1st Choice

IUPAC

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1) word root
2) Prefix
3) Suffix

Iupac name is made of three part's as above

* word root → It Indicate no of carbon in main carbon chain.

No of carbon	
1	meth
2	Eth
3	Prop
4	But (a)
5	Pent
6	hen
7	Hept
8	~~oo~~oct
9	non
10	dec
11	undec
12	dodec
20	Eicos
30	Tricont
40	Tetracont

2) Prefix :—

1) Primary or 1° Prefix ⇒ cyclo (when compound is cyclic)

2) Secondary or 2° Prefix ⇒ It Indicate substituent or side chain's

eg:⇒ X ⇒ halo

Cl ⇒ chloro

I ⇒ Iodo

$-CH_3$ ⇒ methyl

$-OCH_3$ ⇒ methoxy

$-NO_2$ ⇒ Nitro

3) Suffix →

↳ Primary or 1° suffix → It indicate nature of principle carbon chain saturated or unsaturated.

If, saturated carbon chain → 1° suffix → ane → Alkane C_nH_{2n+2}

If

Unsaturated carbon chain (=) → ene → Alkene C_nH_{2n}

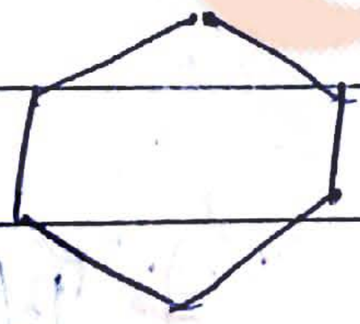
(≡) → yne → Alkyne C_nH_{2n-2}

Note! →

= + ≡ → ene + yne → enyne

= + = → diene

eg :→ $CH_2=CH-CH=CH_2$ ⇒ Buta 1,3 diene



→ C_6H_{12} → Saturated

$CH_2=CH-CH=CH_2$ → C_4H_6 →

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2) 2° suffix → Dt Indicate Principle function group

Functional Group	Prefix	Suffix
i) $-\overset{O}{\overset{\|\|}{C}}-O-H$ or $COOH$	- Carbony	-oic acid
ii) $-SO_3H$ or $-\overset{O}{\overset{\|\|}{\underset{O}{\underset{\|\|}{S}}}}-O-H$	- Sulpho	- Sulphonic acid
iii) $-\overset{O}{\overset{\|\|}{C}}-O-\overset{O}{\overset{\|\|}{C}}-R$ or $RCOOCOR$ or $(RCO)_2O$ Anhydride	—	oic anhydride
iv) $-\overset{O}{\overset{\|\|}{C}}-O-R$ or $-COOR$ ester	a) Alkanoyl oxy (Connecting atom oxygen)	oate
	b) carbal Kony or Alkony carbonyl (Connecting atom carbon)	

vi)	$-\overset{\overset{O}{\|}}{C}-X$ acyl Halide	Halo formyl	acyl halide
vii)	$-\overset{\overset{O}{\|}}{C}-NH_2$ Amide	a) - Alkanoyl amino (Connecting atom "N")	Amide
		b) Amido a Carbomoyl (Connecting atom C)	

Note
3, 4, 5, 6 are Carbonyl'd known as acid derivatives

vii)	$-CN$	- Cyano	Nitrile
viii)	$-NC$	Isocyano	Isonitrile

IUPAC में "C" select नहीं करते जबकि Common में consider करते हैं।

ix)	$-\overset{\overset{O}{\|}}{C}-H$	Formyl or Oxo	Al
x)	$-\overset{\overset{O}{\|}}{C}-$	- Oxo or Keto	- one

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xi)	-OH	-hydroxy	-ol
xii)	-SH	-mercapto	-Thiol
xiii)	$-NH_2$	-amino	-amine
xiv)	-OR	-alkoxy	-

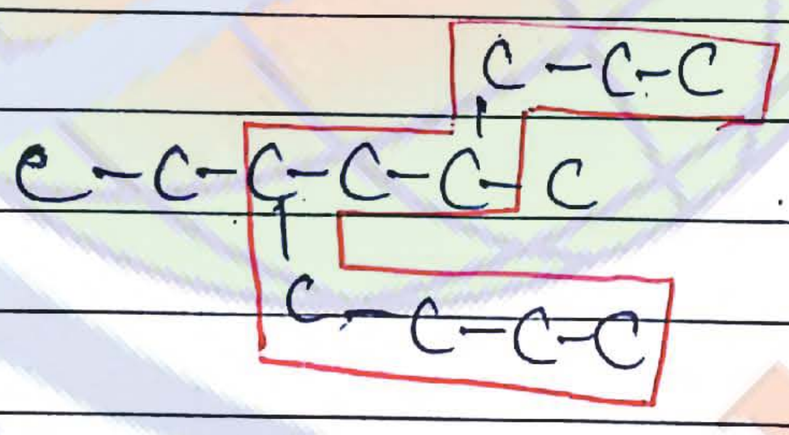
नोट:- किसी compound में no of function group पता करने में consider किया जाता है। { जबकि Naming में function group के तरह treat नहीं हो सकता }

Topic

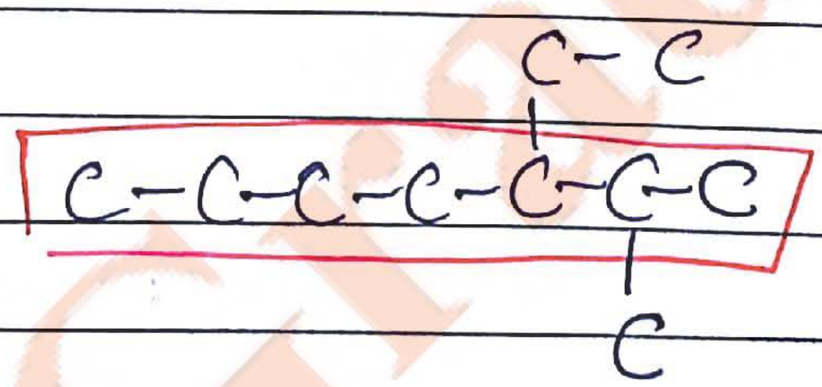
* IUPAC Name ⇒ 2° prefix + 1° Prefix + word root + 1° suffix + 2° suffix

IUPAC Naming of saturated hydrocarbon

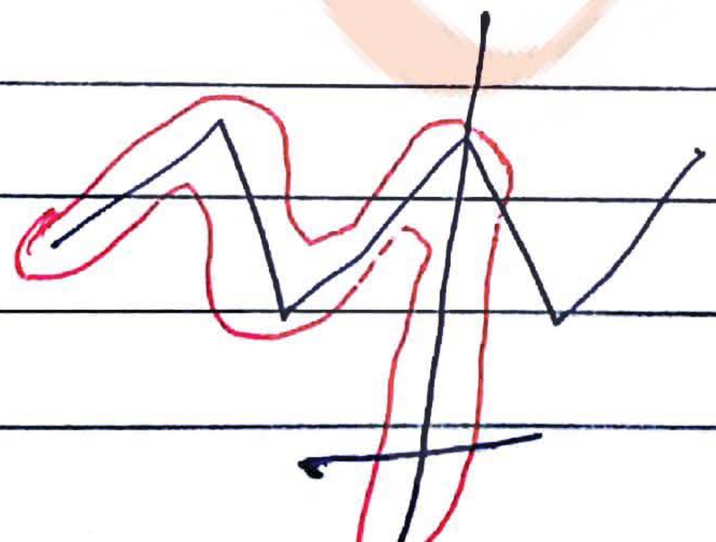
Rule 1 ⇒ Selection of longest carbon chain



Rule 2 ⇒



More no. of side chain.



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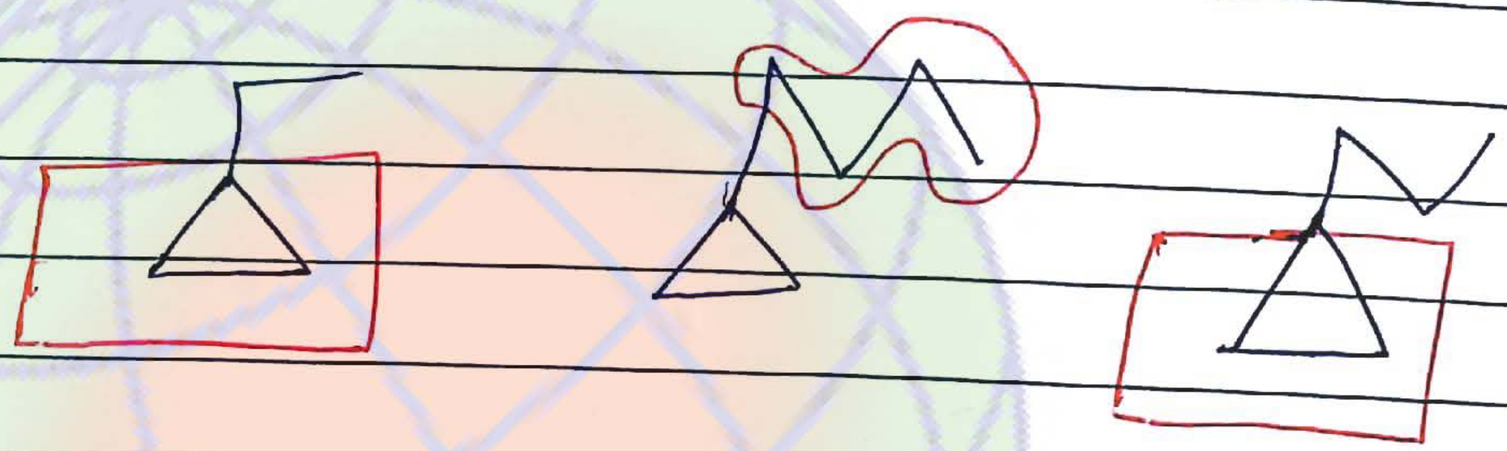
So, we say that
If there are two carbon chain with equal no. of carbon then Principal carbon chain contain more number of side chain.

