate in Resonance > participate in Resonance

अर्थात

Base strength ∝ e⁻ density

Note

B.S ∝ 1 / No. of R.S

2nd step

By Hybridisation.

$-\ddot{N}- > =\ddot{N}- > \equiv N:$

sp^3 sp^2 sp

Part 1

Note

Acidic strength ∝ E.N ∝ 1/ No. of R.S ∝ 1/P(R.S participate in resonance)

3rd step

B.S ∝ +I / −I

Base strength order

eg.

(a) (b) (c) (d)

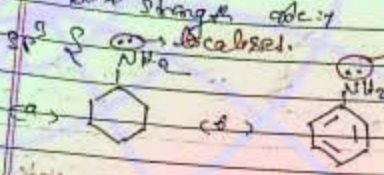
(a) Pyrrole sp^2 (b) Piperidine sp^3 (c) sp^3 (d) Pyridine sp^2

B.S

b > c > d > a

participate करता है

Q9) Base strength order:-



+m +m

BS → a < b

RS → a > b

(i) $CH_3 - CH_2 - \ddot{N}H_2$ — sp^3

(ii) $CH_2 - CH = \ddot{N}H$ — sp^2

(iii) $CH_3 - C \equiv \ddot{N}$ — sp

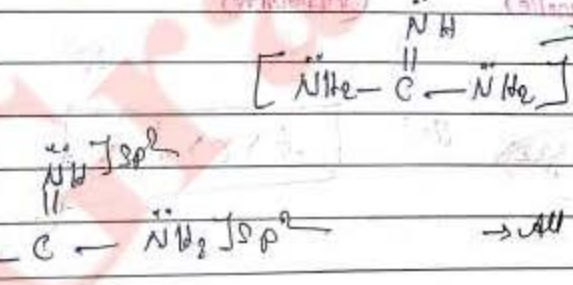
Sol'n methanamide > ethanamide > propanamide

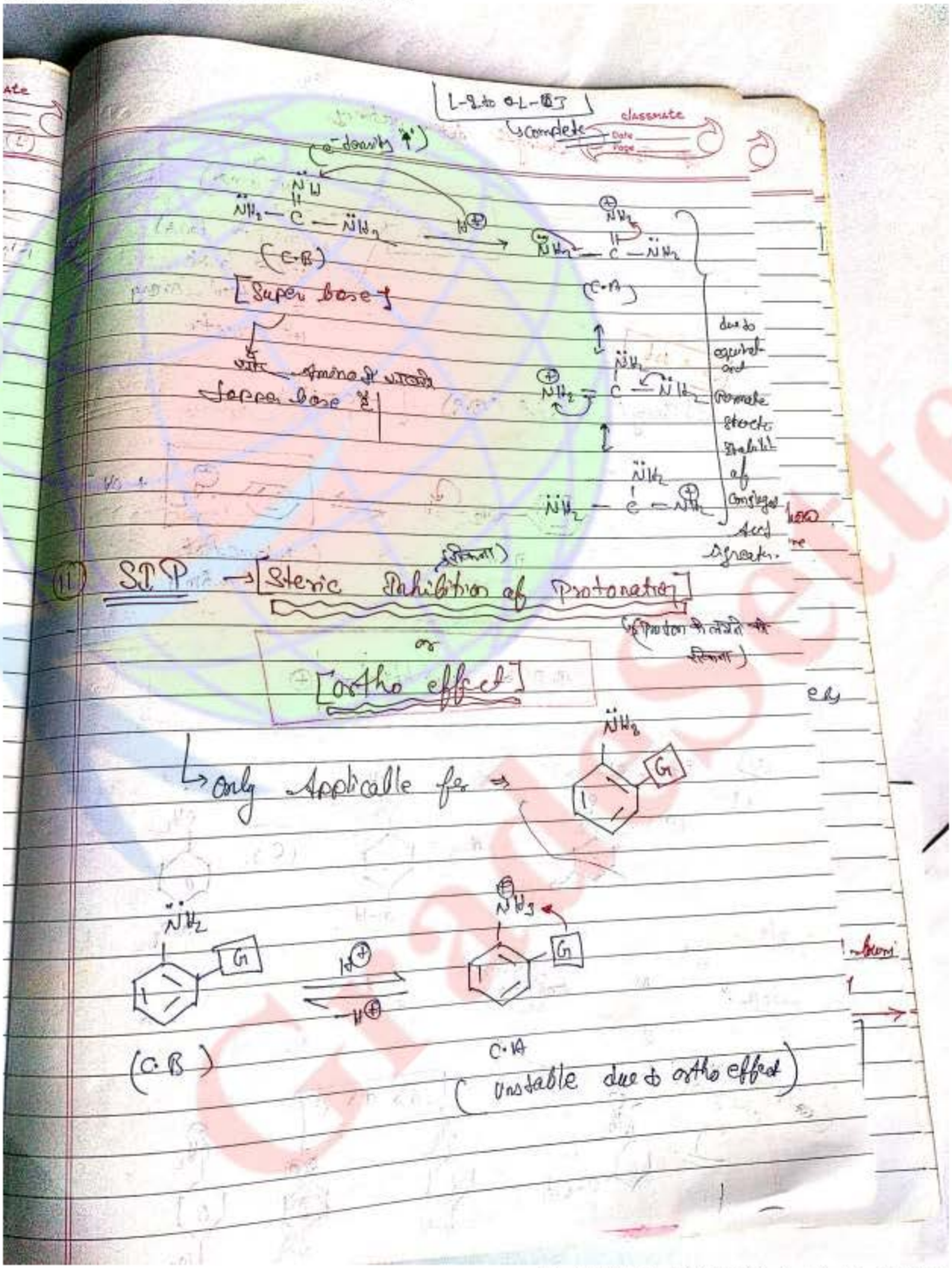
BS → a < b < c

RS → a > b > c

Q9)

Base nature in Guanadine base?





Ra1, Ra2

+m > +H > +I > 0 > -I > -H > -m

b a c

b > a > c

Q.1) Rate of Rex^n with conc. HCl

(a) (b) (c) (d)

Not phen Resonance

-m +m +m +m

c > b > a > d

Ra1 Reason

(+H>+I) Stabilise by resonance (d>2) Stabilise by resonance

Ra2 (X) not Stabilise by Resonance. (-I) Ph EW

R > H > I

c > b > a > d

Reason Base strength on the basis of Lewis / bronsted-lowry concept

Step 1st → ⊙/⊖ in Resonance (Delocalized) < ⊖/⊙ not in Resonance (localised)

No of R.S ∝ 1/R.S

Step 3rd :-
hybridisation bond :-

B.S = $sp^3 > sp^2 > sp$

$-\ddot{N}- \quad =\ddot{N}- \quad \equiv\ddot{N}$

Step 4th :-

B.S $\propto \frac{+I}{-I}$

eg.) Base strength order.

(a) (b) (c)

(d) (e)

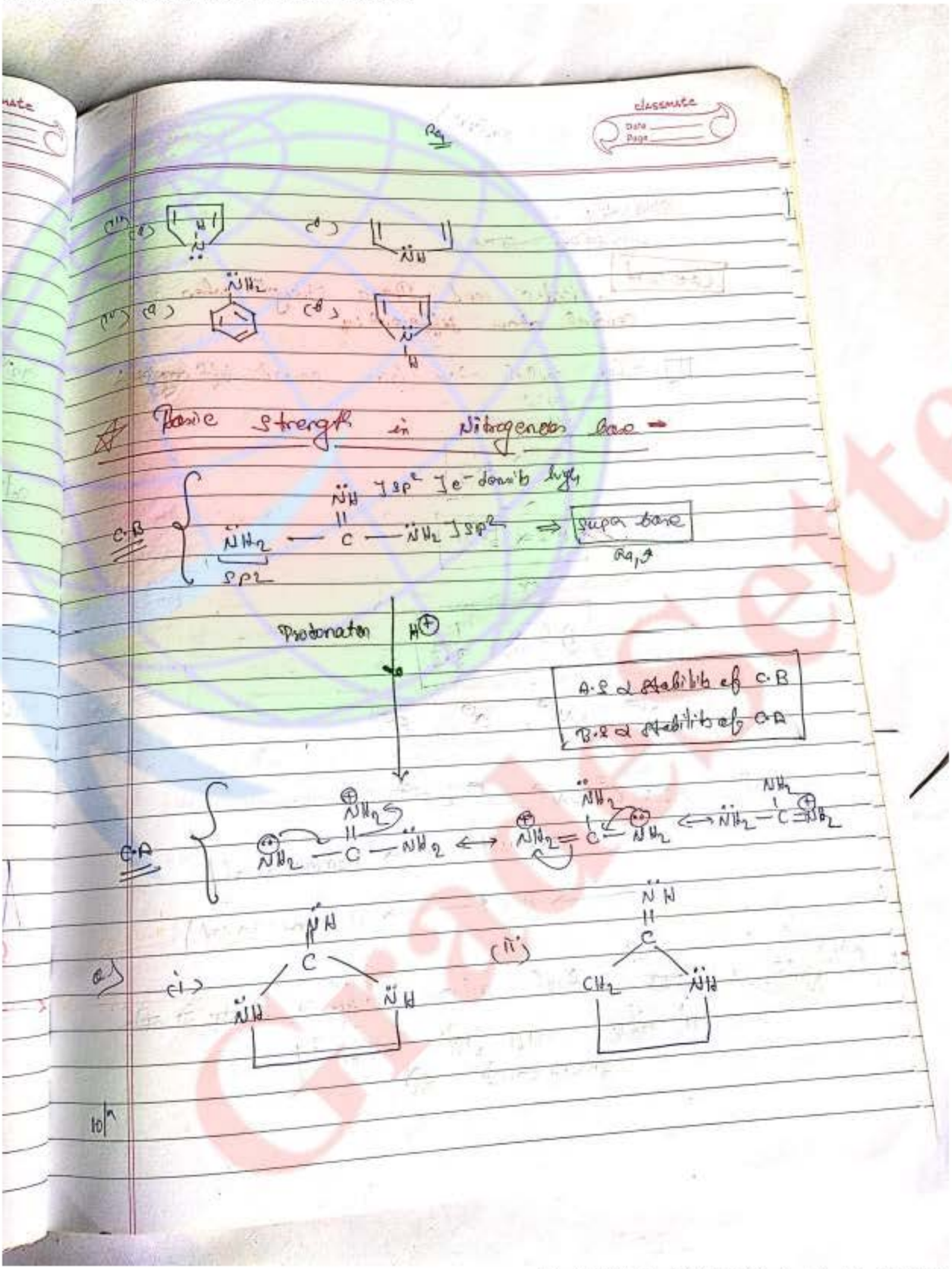
B.S order :-

$a > e > c > b > d$

eg.) Basic strength order :- (on the basis of lewis concept)

(i) (a) (b)

(ii) (a) (b)



Rq (Lvl)

Step ordi 1
hybridization
Case 3rd

Acidic and Base strength when central atom different :-

[I] when central atom from period left to right

$B.S \propto \frac{1}{E.N}$

or

$A.S \propto E.N$

or

$A.S \propto \frac{1}{B.S}$

eg) $C^{\ominus}$, $N^{\ominus}$, $O^{\ominus}$, $F^{\ominus}$

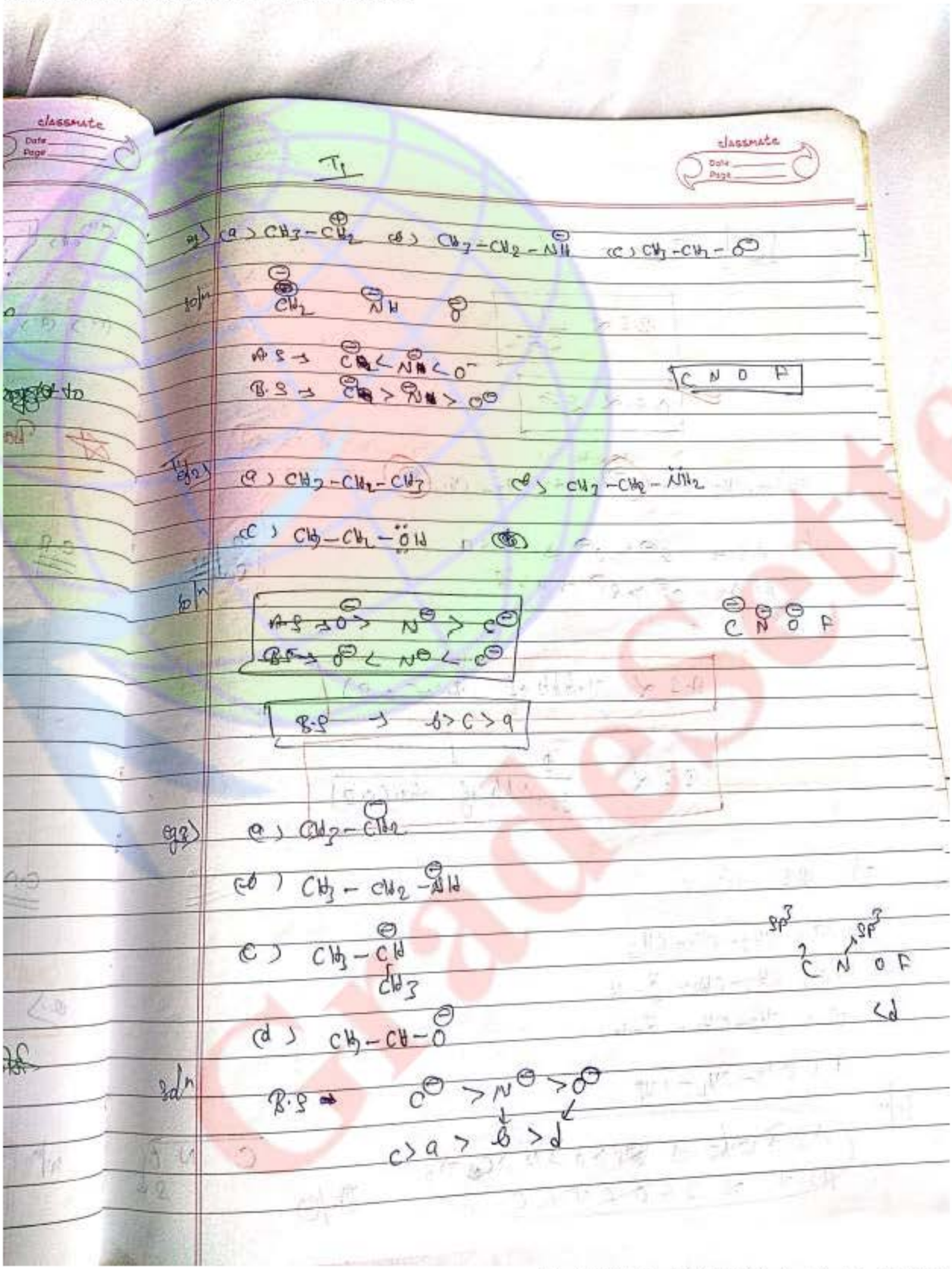
A.S → $C^{\ominus} < N^{\ominus} < O^{\ominus} < F^{\ominus}$

→ E.N ↑ → (Same period)

→ A.S ↑ → (Same period)

Rq (Lvl)

Note → जब central atom diff. हो जाए तो कोई भी effect काम नहीं करता है। तो EN check करें



(II) In case of groups :-

$$B.S \propto \frac{1}{Size}$$

$$A.S \propto Size$$

Q) (a) $CH_3-CH_2-O^{\ominus}$ (b) $CH_3-CH_2-S^{\ominus}$

Sol: A.S → $S^{\ominus} > O^{\ominus} \Rightarrow b > a$

B.S → $O^{\ominus} > S^{\ominus} \Rightarrow a > b$

$$A.S \propto \text{Stability of Anion (C.B)}$$

$$B.S \propto \frac{1}{\text{Stability of Anion (C.B)}}$$

Q) B.S order :-

(a) $CH_3-CH_2-CH_3$

(b) $CH_3-CH_2-\ddot{S}-H$

(c) $CH_3-CH_2-\ddot{O}-H$

(d) $CH_3-CH_2-\ddot{N}H_2$

Sol: A.S → ~~$\ddot{S} > \ddot{O} > \ddot{N} > C$~~ ⇒

B.S → ⇒ $\ddot{S} < \ddot{O} < \ddot{N} < C$

C N O S

N > C > O > F

Q) Which carbocation is more stable?

(a) $CH_2 \leftarrow \ddot{O} - CH_3$

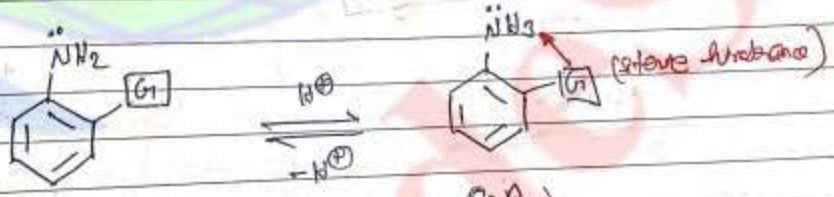
(b) $CH_2 \leftarrow \ddot{N}H - CH_3$

(c) $CH_2 \leftarrow \ddot{O} - CH_3$

Ans (b)

C N O F

Case 4th Steric Inhibition Protonation (SIP)
or
ortho effect



C.B
Aniline

C.A
(de-stabilised
(Anilinium)

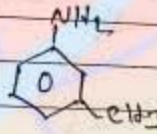
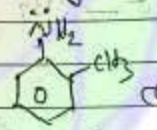
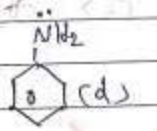
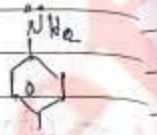
Ortho effect

G1 is bulky or smaller group
but not $-\ddot{O}R$, $-\ddot{O}H$

i) SIP is only applicable on anilines.

ii) o-the substituted anilines destabilised conjugated acids due to steric hindrance therefore o-the effect (SIP) always decreases basic strength.

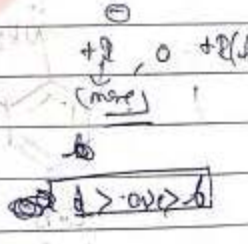
iii) "G" must be at o-the position and "B"
or
G may be or may be not bulkier

eg.) (a)  (b)  (c)  (d) 

Sol: P.S.I.

+M > +H > +I > 0 > -I > -H > -M

d > a > c > b



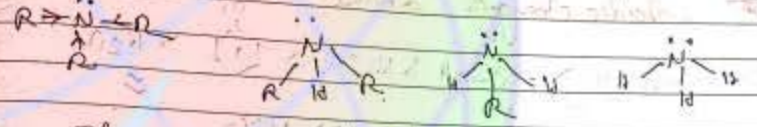
d > a > c > b

☆ Base strength of aliphatic Amines

(1) In gaseous phase

Base strength depends upon electronic effect (π effect)

B.S ∝ +I / −I



3° 2° 1°

3° > 2° > 1° > NH_3

(2) In aqueous medium (protic solvent)