Rule 3!→



In case of substituted Alicyclic Compound
No. of carbon in ring >= No. of carbon in open chain
Then Ring is considered as Parent chain.
Other wise open chain is considered as Parent chain.

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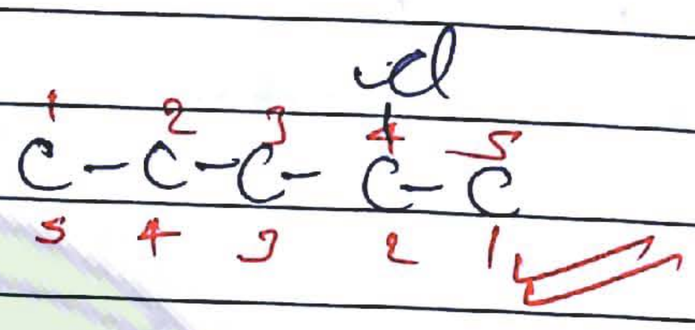
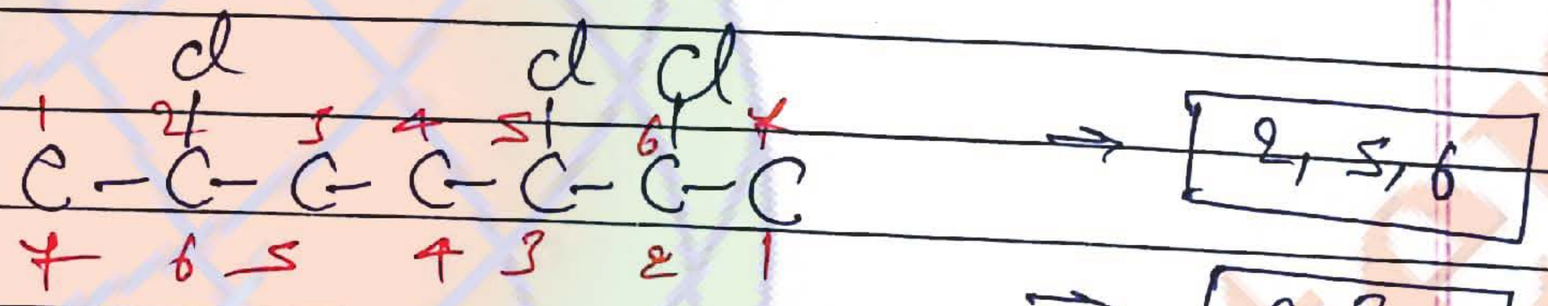
Rule no. 2 ⇒ Numbering of carbon chain

★ Lowest locant rule :-

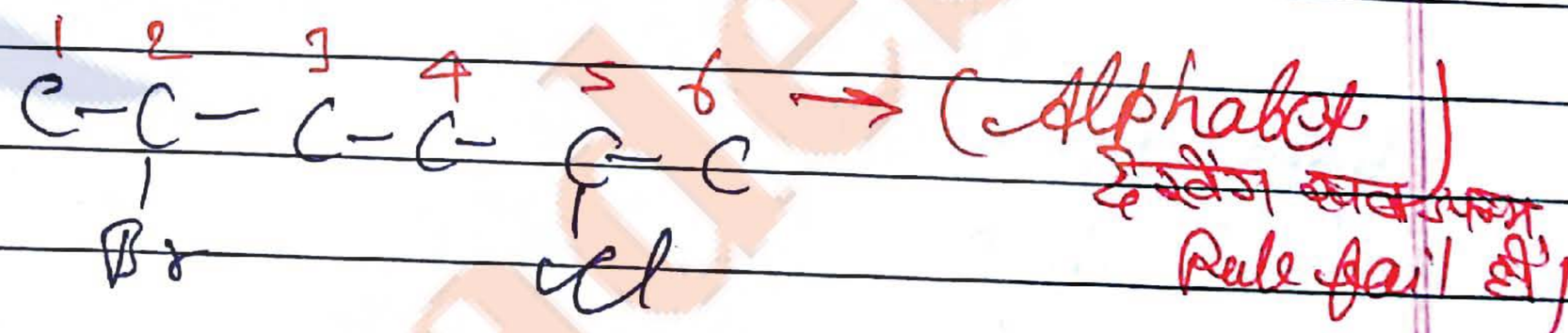


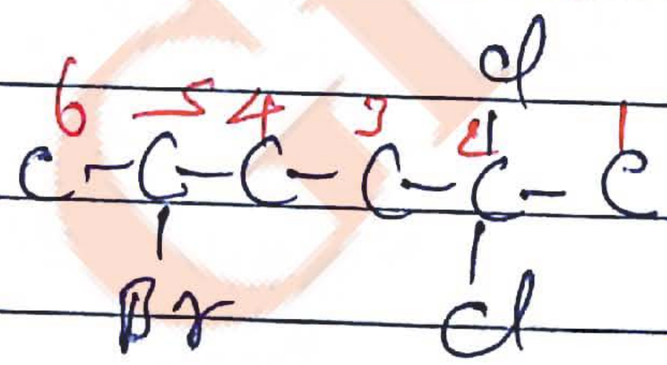
★ Lowest set of locant :-



Lowest set is decided by first point difference rule.

Notes ⇒





If set of locant are similar then alphabetical order.

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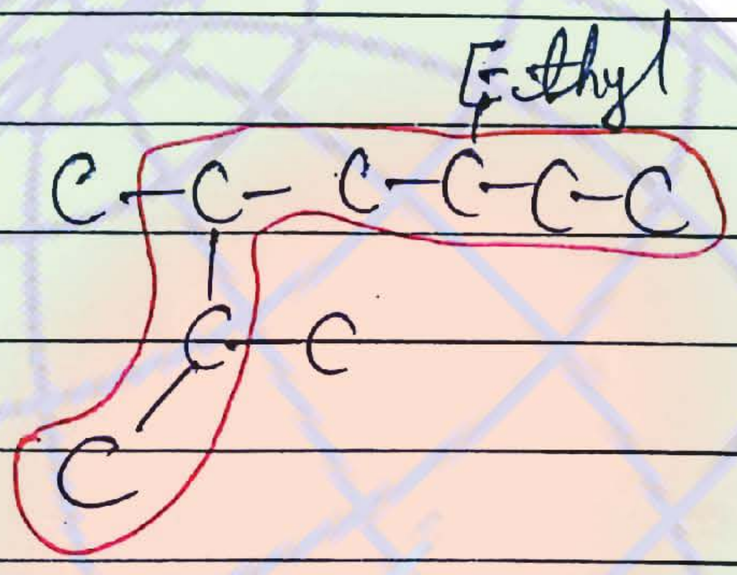
Rule 3 ⇒ Naming of Saturated Hydrocarbon →

Name of Substituents are written in alphabetical order.

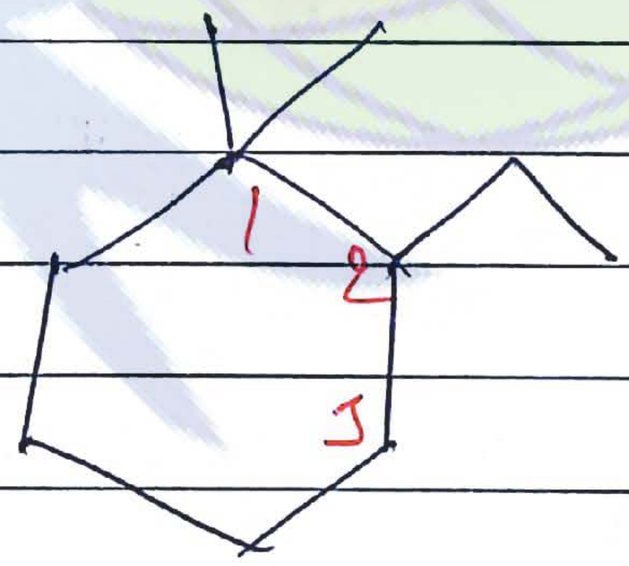
Di, Tri, Tetra are not considered for alphabetical comparison but Di and neo are consider.

*



5 ethyl 2,3 dimethyl Heptane.

*

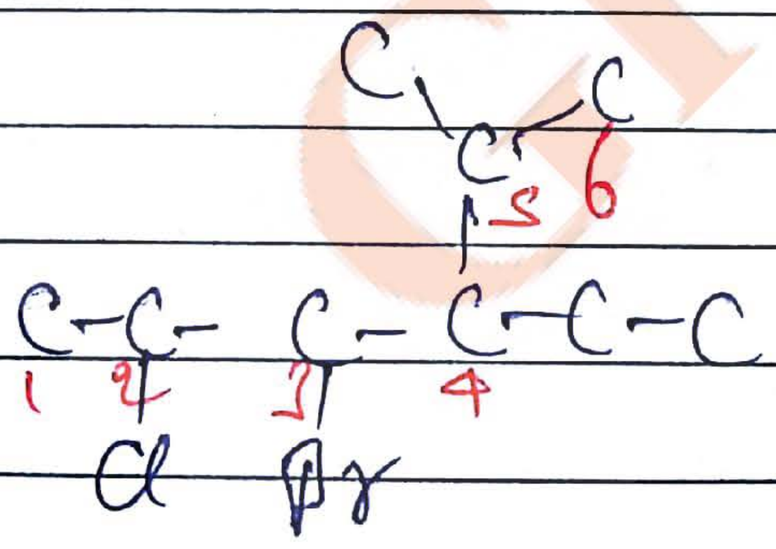


∴ 1, 1, 2

1, 2, 2

2 ethyl 1,1 dimethyl cyclo hexane.

*



3 Bromo 2 chloro 4 ethyl 5 meth
Hexane

☆ Naming of hydrocarbon group →

C_nH_{2n+2} (Alkane) ⟶ C_nH_{2n+1} Alkyl

CH_4 → CH_3- (methyl) (me) — shortcut

CH_3-CH_3 → CH_3-CH_2 → (ethyl) (Et) — shortform.