H

H_2O / R-OH / R-C(=O)-OH etc

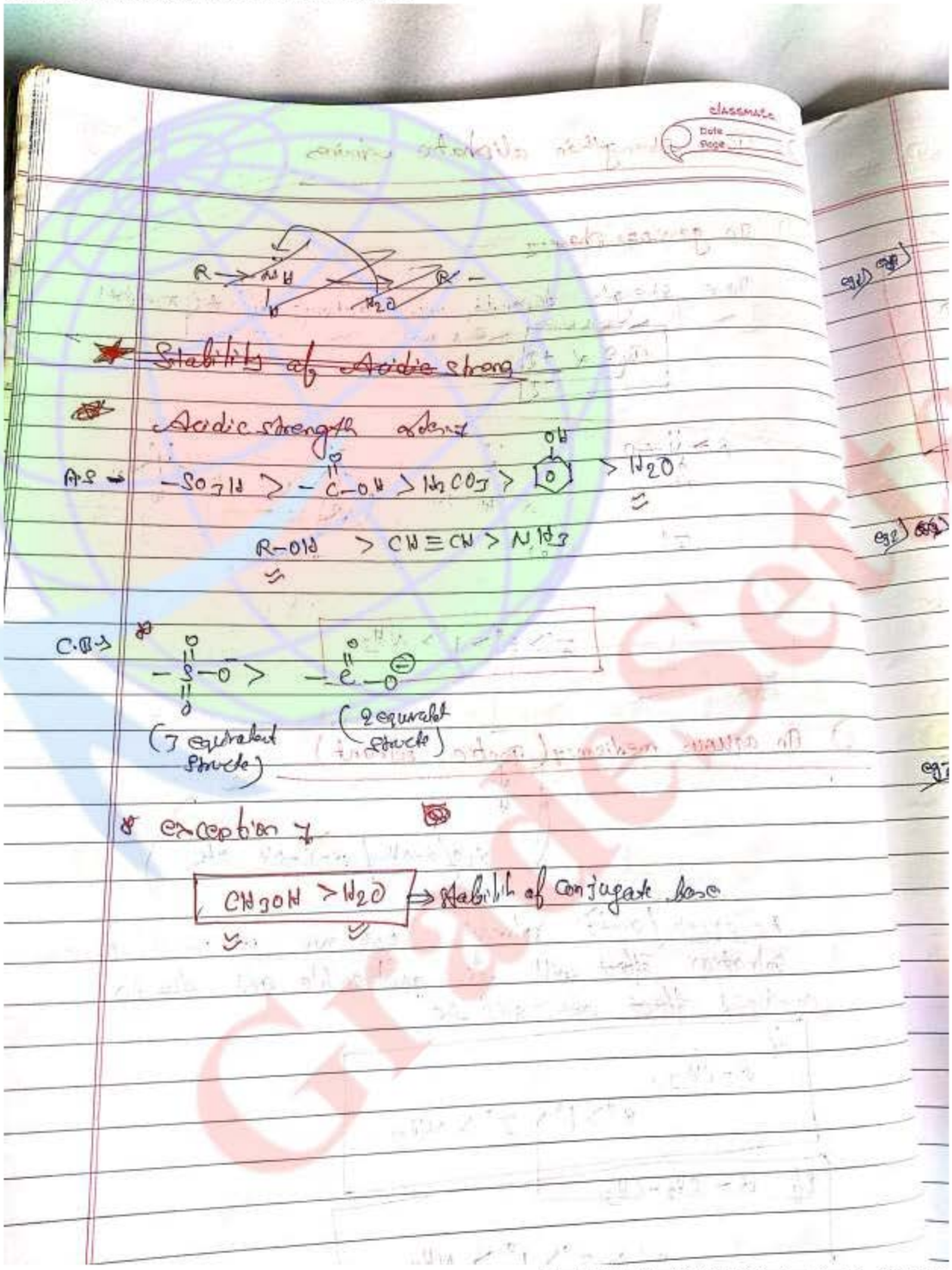
In aqueous / protic solvent electronic as well as solvation effect will be applicable and due to combined effect order will be

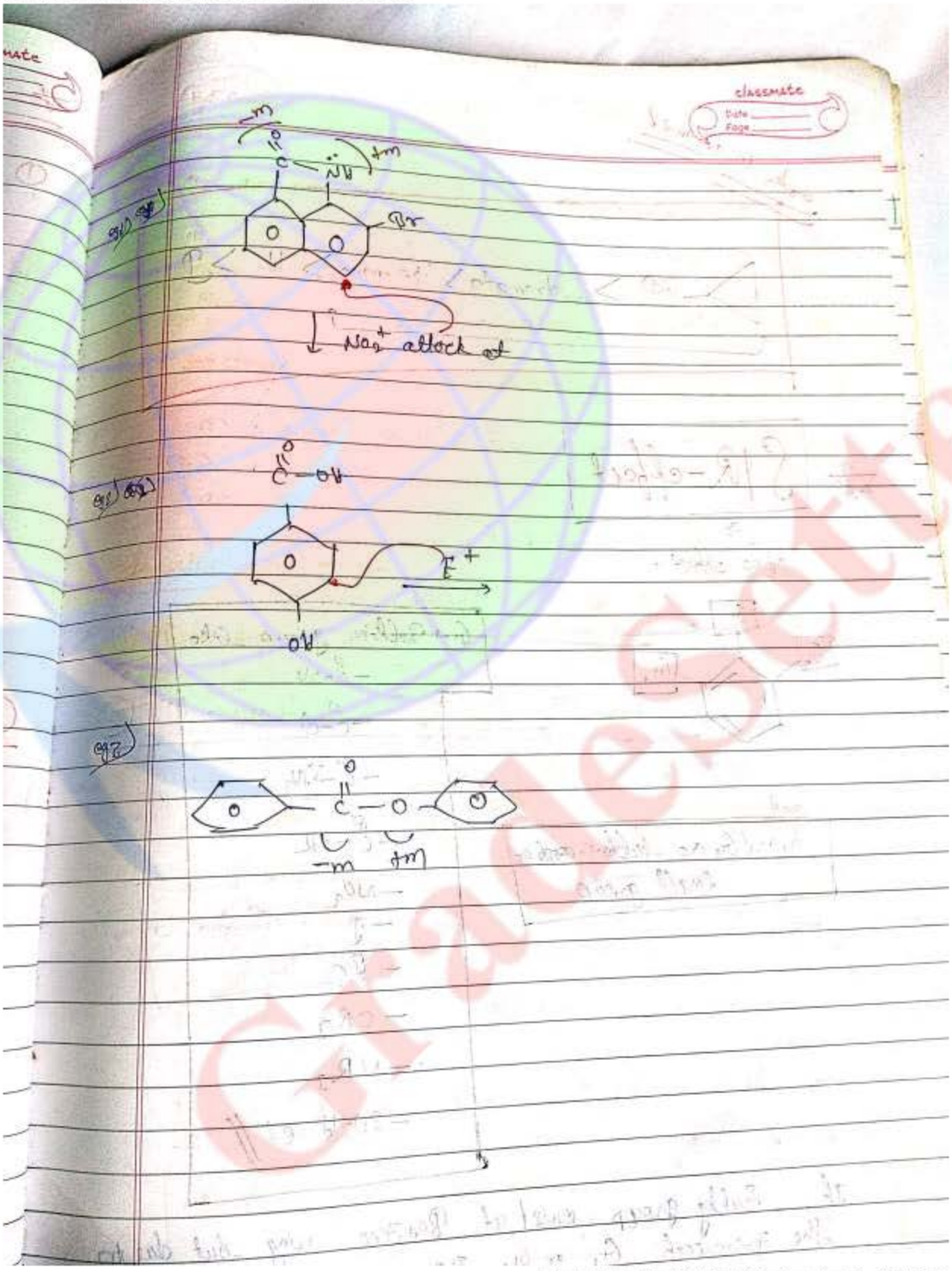
If R-CH_3

2° > 1° > 3° > NH_3

If R-CH_2-CH_3

2° > 3° > 1° > NH_3





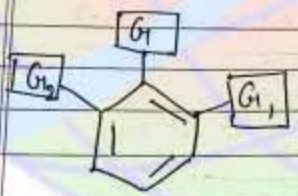
Order in advanced

$C^{\oplus}$ > Aromatic > Resonance > H > I

★ S I R - effect

or

ortho effect.



and

G1 and G2 are bulky or small group

G = Bulky group like

- $-\overset{O}{\overset{\|}{C}}-OH$
- $-\overset{O}{\overset{\|}{C}}-Cl$
- $-\overset{O}{\overset{\|}{C}}-NH_2$
- $-\overset{O}{\overset{\|}{C}}-OR$
- $-NO_2$
- $-I$
- $-Br$
- $-CR_3$
- $-NR_3$
- $-SO_3H$ etc

If Bulky group exist at Benzene ring but due to the presence of G_1 or G_2 group at ortho position

It's comes out from the plane of benzene ring by steric hindrance. then it is said to be SIR effect (ortho effect).

Due to SIR bulky group never participate in Resonance with benzene ring.

Structural condition for SIR :-

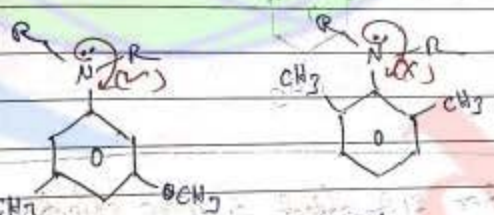
(1) "G" groups must be bulky.

(2) G_1 or G_2 may be bulky or may be not but must be at ortho position.

☆ Application →

(1) Bond length :-

$$C=C < C-C < C-C$$



[A]

[B]

SIR (✗)

✗ ⊙ of Nitrogen(N) participate in resonance

✗ B.L → C⋯⋯N (Partial)

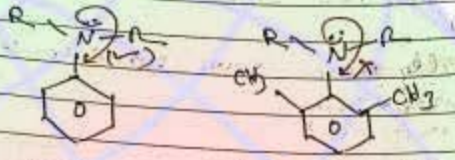
SIR (✓)

✓ ⊙ of Nitrogen not participate in Resonance

✓ C—N (Pure)

B.L order → A < B

(2) Base strength →



[A]

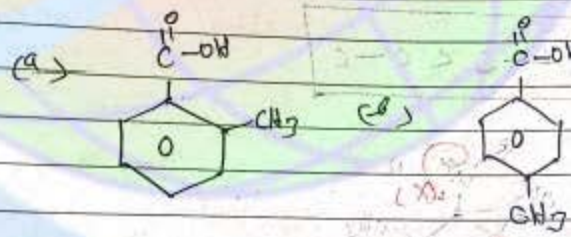
[B]

SIR(X)

SIR(—)

Basic strength :→ [B > A]

(3) Acidic strength in Benzoic acid



(a)

(b)

Note → ortho-effect or SIR effect is more effective than other

SIR(—) SIR(X)

☆ stability of C.B "↑"

☆ A.S ↑

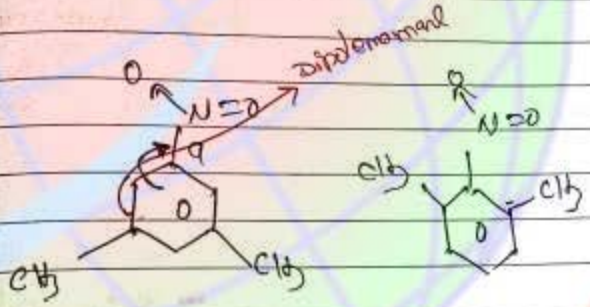
∴ A.S :→ [a > b]

Q1

SIP / o-effect → always decrease Basic strength of Aniline

SIR / o-effect → always Increase Acidic strength.

eg)



dipole moment ⇒ a > b

Std

[B] Organic Intermediate species

* organic Intermediate obtain by bond fission.

Bond-fission / cleavage / division

(A) Homolysis cleavage
[Homo = equal
lysis = to break]
or
Homolytic cleavage

(i) A — B → A• + B•
EN EN (free radical)

(ii) Energy ↓
Requires less energy

(iv) Condition for homolytic or Homolysis ↓

HELP RATES H

N → Heat (Δ/hγ/temp)
E → electron (colbay electrolysis)
L → light [uv/diffused sunlight]
P → Peroxide [R_2O_2] R–O–O–R
is anti markownikoff reb
R → Radical itself (free radical)

(iv) medium ↓
Non-Polar
eg CCl_4/ CS_2 etc

(B) Heterolysis cleavage
[Hetero = diff]
or
Heterolysis.

(i) A : B → $A^{\oplus}$ + $B^{\ominus}$/B
EN < EN (ions)

(ii) Energy ↑
Requires high energy
(due to opp. charges attract)

(iii) condition.
Electron negativity difference maximum.

(v) medium
Polar.

☆ Intermediate

① Carbocation [Carbonium] → $\left[-\overset{|}{\underset{|}{C}}+\right]$

② Carb free radical $-\overset{|}{\underset{|}{C}}\cdot$

③ Carb Anion $-\overset{|}{\underset{|}{C}}\ominus$

④ Carbene $\rangle C:$

⑤ Nitrene $-\ddot{N}:$

Ray

Nature

1) Type of Bond cleavage

2) outer shell e⊖

3) organic Reagents

4) magnetic nature

5) Hybridisation

6) Stability

Comparative Studies

$\dot{C}^{\oplus}$

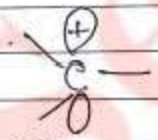
~~Homolysis~~ Heterolysis

6 (octate incomplete)

Electrophile ($E^{\oplus}$) (charged)

→ magnetic

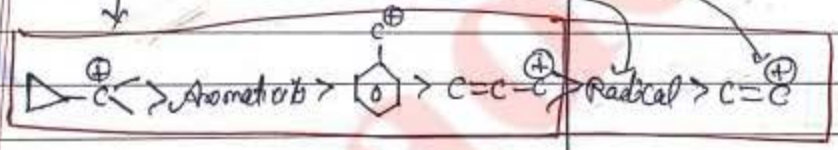
sp^2



[Planar triangular]

Stability of $-\dot{C}^{\oplus}$

$R > H > I$



Ray

$-\dot{\underset{|}{C}}\cdot$

Homolysis

≠

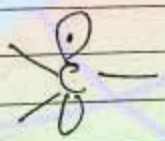
(octet ✗ complete)

Electrophile ($E^{\oplus}$)

(Neutral)

Paramagnetic

sp^2



[Planar triangle]

$R > H > I$

$-\dot{\underset{|}{C}}\ominus$

Heterolysis

$-I$

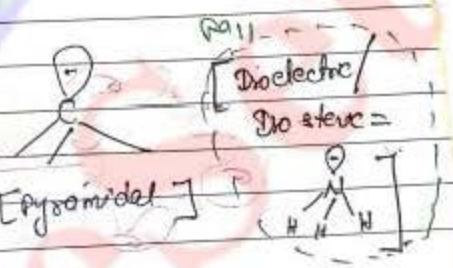
(octet ✓ complete)

Nucleophile ($Nu^{\ominus}$)

(charged)

Di-magnetic

sp^3

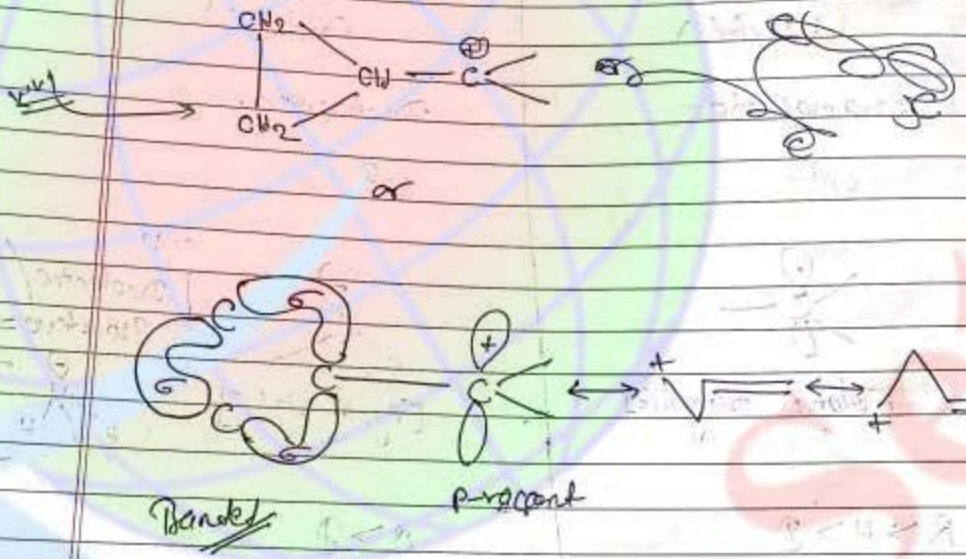


[Pyramidal]

$R > I$

① Carbocation :-

② ↳ Resonance / Dancing Resonance in Cyclo Propyl methyl Carbocation



② Re-arrangement :-

Carbocation Re-arranges towards more stability

$(3^{\circ} > 2^{\circ} > 1^{\circ})$

by :-

(i) Hydrid shift

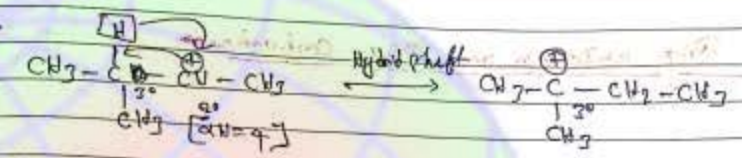
(ii) methyl shift

(iii) Phenyl shift.

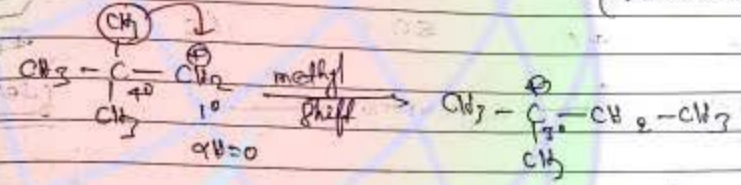
Rq (Ti)

classmate Date Page

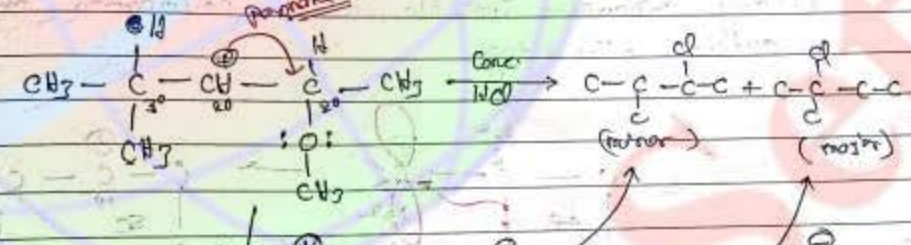
eg:-

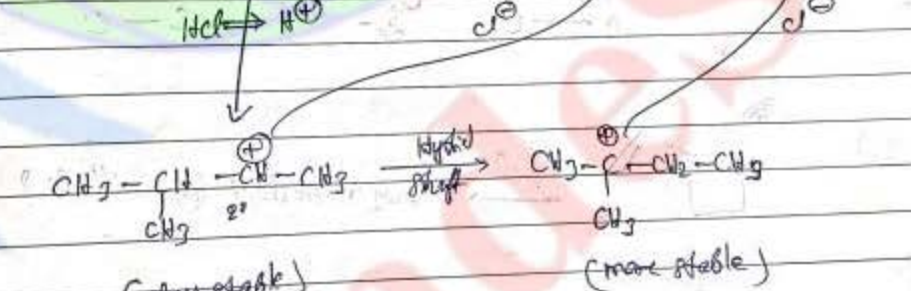


eg:-



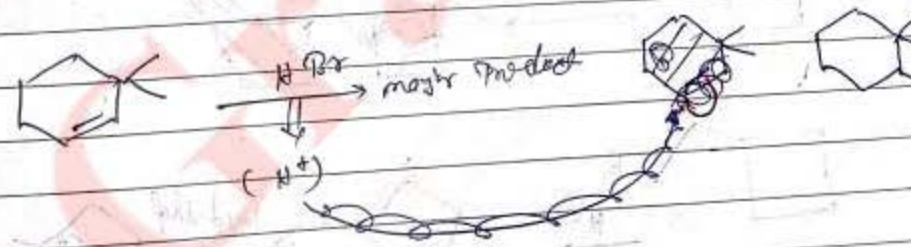
Rq eg:-





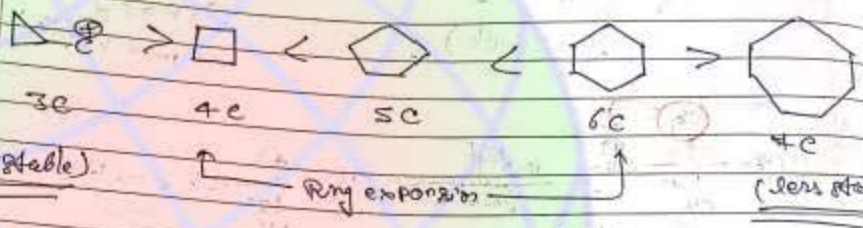
Ho

(1)



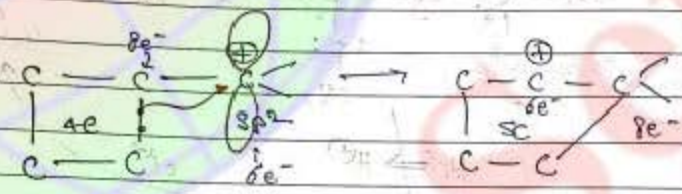
(2)

(b) Ring expansion and Ring contraction →

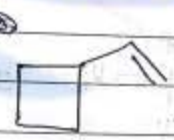


eg.