Ex. Possible hydrocarbon:-

C_3H_8 → $CH_3-CH_2-CH_3$ (Propane) ⟶ $CH_3-CH_2-CH_2-$ (C_3H_7-) n-Propyl

$CH_3-\overset{1}{C}H-\overset{2}{C}H_3$ (free valency on C-1)

(1-methyl Ethyl) or Accepted common name (Iso propyl)

नोट ⇒ Radical की IUPAC naming में अन्त में "Alkyl" आता है क्योंकि Alkane से एक H-atom को remove करके Radical form करते हैं।

जरूर Bracket बंद करें।

Notes ⇒ Hydrocarbon में यदि free Radical होगा तो हर स्थिति में वहीं से Number शुरू होगा। चुनी गई स्थिति जो भी हो, free radical को क्रमांक एक दिया जाता है।

Attention ⇒ In hydrocarbon group numbering always start free valency carbon atom and move towards longest carbon chain.

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C_4H_{10}

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

$CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_3$
Iso-butane

$C-C-C-C-$ (C_4H_9-)
n-butyl

$\overset{3}{C}-\overset{2}{C}-\overset{1}{C}-C$
1 methyl Propyl.
or
Sec. butyl

$CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-$
3 2 1
(2 methyl Propyl) or Iso butyl.

$CH_3-\underset{CH_3}{\underset{|}{\overset{1}{C}}}-CH_3$
2
1,1 dimethyl ethyl
or
tertiary butyl
(t-But)

नोट ⇒ इसी से Number of carbon उसके electron configuration से पता चलता है। और इस तरह किसी compound में कितने तरह का carbon atom है यह भी इसी पता चल जाएगी।

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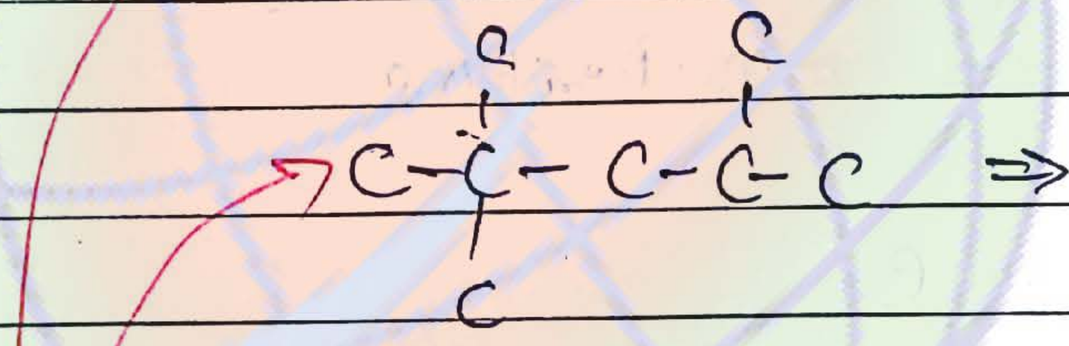
Note:-

$C_4H_8 - \boxed{Olefin}$ → ← Isomer possible

→ Concepts of Iso, neo, Amyl are active in common naming →

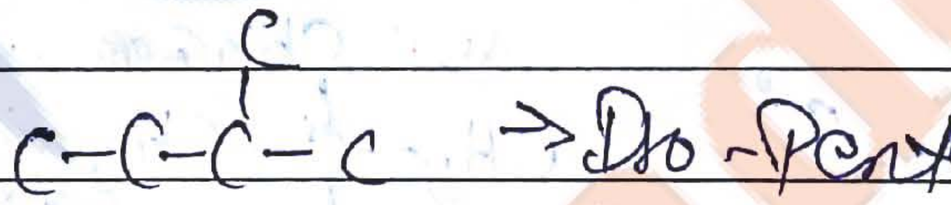
* Iso → This prefix is used when 2nd last carbon contain extra methyl substituent (or side chain)

$CH_3 - \underset{|}{CH} - CH_3$ → Iso propyl



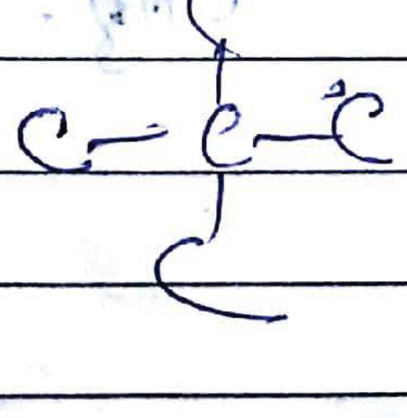
→ Iso - octane

Note → Iso-propyl and Iso-octane are exception to these Prefix.



→ Iso-Pentane

* Neo = There prefix is used when 2nd last carbon contain two methyl substituent.
इसके लिए Compound में minimum "5" Carbon-atom होना आवश्यक है



t-Amyl = Pentyl

N.V.I

t-Achive → This Prefix is used when hydrocarbon group contain ~~optical centre~~ chiral centre which is connected by four different group or valencies.

eg:-

C_5H_{12}

↓

$CH_3-CH_2-CH_2-CH_2-CH_3$

n-Pentane

H C

1° 1°

H_3C-CH_3

2° 2°

$CH_3-CH_2-CH_2$

3° 3°

$CH_3-C(CH_3)-CH_3$

4°

$CH_3-C(CH_3)(CH_3)-CH_3$

Note :-

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

Pentyl or n-Pentyl

1st Choice

→ चारो ग्रुप अलग अलग होना चाहिए

*VVI

$\overset{4}{CH_3} - \overset{3}{CH_2} - \overset{2}{CH} - \overset{1}{\underset{|}{CH}} - CH_3$

1 methyl Butyl or (~~2° Pentyl~~)
(2° Active Pentyl)

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

~~1 methyl~~
1 ethyl propyl (2° Pentyl)

eg1 ⟹

$CH_3 - CH_2 - \overset{CH_3}{CH} - CH_3$ (struck through)

$CH_3 - CH_2 - \overset{CH_3}{\underset{|}{CH}} - CH_3$ → these are same

Iso-Pentane

(Here four type of Hydrogens are Present.)

⇓

$\underset{4}{H_3C} - \underset{3}{H_2C} - \underset{2}{\overset{CH_3}{CH}} - \underset{1}{CH_2} -$ ⟹ 2 methyl Butyl or 1° active Pentyl

Tert Pentane

$\underset{3}{H_3C} - \underset{2}{CH_2} - \underset{1}{\overset{CH_3}{\underset{|}{C}}} - CH_3$ ⟹ 1,1 dimethyl Propyl or 3° Pentyl

$H_3C - \underset{1}{\underset{|}{CH}} - \underset{2}{CH} - \underset{3}{CH_3}$ ⟹ 1,2 dimethyl Propyl
or
2° Iso Pentyl

Active Iso Pentyl

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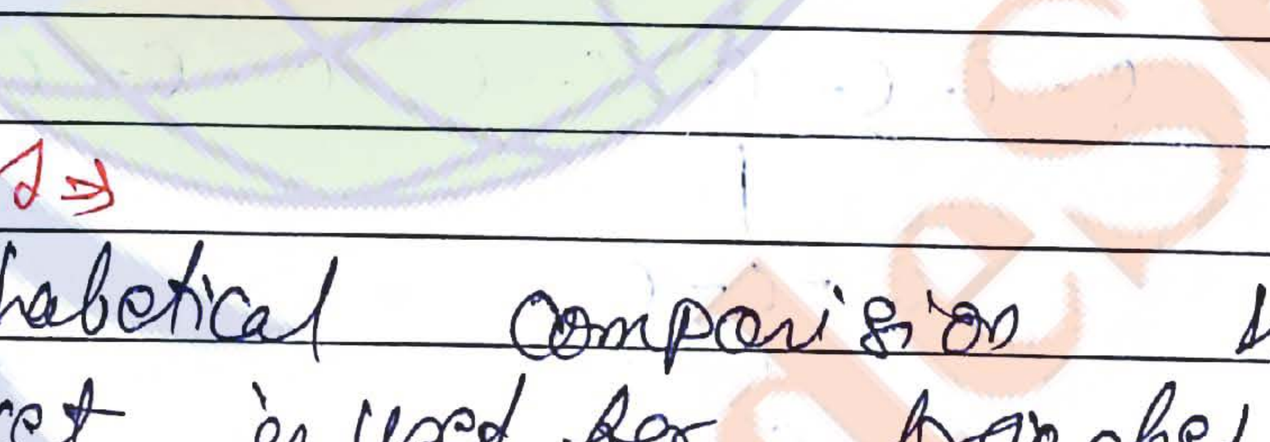
☆ IUPAC naming of branched substituent → hydrocarbon Containing ~~Pentane~~

Rule 1st ⇒ Name of branch Substituent is written in bracket to avoid confusion.

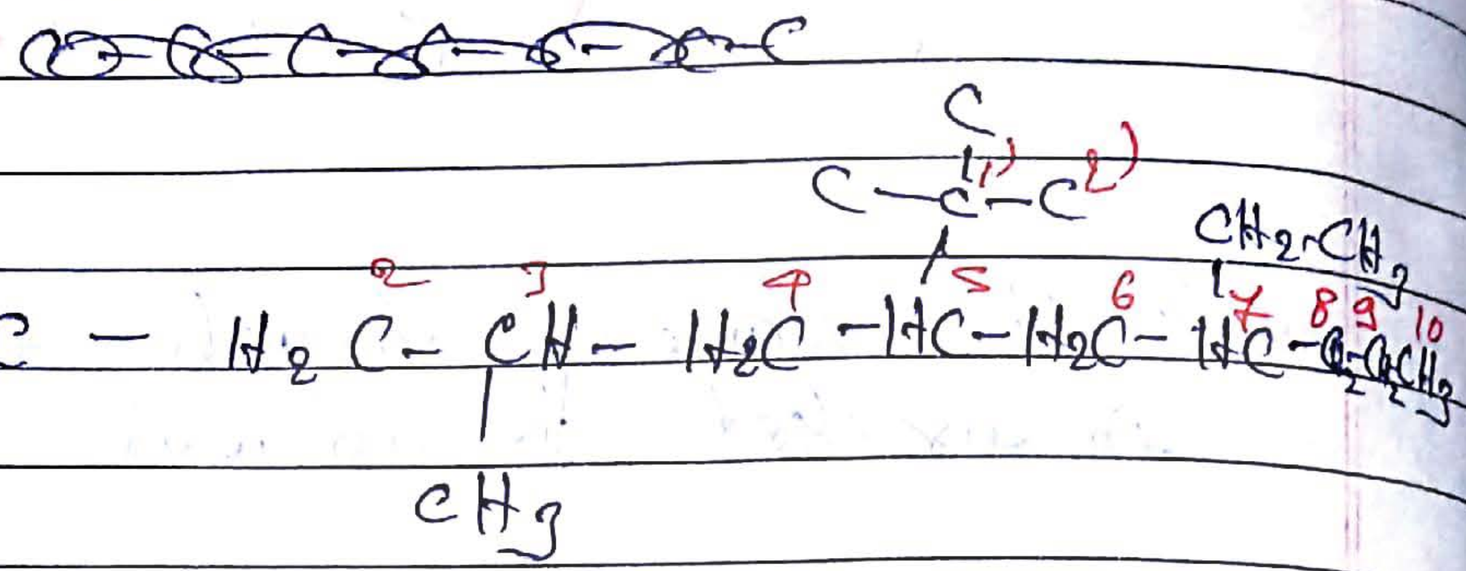
Rule 2nd ⇒ If more than one same branch Substituent is present then their numbers are shown by

Bi's → two
Tri's → three
Tetraki's → four
Pentaki's → five

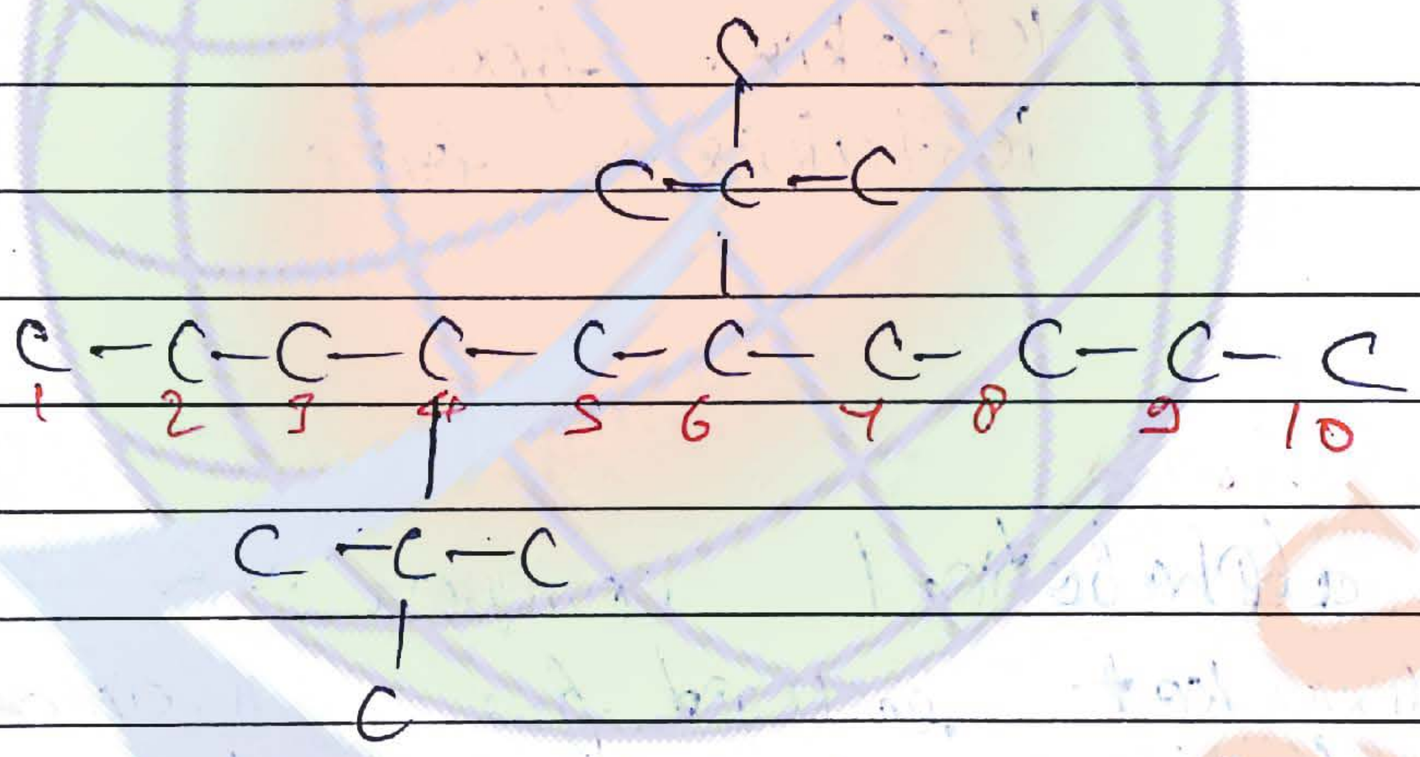
Rule 3rd ⇒
For alphabetical comparison 1st letter in the bracket is used for branched substituent whether it di, tri, tetra etc



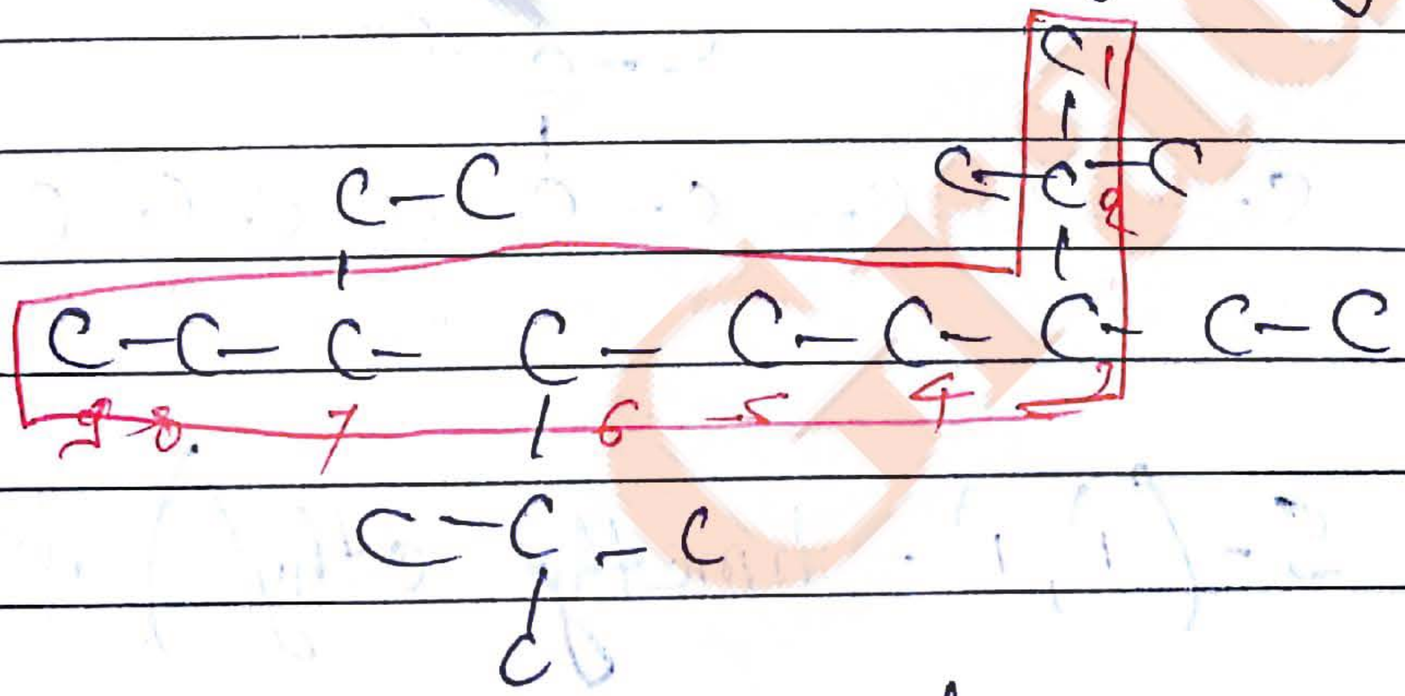
5-(1',1'-dimethyl ethyl) decane.



5-(1',1' dimethyl ethyl) 7-ethyl, 3-methyl decane



4,6 Bis(1',1' Dimethyl ethyl) Decane.



6(1',1' dimethyl ethyl) 3,7 ~~dimethyl~~ di-ethyl 2,2 dimethyl nonane.

IUPAC naming of unsaturated compound →

1) Selection of carbon chain →

longest possible C-chain is selected which contain maximum number of double bond (=) or triple (≡) bond it may not be longest.

2) Numbering of carbon chain →

Numbering is done from the end so that unsaturation get's lowest number.

Note →

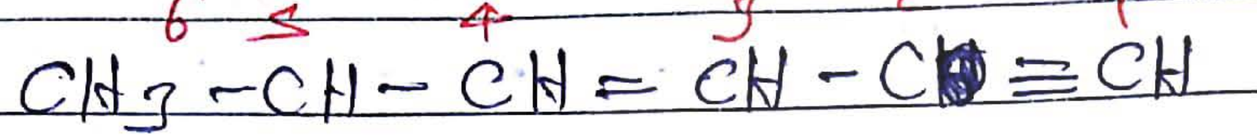
If double bond and triple bond are present at equal position then priority is given to double bond for numbering.