① Ring expansion possible when carbocation present outside the ring

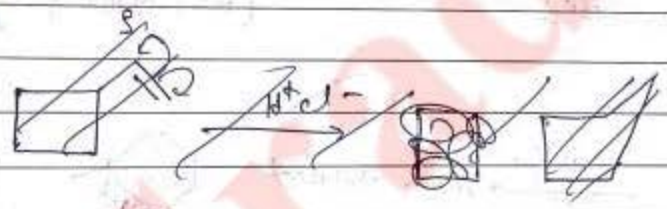


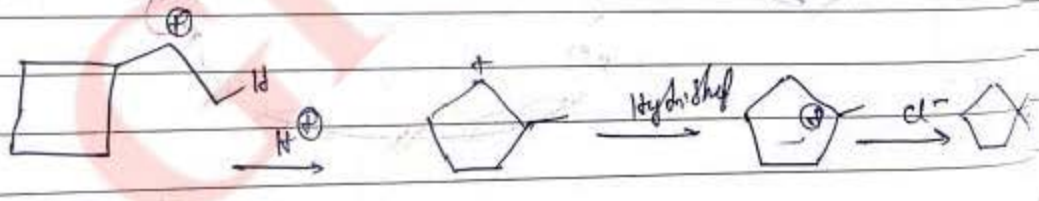
eg.

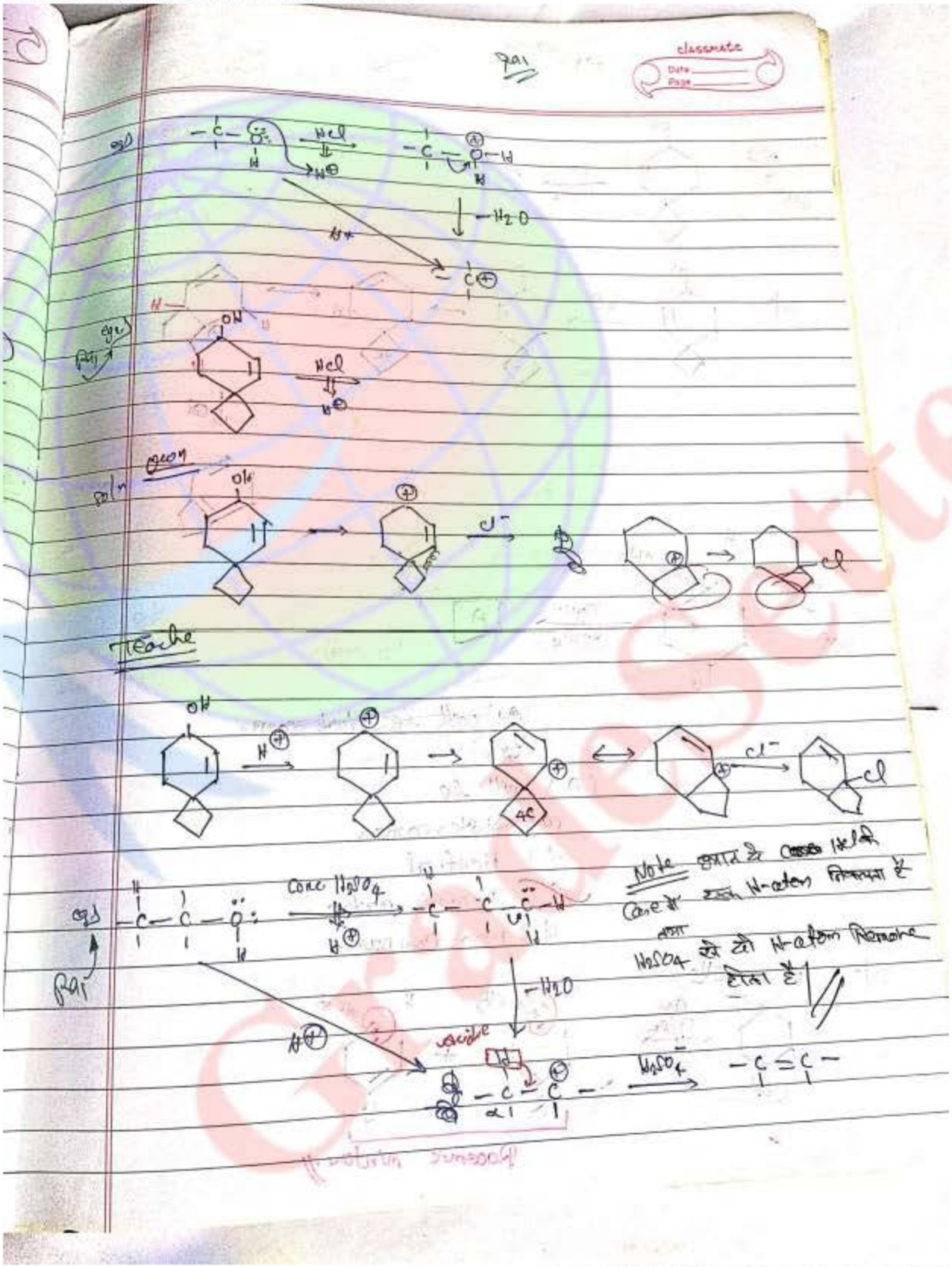


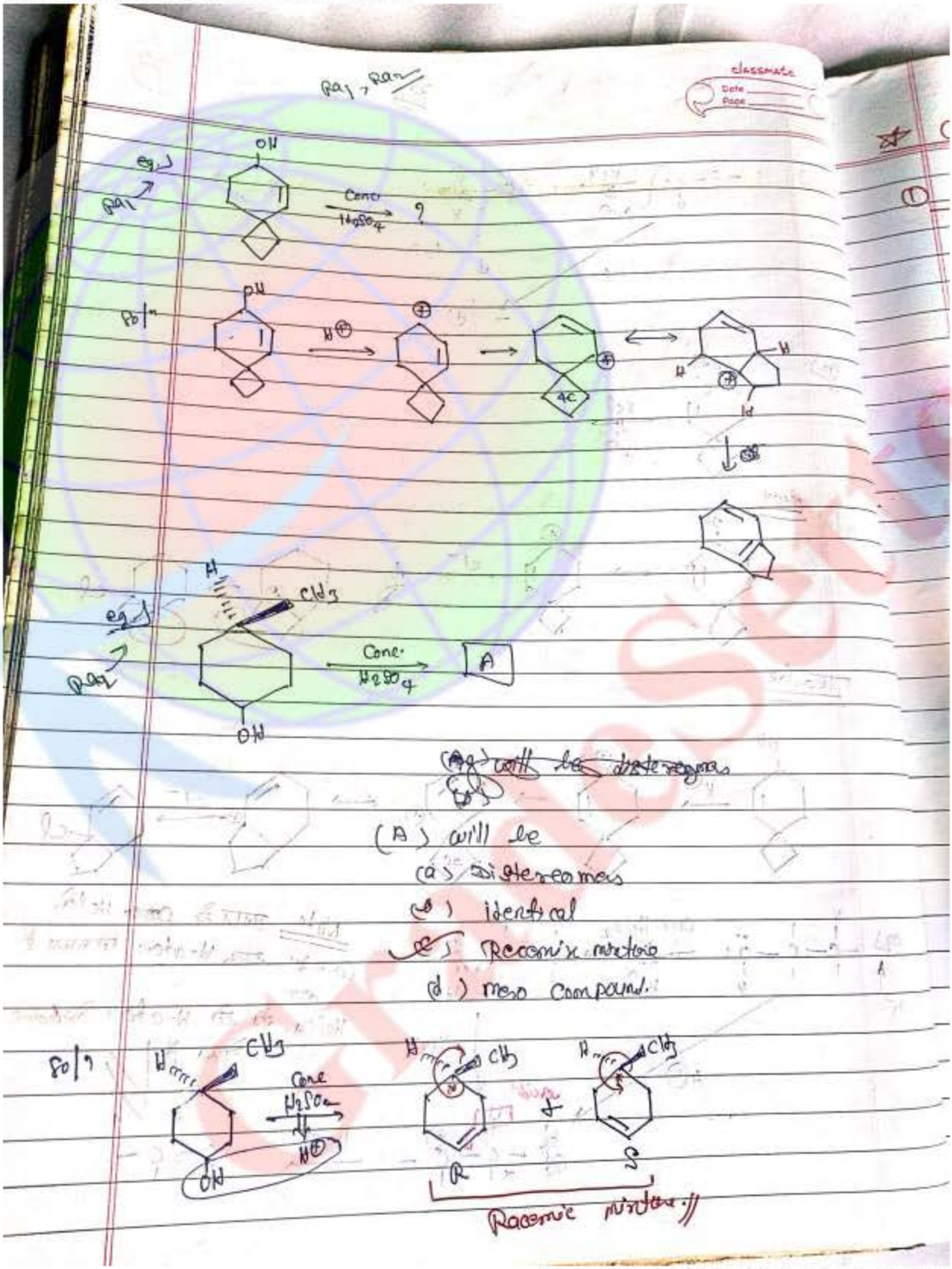
HCl → major product (A) will be ?

Ans









☆ Carb-free Radical →

① Bond Dissociation energy →

Energy required for ~~homolytic~~ cleavage of covalent bond (for shake of study for free radical formation)

B.D.E ∝ $\frac{1}{\text{stability of free radical}}$

eg → (a) $CH_3-CH_2 \overset{a'}{-} H$

(b) $CH_2=CH \overset{b'}{-} H$

(c)  $-CH_2 \overset{c'}{-} H$ — F.R. stability order? — B.D.E order?