$C-C-C=C$

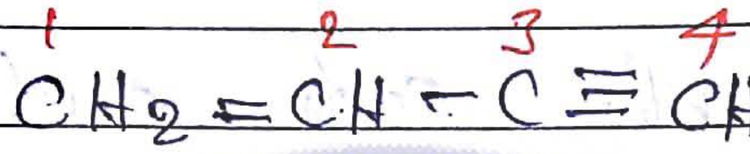
But-1-ene
or
1-butene

$CH_2=CH-CH=CH_2$

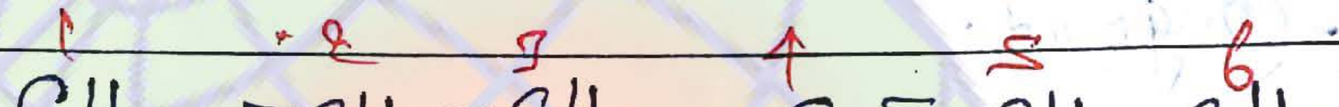
Buta-1,3 diene



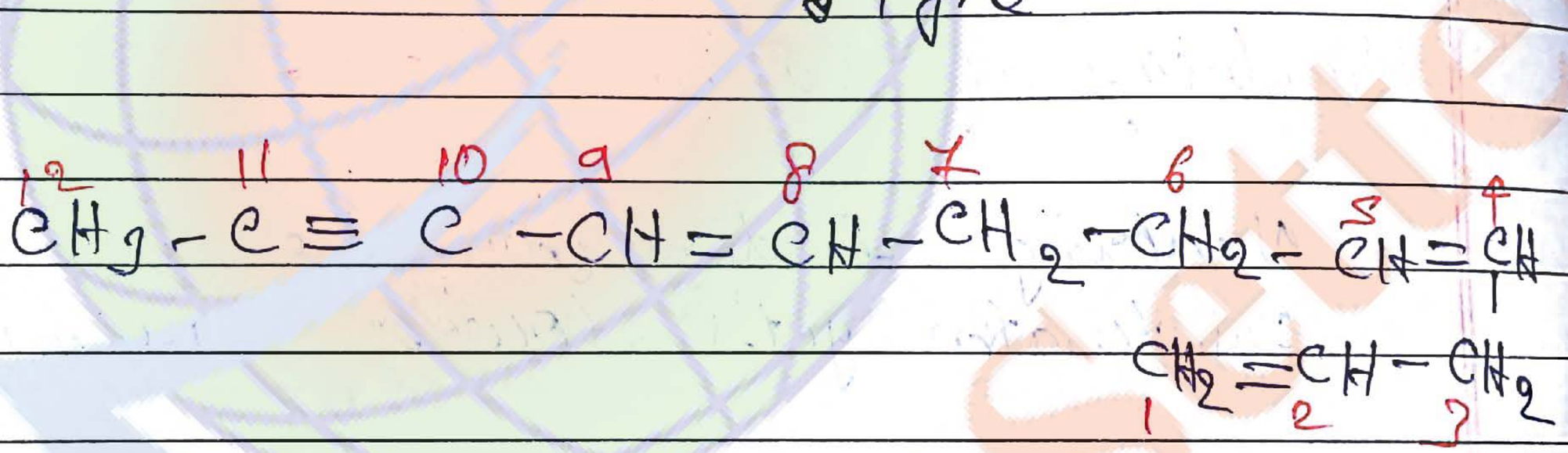
Hex - 3ene - 1yne



But - 1en - 3yne



Hex - 1en - 4yne



Dodec 1, 4, 8 trien - 10yne

2-ethyl, 3-methyl

Buta 1, 3 diene.

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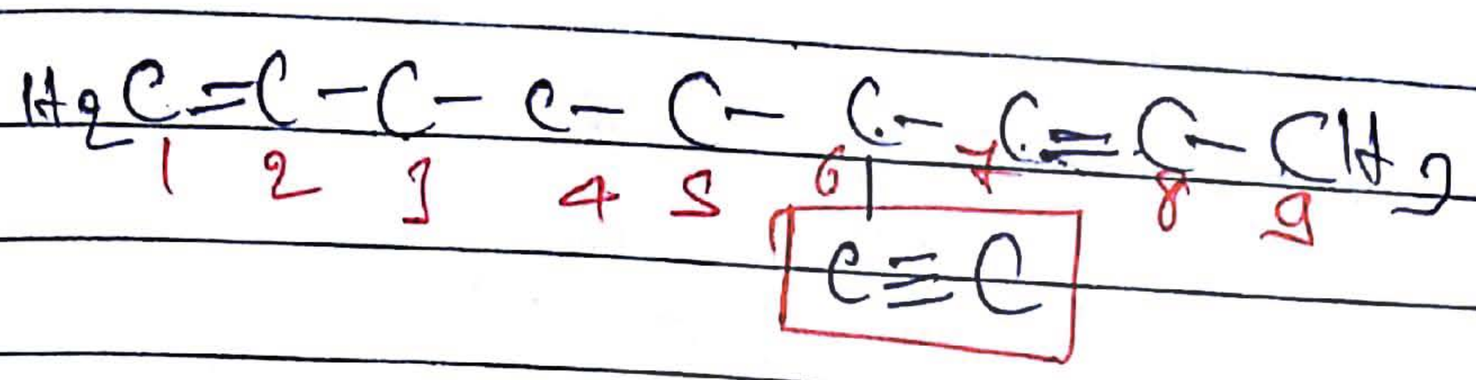
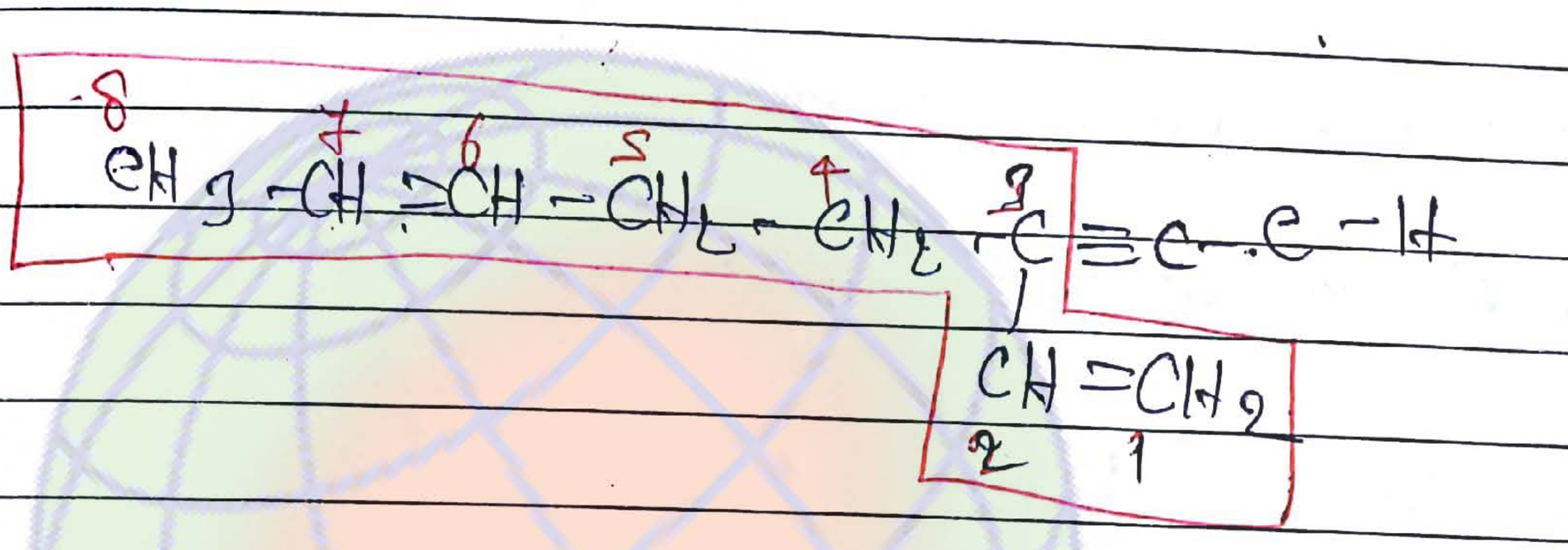
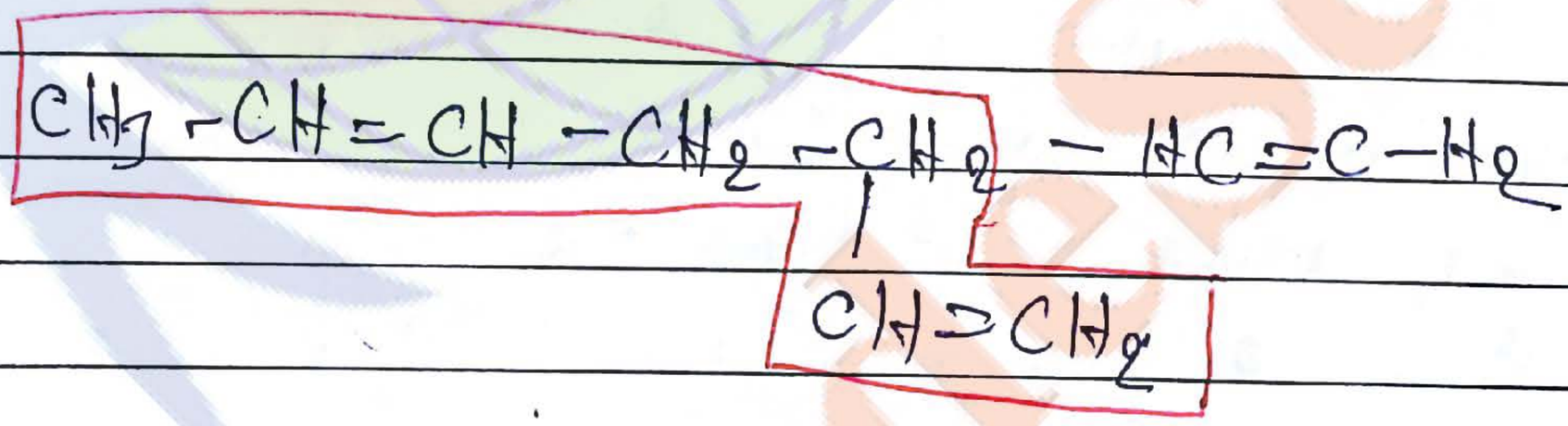


6-Ethynyl non 1,7 diene



3-ethynyl octa 1,6 diene



3 ethenyl Hepta-1,5 diene.