(d) $CH_2=CH-CH_2 \overset{d'}{-} H$

Sol

$CH_3-\dot{C}H_2 + \dot{H}$

$CH_2=\dot{C}H + \dot{H}$

 $-\dot{C}H_2 + \dot{H}$

$CH_2=CH-\dot{C}H_2 + \dot{H}$

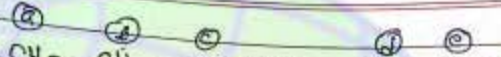
Note → जो free Radical जितना stable होगा, अर्थात ~~.....~~ जिसमे उतना एक से stable free Radical बनाने का क्षमता होगा है और तोड़ने में उतना ही B.D.E देना होगा ||

F.R. stability order ⇒ R > H > I

c' > d' > a' > b'
(Resona) (Hyper)

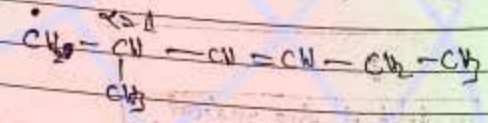
B.D.E order ⇒ c < d < a < b

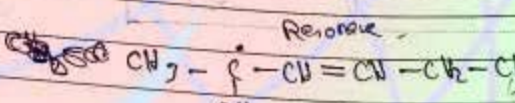
Q.1

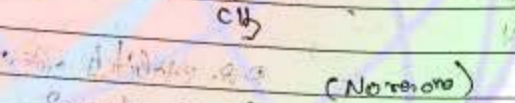


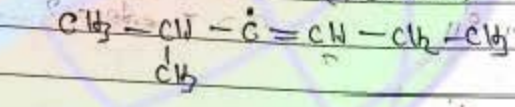
B.D.E order =?

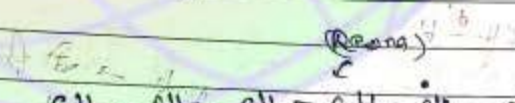
Sol:









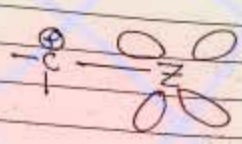


Free radical stability order $c < a < e < d < b$

B.D.E order $c > a > e > d > b$

Carbanion

(1) d-Resonance



[vacant d-orbital]
↓
(P/S/Cl/Br/I)

Note

d-Resonance > π-resonance

d-resonance occured in carb-anions which contains vacant-d-orbitals at neighbour side.

(Imp)

Stability order

(a) $C_6H_5-\overset{\ominus}{C}H_2$

(b) $\overset{\ominus}{C}Cl_3$

(c) $CH_2=\overset{\ominus}{C}H$

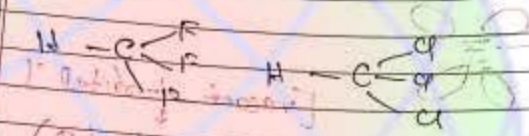
(d) $CH_2=CH-\overset{\ominus}{C}H_2$

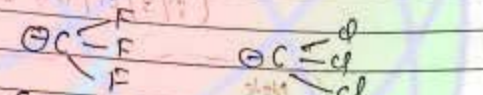
Stability of ⊖ * R > I
(Br, Cl)
↓
(d-resonance possible)

Stability order
a > d > c
↓
d-resonance not possible

Q) Arrange in
(a) CH_3F (b) $CHCl_3$

Sol:





(π-resonance) (d-resonance)

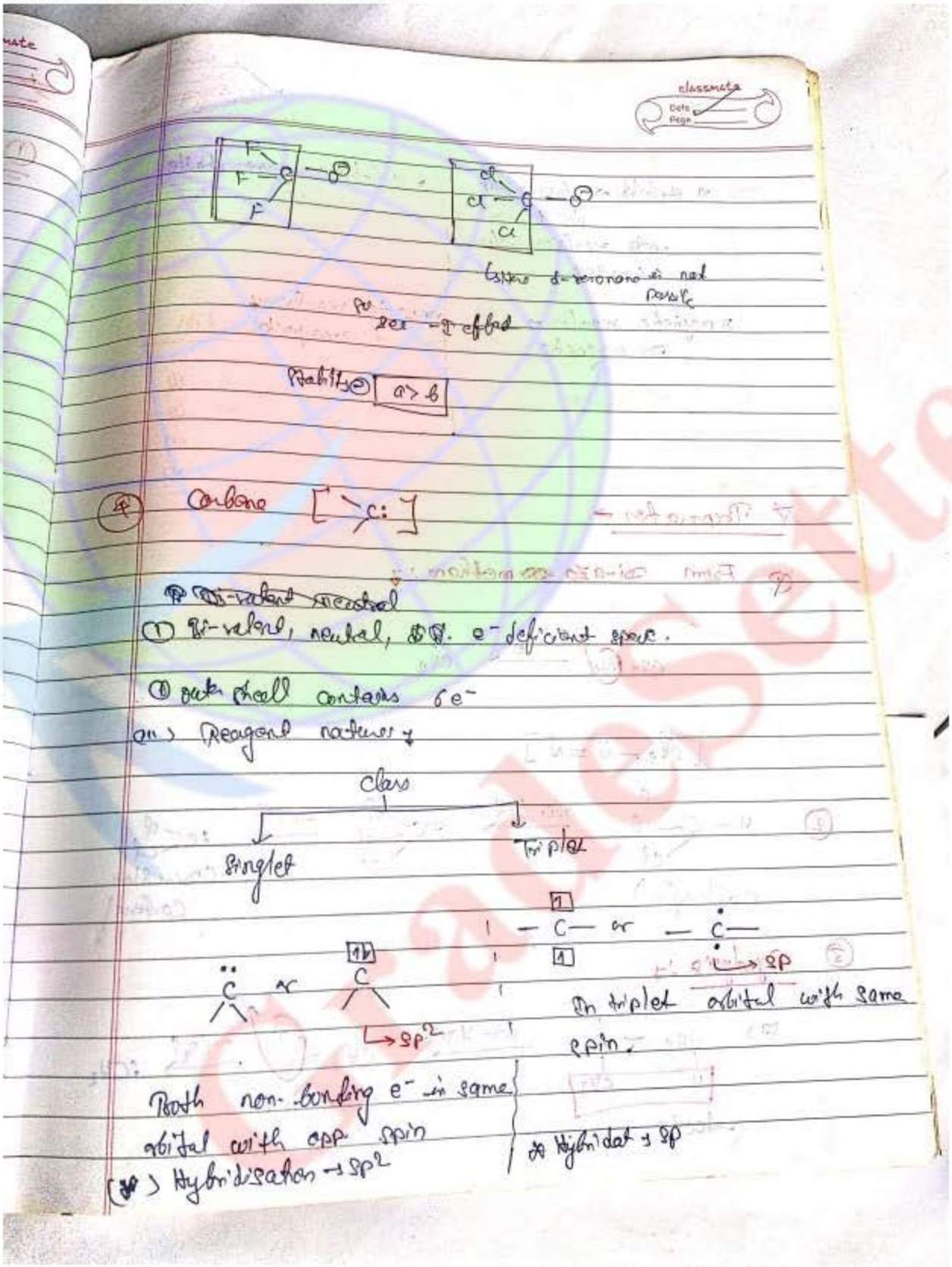
Stability $\propto R > I$

So,

Stability of $C^{\ominus}$ is $a > q$

eg.) Arrange in
(a) di fluoro methanol (b) tri chloro methanol.

Sol:



* Stability → less stable due to more repulsion e/a two spin

* magnetic repulsion → Di magnetic

* Stability → more stable

* magnetic repulsion → Paramagnetic

Preparation →

(1) From Di-azo methane :→

$CH_2(N_2) \xrightarrow{\Delta} :\ddot{C}H_2$

$[\overset{\ominus}{C}H_2 - \overset{\oplus}{N} = N]$

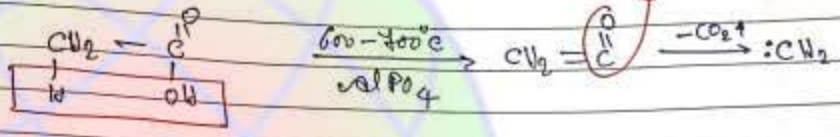
(2) $H-CCl_3 \xrightarrow{\text{alc. KOH}} \ominus CCl_3 \xrightarrow{-Cl^{\ominus}} :CCl_2$

(chloroform) (Di-chloro carbene)

(3) Pyrolysis :→

(a) $CH_2(H)-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{600-700\,^{\circ}C} CH_2=C=O \xrightarrow{-CO_2} :CH_2$

Acetone (ketene)

(6) 

Acetic Acid

(5) Nitrene :→ (— N̈ :)

(i) Analogus true carbene
(ii) monovalent neutral electon deficient spec.
(iii) Electrophile neutral //
(iv) Hoffman Hypo bromide. //

Nucleophilicity

(Nucleophilic strength)

(N.S)

Nu: / $Nu^{\ominus}$

Nucleophilicity

1) Nucleophilicity is kinetic property.
2) Nucleophilic is reactivity of e⁻ rich species to donate e⁻ pair towards e⁻ deficient species.

Nucleophile and base difference

Base ($B^{\ominus}$ / B:) → $H^{\oplus}$ (Proton)

e⁻ rich

Nucleophile ($Nu^{\ominus}$ / Nu:) → $E^{\oplus}$ (Proton & electrophile)