Note ⇒ common name is most Important.

$CH_2=CH-$ → ethenyl or vinyl

$\overset{3}{CH_2}=\overset{2}{CH}-\overset{1}{CH_2}-$ → 2Propenyl or Allyl

$CH\equiv C-CH_2-$ → 2Propynyl or Propargyl

H.W → D.P.P.S → No

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* IUPAC naming of Compound's Containing unifunctional group →

1) Selection of Principle chain →

Principle functional group > Unsaturation > No. of C > No. of Substituent.

↓

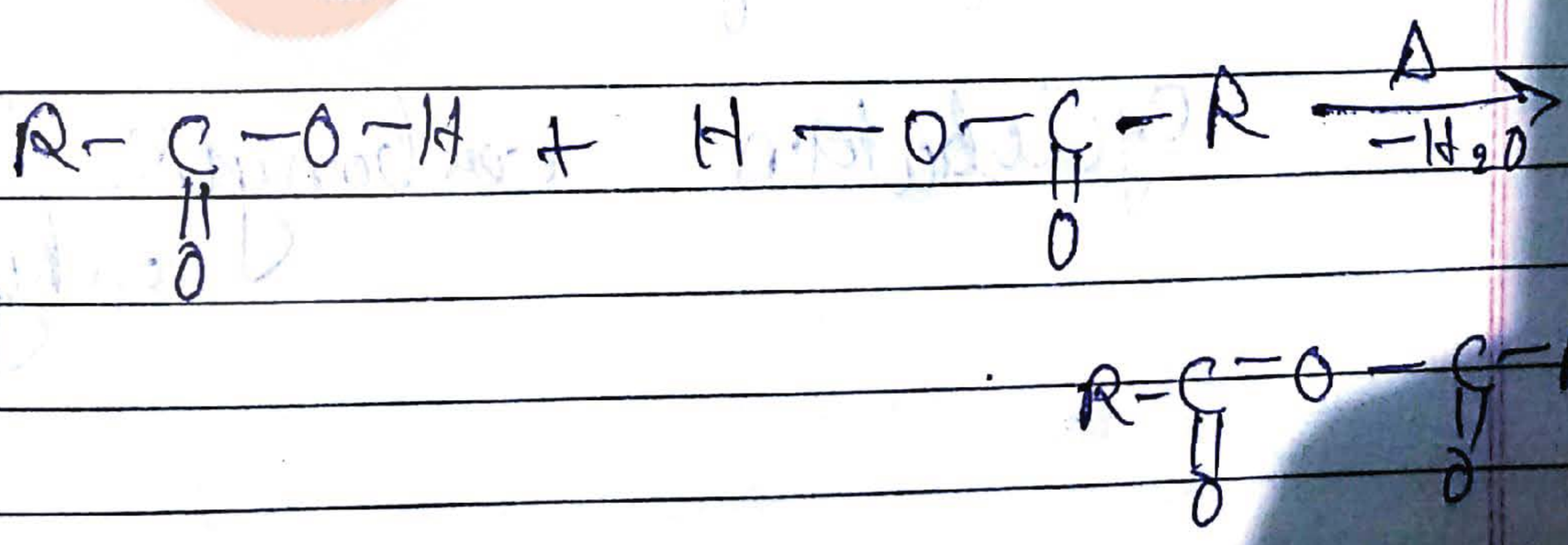
Priority order for selection of Principle chain.

2) No. of Principal chain :-

In case of terminating functional group number start from functional group carbon whereas in case on non-terminating funct group number start from the end which is closer (nearer) to functional group.

Note:

Naming of Anhydride :→



Suffix:- oic Anhydride

Symmetrical anhydride

$R = R'$

word root = $\frac{\text{Total no of C}}{2}$

(4)

$CH_3 - \underset{\underset{O}{\|}}{C} - O - \underset{\underset{O}{\|}}{C} - CH_3$

PAE → ethanoic anhydride
mon → acetic anhydride

Suffix:- oic Anhydride

Asymmetric anhydride

$R \neq R'$

word root

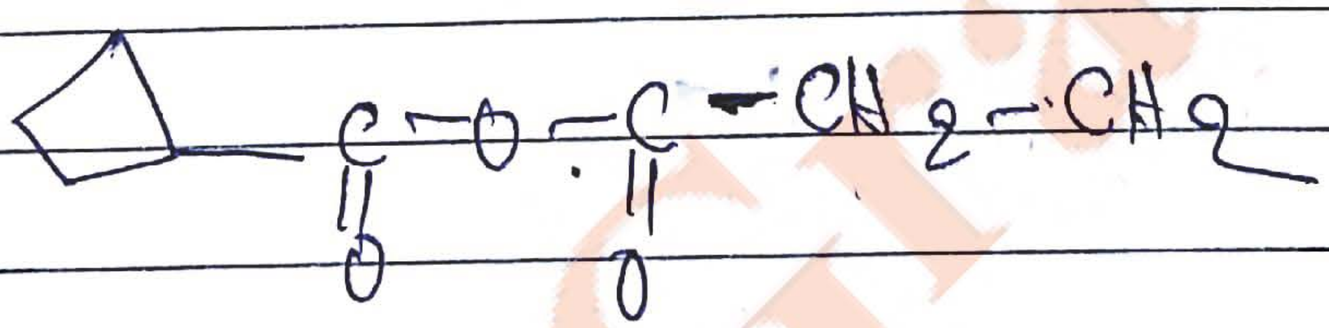
(2)

$CH_3 - \underset{\underset{O}{\|}}{C} - O - \underset{\underset{O}{\|}}{C} - CH_2 - CH_3$

ethanoic Propanoic anhydride
Acetic Propanoic anhydride

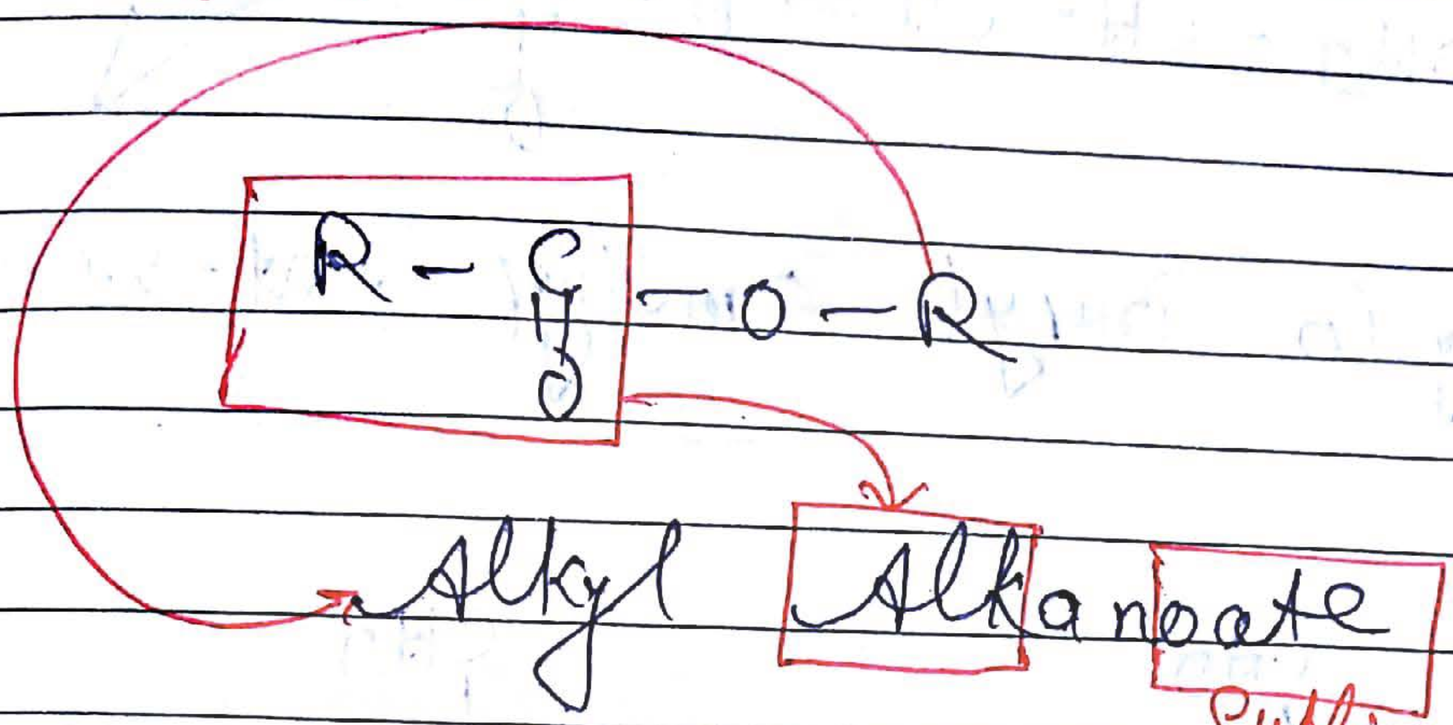
Prefix → 1
Acet → 2
Propion → 3
Butyr → 4
Valer → 5

eg 1:-



Cyclobutan carbonyle Propanoic anhydride

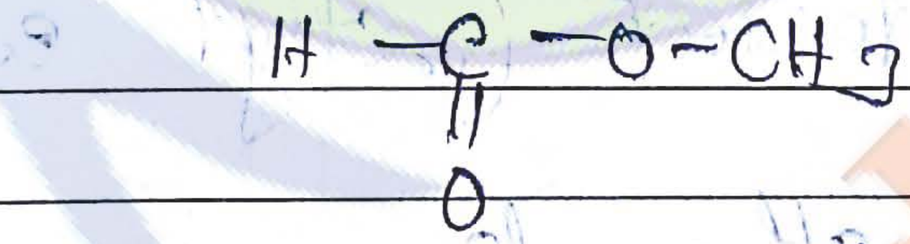
Naming of ester →



First of all name of alkyl group which is attached to oxygen is written and then word root is used for remaining carbon chain. followed by suffix oate.

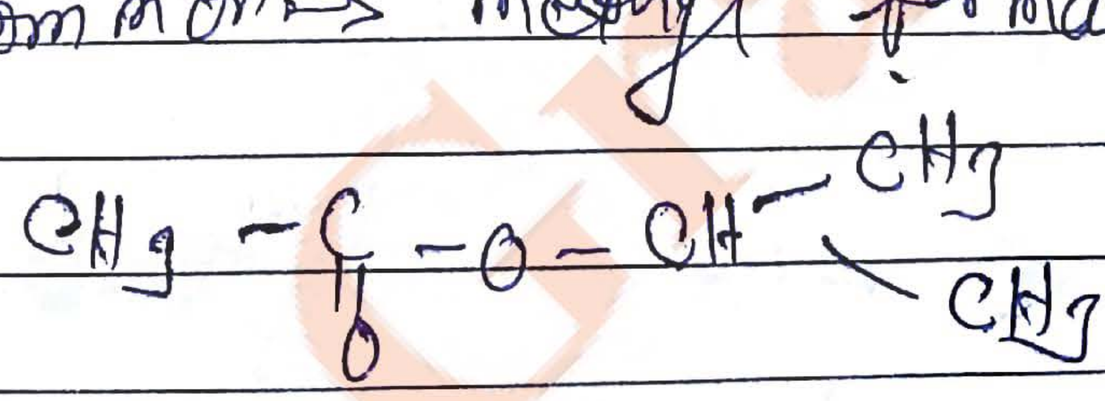
Notes –

In common naming "ate" suffix is used for ester.

eg:> 

IUPAC → methyl methanoate.

common → methyl formate.

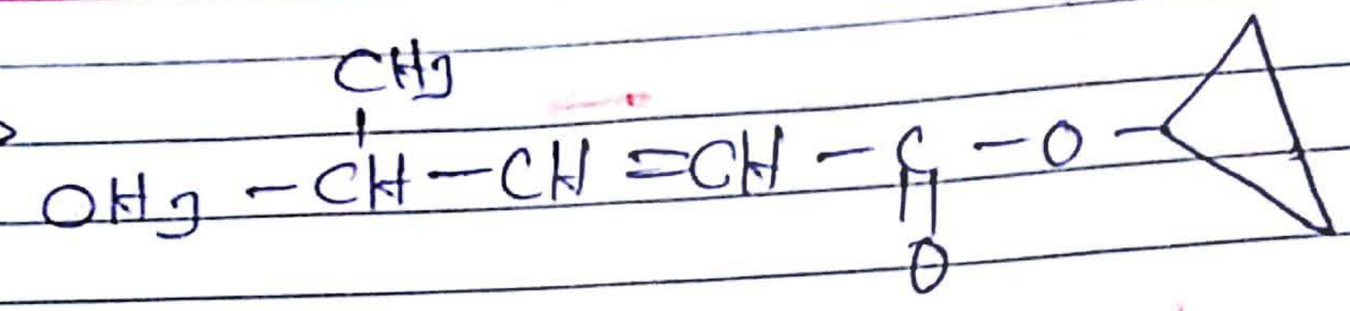
eg:> 

methyl ethyl ethanoate

or

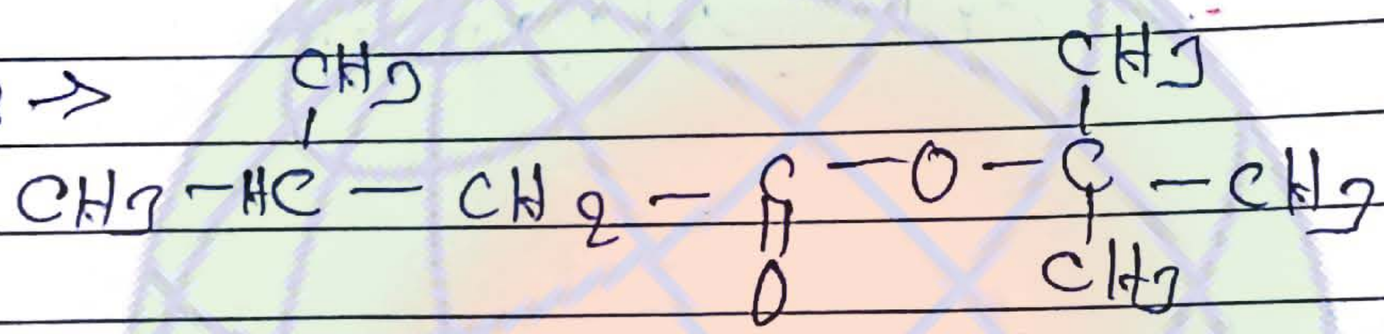
Iso-Propyl Acetate.

eg ⇒

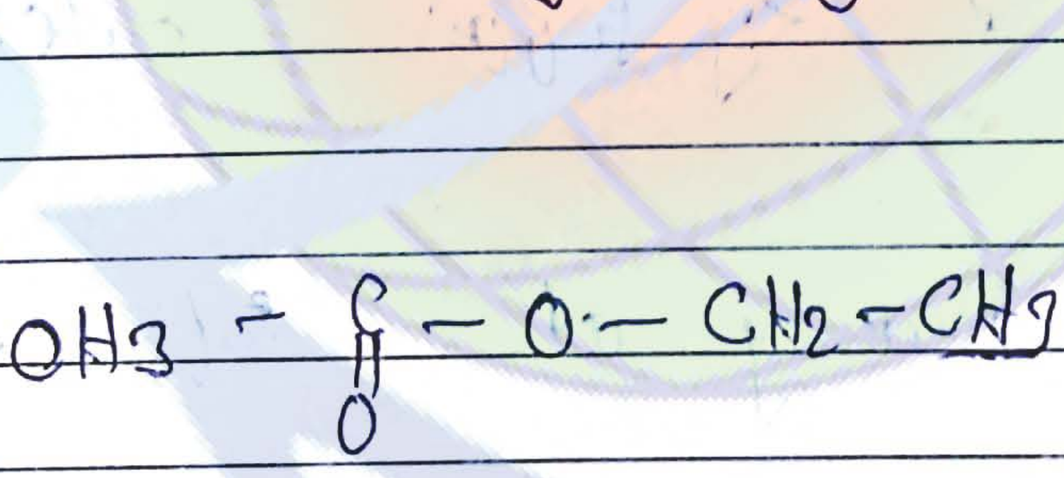


cyclo Propyl 4 methyl Pent-2-en oate.

eg ⇒



1;1 dimethyl ethyl 3-methyl Butanoate



ethyl Acetate (or ethyl ester)

IUPAC ⇒ ethyl ethanoate

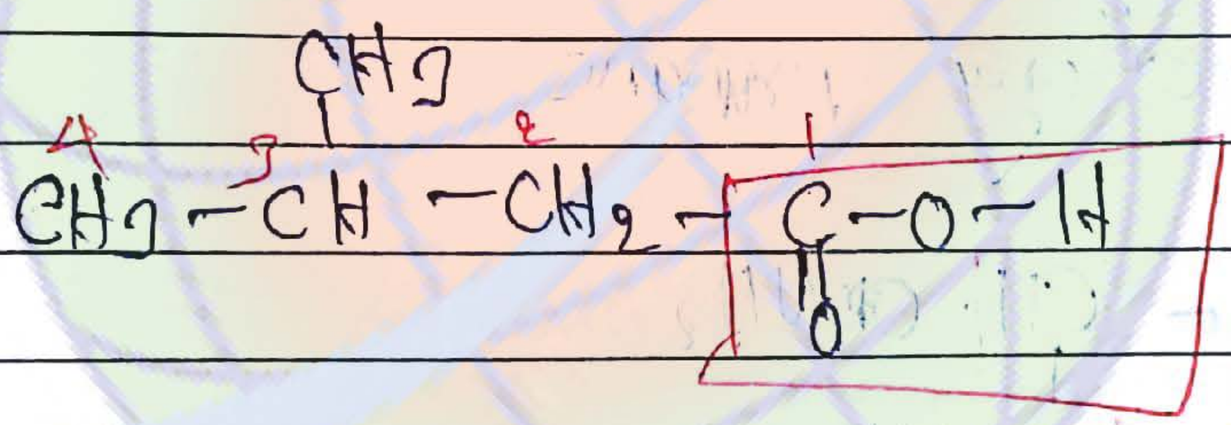
ether

cyclic → epoxy
open → Alkoxy

→ O

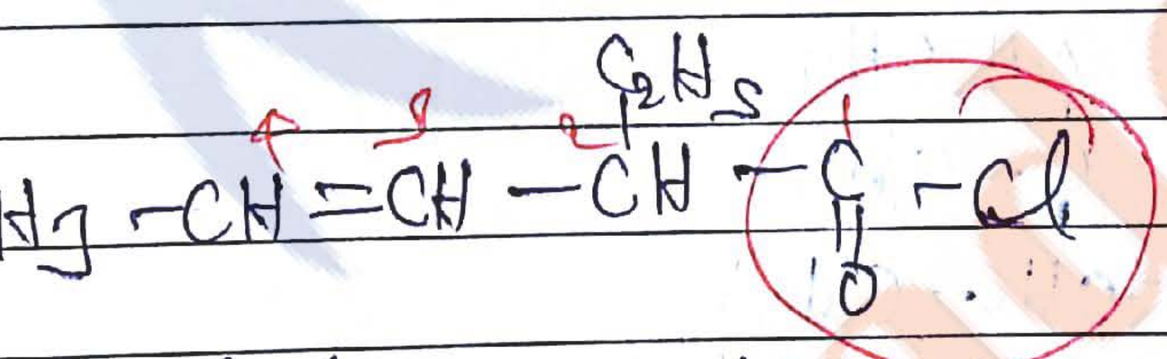
Example write IUPAC name for following compound.

i)