e⁻ rich

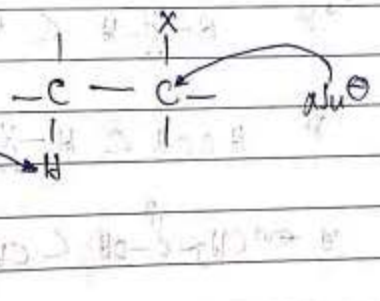
$HO^{\ominus}$ → $H^{\oplus}$

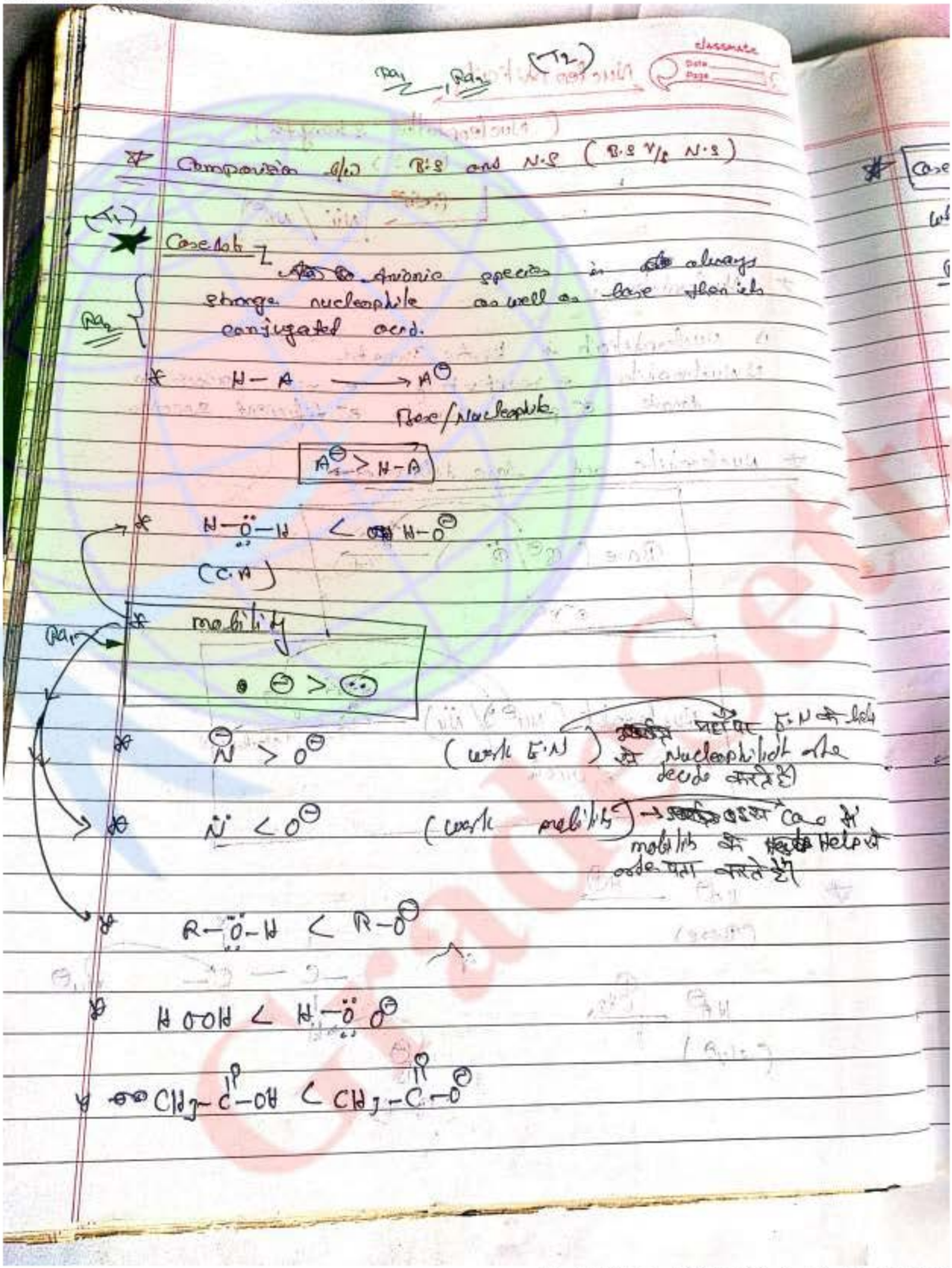
(Base)

$HO^{\ominus}$ → $CH_3^{\oplus}$

($Nu^{\ominus}$)

or





Rate1 → Rate2 (T2)

★ Comparison b/w B.S and N.S (B.S V/s N.S)

(T1) ★ Case Stab ↳ Anionic species is always stronger nucleophile as well as base than its conjugated acid.

Rate2 ✱ H–A ⟶ $A^{\ominus}$

Base / Nucleophile

$A^{\ominus}_{1} > H-A$

✱ $H-\ddot{O}-H < H-O^{\ominus}$

(C.M)

Rate1 ✱ mobility

$\ominus > :$

✱ $\ddot{N}^{\ominus} > O^{\ominus}$ (work B.N) → Nucleophilicity को decide करते हैं

✱ $\ddot{N} < O^{\ominus}$ (work mobility) → Ca.o में mobility के Help से decide करते हैं

✱ $R-\ddot{O}-H < R-O^{\ominus}$

✱ $H-OH < H-\ddot{O}^{\ominus}$

✱ $CH_3-\overset{\overset{O}{\|}}{C}-OH < CH_3-\overset{\overset{O}{\|}}{C}-O^{\ominus}$

Case 2nd →

When central atom from period left to right

Rule No. →

When central atom differ to each other then

$B.S = N.S$

$C^{\ominus}$ $N^{\ominus}$ $O^{\ominus}$ $F^{\ominus}$

$B.S \propto \frac{1}{E.N}$

$B.S = C^{\ominus} > N^{\ominus} > O^{\ominus} > F^{\ominus}$

$N.S \propto \frac{1}{E.N}$

$N.S = C^{\ominus} > N^{\ominus} > O^{\ominus} > F^{\ominus}$

Case 3rd

Q) order of N. S :-

(a) $CH_3-CH_2-O^{\ominus}$ (b) $CH_3-CH_2-NH^{\ominus}$

(c) $CH_3-CH_2-\overset{\ominus}{C}H_2$ (d) $CH_3-CH_2-\overset{\ominus}{N}-CH_3$

Rule 8) Overall **E·N ∝ Acidic nature**

C N O F

A·S → a > b > d > c

$Nu^{\ominus}$ / N·S / B·S → a < b < d < c

eg.)

E^+ / Acidic → C N O F

Rule 9)

If central atom same but differ in categories then

B·S = N·S

$$B·S \propto \frac{1}{\text{stability of Anion}}$$

$$N·S \propto \frac{1}{\text{stability of Anion}}$$

AR →

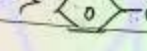
eg) $H-O^{\ominus}$ $R-O^{\ominus}$  $R-\underset{O}{\overset{\|}{C}}-O^{\ominus}$

NS →

R > I

NS → d-resonance > π-resonance

equivalent > R.S

Stability → $R-\underset{O}{\overset{\|}{C}}-O^{\ominus}$ >  > $H-O^{\ominus}$ > $R-O^{\ominus}$

B.S →

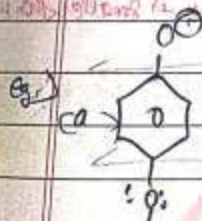
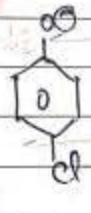
NS →

eg) (a) $CH_3-CH_2-O^{\ominus}$ (c) $CH_3-CH_2-\overset{\ominus}{N}H$

(b) $CH_3-\underset{CH_3}{\overset{}{CH}}-O^{\ominus}$ (d) $CH_3-CH-\overset{\ominus}{N}H-CH_3$

Stability → e and b > conj N O F

Ans B.S → d > c > b > a

eg)  (a)  (b)  (c)

c < N < O < P

Stability → b > e > a

CH_3 (−M > −H > −I > ———)

B.S = a > c > b

NS = a > c > b

Rule 1

If central atom as well as adjacent atom

B.S ≠ N.S

Alkoxide → Nucleophilicity ∝ ||

Ethoxide — I

Iso propoxide — II

T-butoxide — III

N.S → I > II > III

B.S → I < II < III

Size of Nu ↑ Steric hindrance ↑

Steric hindrance Increase (↑)

+I Increase (↑)

N.S = N.S ∝ β / Steric hindrance

B.S = B.S ∝ +I

Rule 3rd

If central atom as well as category similar then

B.S ≠ N.S

Alkoxide → Nucleophilicity ∝ B.S

Ethoxide (I)

Iso propoxide (II)

T-butoxide (III)

N.S → I > II > III

B.S → I < II < III

Steric hindrance ∝ Increase (↑)

+I Increase (↑)

N.S = N.S ∝ 1/(steric hindrance)

B.S = B.S ∝ +I

Case II

When central atom from group (top to bottom)

* In Groups EN approximately same, so deciding factor will be size.
* Nucleophilicity affected by size as well nature of solvent. (Difference with Base strength)

Type of solvent :-

(1) Polar Protic solvent :- (P.P.S)

H^+

Polar solvent which contains acidic H^+ / Active Hydrogen which able to form hydrogen binding with Anion's

(Ion-dipole Interaction)

$H-\overset{\delta-}{O}-\boxed{\overset{\delta+}{H}}$ / $R-\overset{\delta-}{O}-\boxed{\overset{\delta+}{H}}$ / $R-\overset{O}{\overset{\|}{C}}-\overset{\delta-}{O}-\boxed{\overset{\delta+}{H}}$ etc.

(2) Polar Aprotic solvent :-

Polar solvent without Acidic H^+

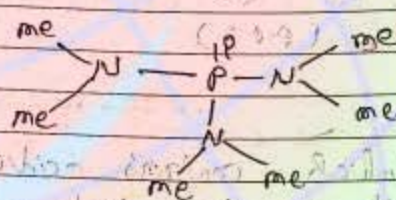
eg :- DMF :- (Dimethyl formamide) $H-\overset{O}{\overset{\|}{C}}-\underset{CH_3}{\overset{CH_3}{N}}$ ($\overset{\delta-}{O}$, $\overset{\delta+}{C}$)

DMSO [Dimethyl sulphoxide] $CH_3-\overset{O}{\overset{\|}{S}}-CH_3$

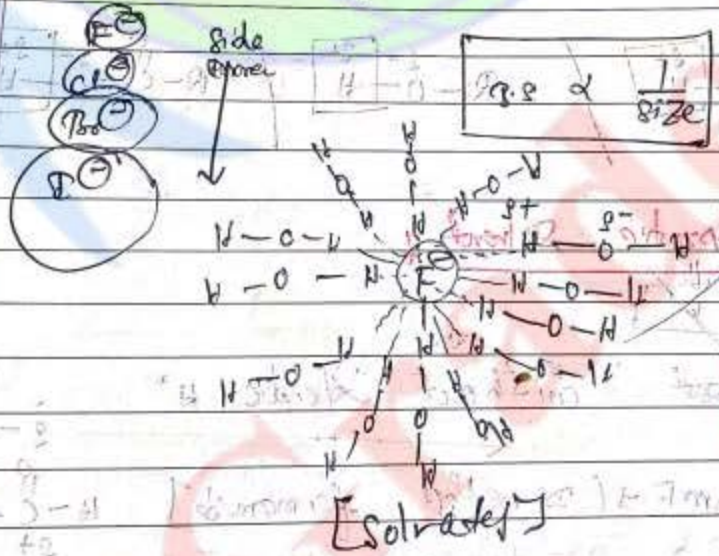
Ethar → [O] → THF tetrahydro furan.

[O O] dioxane

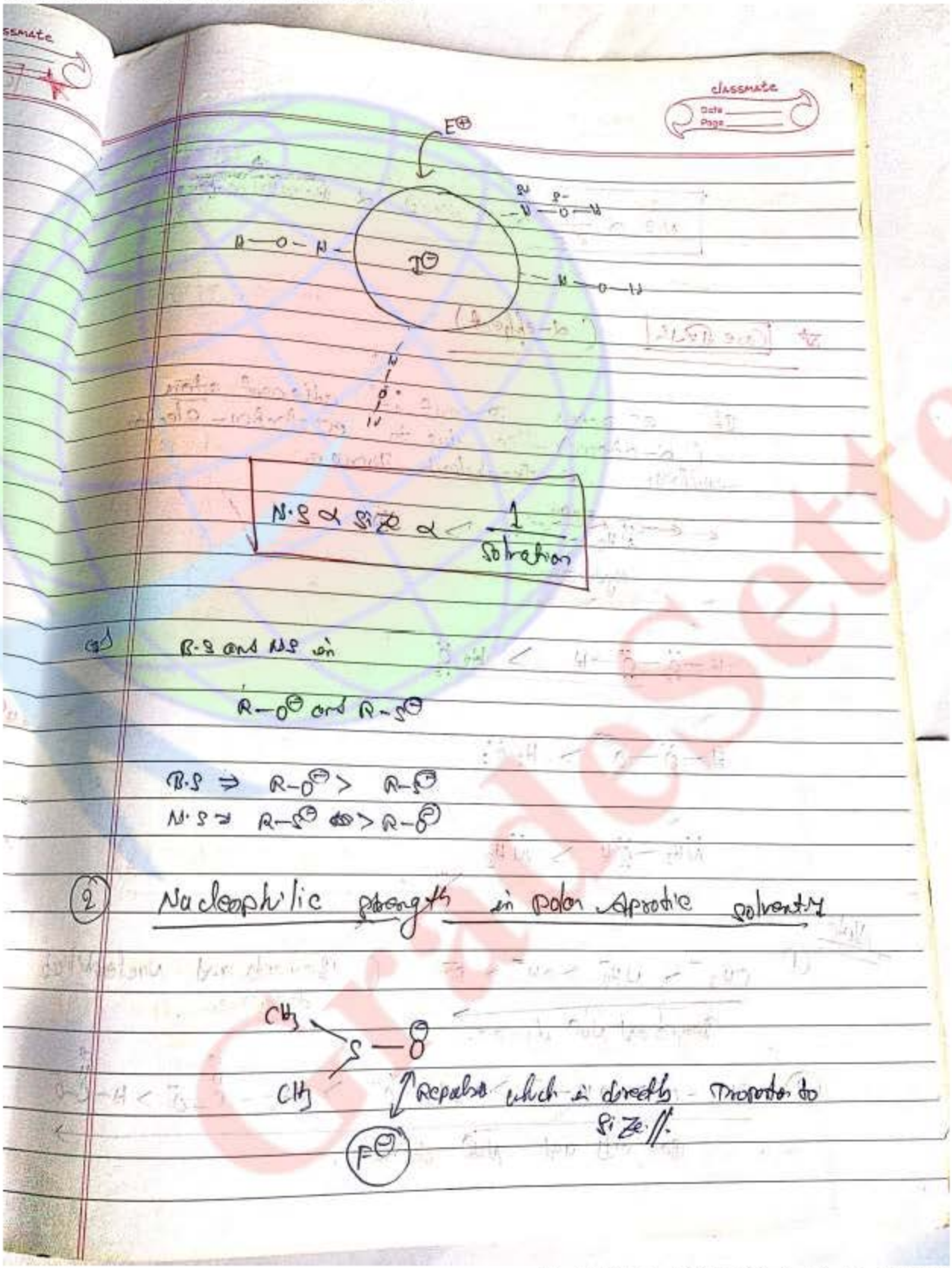
HMPA → [Hexa methyl phosphoramide]



Nucleophile strength in polar protic solvent



F⊖ (Not able to attack due to small size of F⊖)



$N.S \propto \frac{1}{size} \propto e^-$ density $\propto$ Repulsive force

Case IV th (α-effect)

If e^- pairs present at adjacent atom (α-atom) than due to electron-electron repulsion, Nucleophilicity Increase.

$NH_2 - \ddot{N}H_2 > NH_3$

Hydrazine

$H-\ddot{O}-\ddot{O}-H > H_2O_2$

$H-\ddot{O}-O^{\ominus} > H_2O$

$NH_2-OH > NH_3$

Note

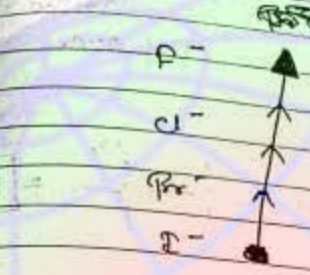
(1) $CH_3^- > NH_2^- > OH^- > F^-$ (Basicity and Nucleophilicity decrease.)

Basicity and Nuc decrease.

(2) $CH_3-O^- > \phi N-O^- > C_6H_5-O^- > CH_3-\overset{O}{\overset{\|}{C}}-O^- > H-\overset{O}{\overset{\|}{C}}-O^-$

Basicity and Nuc decrease.

(3)



but Nucleophilicity decrease.
or
(when we use decreasing polar protic solvent)
तथा
इसका ठीक उल्टा
Aprotic में होता।

Leaving group.

(4)

Nucleophilicity or leaving group.
fluorine का सबसे कम होता है
इसी fluorine सबसे स्थिर है क्योंकि
यह सा से जादा e⁻ लेना है और
को जल्दी छोड़ता है।

(5) leaving Group order

$I^- > Br^- > Cl^- > F^- > HS^- > CN^- > OH^- > RO^-$

Good leaving Group — Bad leaving group

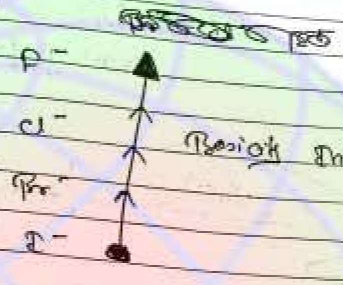
(6)

Excellent Nucleophile → $CN^- > HS^- > I^-$

Good Nucleophile → $OH^- > Br^- > N_3^- \simeq NH_3 > NO_2^-$

Poor Nucleophile → $Cl^- > CH_3COO^- > F^- > CH_3OH \simeq H_2O$

(3)



Leaving group or Nucleophilicity decrease. (atom size decrease in polar protic solvent) तथा इसका उल्टा Aprotic में होगा।

(4)

Nucleophilicity or leaving group florine का सबसे कम होता है क्योंकि florine सबसे छोटा है इसलिए यह ना तो जल्दी e^- देता है और ना ही जल्दी निकलता है।

(5) Leaving Group order

$I^- > Br^- > Cl^- > F^- > HS^- > CN^- > OH^- > RO^-$

Good leaving Group — Bad leaving group

(6) Excellent Nucleophile → $CN^- > HS^- > I^-$

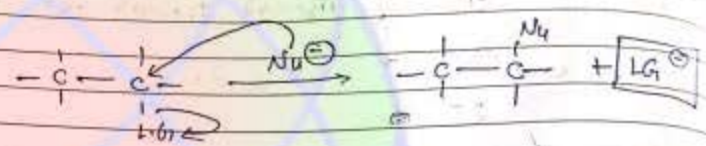
Good Nucleophile → $OH^- > Br^- > N_3^- \approx NH_3 > NO_2^-$

Poor Nucleophile → $Cl^- > CH_3COO^- > F^- > CH_3OH \approx H_2O$

Leaving Group (L.G)

① Nucleophilic species which remove from substrate said to be leaving group.

eg:



[Eg; Nucleophile species always -ve]

② Good leaving group:-

Good L.G → Stable anion (C.B) ⇒ R > I
or
weak base
or
size bigge
trick → strength of L.G

[Acidic strength of C.A (acidic) ∝ strength of L.G]

or

[Acidic strength ∝ L.G ability]

③ (a) $NH_2^{\ominus}$ (b) $CH_3-\overset{\overset{O}{\|}}{C}-O^{\ominus}$

- stable of anion → E.N ∝ [a<b] ∴ $O^{\ominus}$ is more stable than $^{\ominus}NH_2$

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

- weak base $CH_3-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O}$ > $\ddot{N}H_2$ (weak base, strong base)
- C.A order of $\ddot{N}H_2$ < $CH_3-\overset{O}{\overset{\|}{C}}-O-H$
- L.G. order of $\ddot{N}H_2$ < $CH_3-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O}$ (Good L.G)

(A) order of L.G is

(a) $CH_3-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O}$ (b) $CH_3-CH_2-\overset{\ominus}{O}$ (c) $\ddot{N}H_2$ (d) $Cl^\ominus$

L.G = a > b > d > c

C N → O Pq

- Stability of anion ⇒ $Cl^\ominus$ (Size) > $CH_3-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O}$ > $CH_3-CH_2-\overset{\ominus}{O}$ > $\ddot{N}H_2$ (C-N, same group)
- order of B.S ⇒ $\ddot{N}H_2$ > $CH_3-CH_2-\overset{\ominus}{O}$ > $CH_3-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O}$ > $Cl^\ominus$
- order of A.S of CA = HCl > $CH_3-\overset{O}{\overset{\|}{C}}-OH$ > CH_3-CH_2-OH > $\ddot{N}H_3$
- order of L.G = $Cl^\ominus$ (Good L.G) > $CH_3-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O}$ > $CH_3-CH_2-\overset{\ominus}{O}$ > $\ddot{N}H_2$ (Poor L.G)

(S) $R-\overset{O}{\overset{\|}{C}}-Z \xrightarrow{Nu^\ominus} R-\overset{O}{\overset{\|}{C}}-Nu + Z^\ominus$

Z⁻ will be

(a) $\ddot{N}H_2$ (b) $Cl^\ominus$ (c) $CH_3-COO^\ominus$ > (d) $CH_3CH_2O^\ominus$

(d) for reason see point number "4".

[Cl^- is Good L.G]

(b) (a) F—C(=O)—O⊖ (b) CH_3—C(=O)—O⊖ (c) CH_3—C(R)(=O)—O⊖ (d)

(triplate Don)

Sol^n ⊖ ⇒ R > equivalent > equivalent resonance > I

a > b > c > d

a → good leaving group

d → poor L.G → No resonance

equivalent Resonance number > 2

equivalent Resonance number > 3

Effect group +I equivalent Resonance number > 3