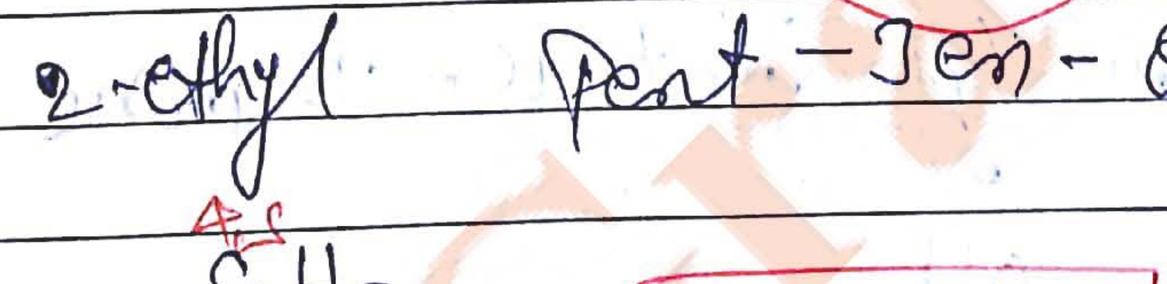
3-methyl Butanoic acid

ii)



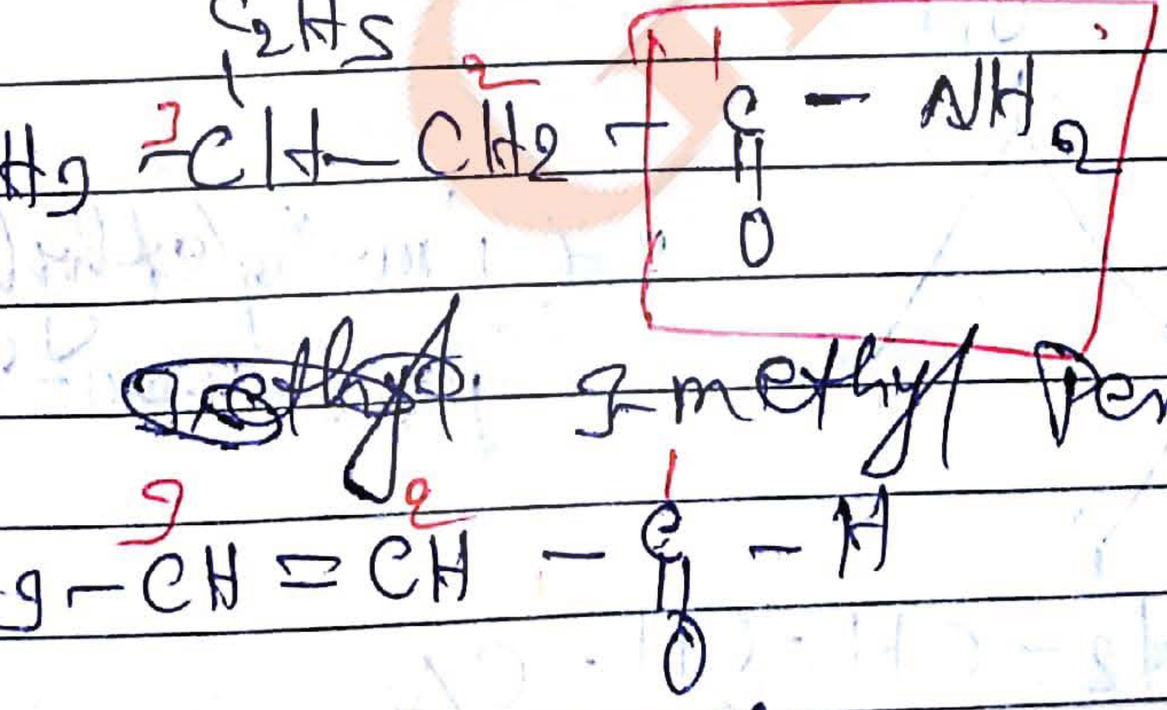
2-ethyl Pent-3en-oyl chloride

iii)



~~2-ethyl~~ 3-methyl Pentanamide

iv)



But-2-en-al

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* IUPAC naming of compound Containg Polying functional group →

I) Selection of Parent functional group:-

It is selected according to priority table.

II) Selection of carbon chain:-

It is selected in the manner that they contain max no of principal functing group.

old Recommendation

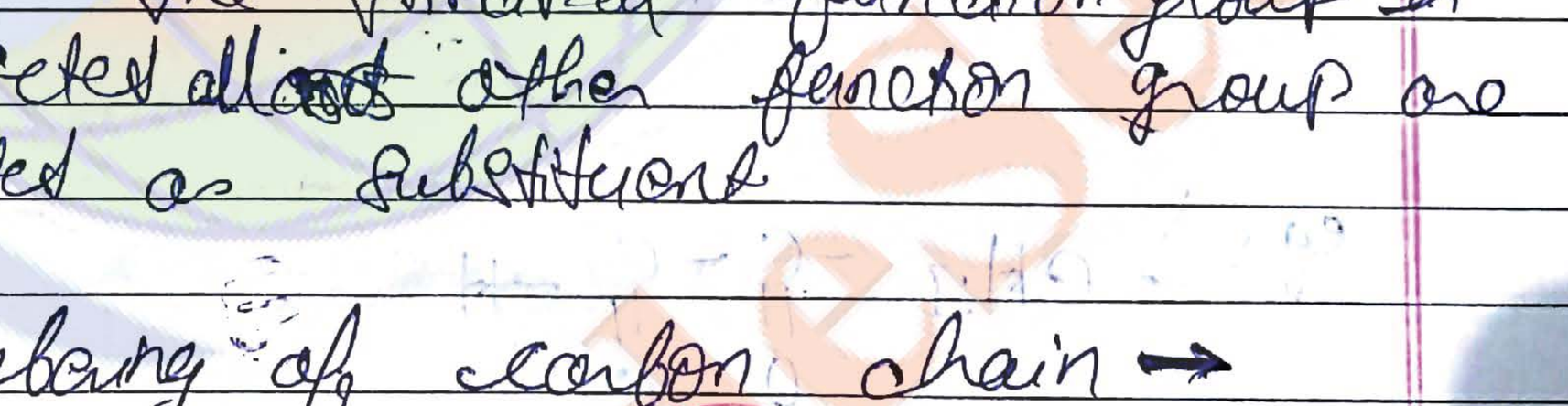
Once the Principal function group is selected all other function group are treated as substituent

III) Numbering of carbon chain →

Principal functional group > UNsaturation > Substituent

Priority order

eg:1 →



octan 2, 4, 4, 6 tetra ol

Start

Solid state

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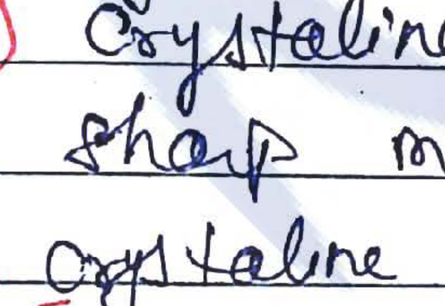
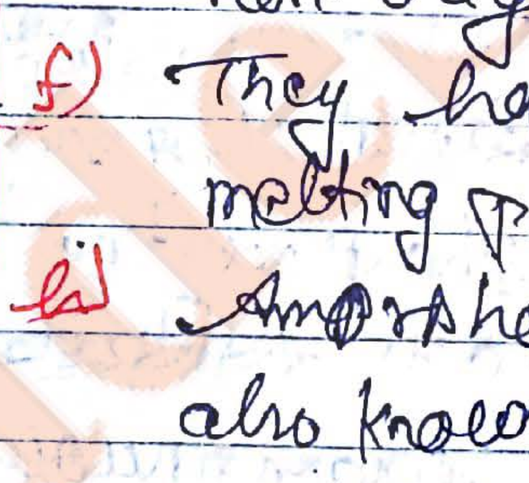
★ On the basis of arrangement of constituent particles solid can be classified into two categories.

1) Crystaline solid or True solid	2) Amorphous solid or Pseudo solid or Super cooled liquid
a) In such type of solid their is regular arrangement of constituent particles.	a) Their is Irregular arrangement of constituent particles.
b) They have long range order.	b) They have short range order.
c) They are formed by slow cooling of liquid	c) They are form by rapid cooling of the liquid
d) Examples:- Diamond, Graphite, NaCl, Zn etc.	d) Example:- Glass, Plastic rubber etc.
e) Crystaline solid's are rigid in nature.	e) Amorphous solid are non-rigid in nature.
f) Crystaline solid's have sharp melting point	f) They have range of melting point.
g) Crystaline solid's are also known as "True solids"	g) Amorphous solid's are also known as Pseudo solid's or Super cooled liquid or short range solid.
h) Crystaline solid shows anisotropic behavior.	h) Amorphous solid shows Isotropic behavior.

i) 

Example of Anisotropic :- The electric and thermal conductivities are different in different direction.

They have physical properties in different direction.



Isotropic means they exhibit same physical properties in all the directions.

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★ Types of crystaline solid ⇒

Depending upon the "nature of force of attraction" acting b/w the constituent particles. Crystaline solid can be divided into four categories :-

Type	constituent particles	Interaction force	Example
a) Ionic	Ions	Ionic Bond electrostatic	NaCl, ZnS
b) covalent / Network	atom	covalent bond	SiC, graphite, diamond, SiO_2, SiC
c) metallic	atom (+ve ion and free electron)	metallic bond	Cu, Ag, Au
d) molecular	molecule	vander waal / H-Bond ✓	$I_2(s)$, HCl, P_4H_{10}, $H_2O(s)$ ✓ H-bond

for more must Read N.C.E.R.T Page-

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* Crystal → A crystal is a homogenous portion of a solid substance made by regular patter of structural unit's bonded by plane surface making definite angles with each other.

* Crystallographys → A branch of Physics Science that deal's with study of crystals, viz their sources, classifications, properties, structure etc. is called crystallography.

* Interfacial angles → The angle b/w the perpendicular two intersecting faces called Interfacial angle.

* Law of constancy of Interfacial angle → The Interfacial angles of for all the crystal's of a given crystalline substance are always the same irrespective to the shape and size of crystal.

This is knows as law of constancy of Interfacial angles.

* Amorphous silicon is one of the best "photovaltaic material" or "Photovaltaic cell" available for conservesion of sunlight into electricity.

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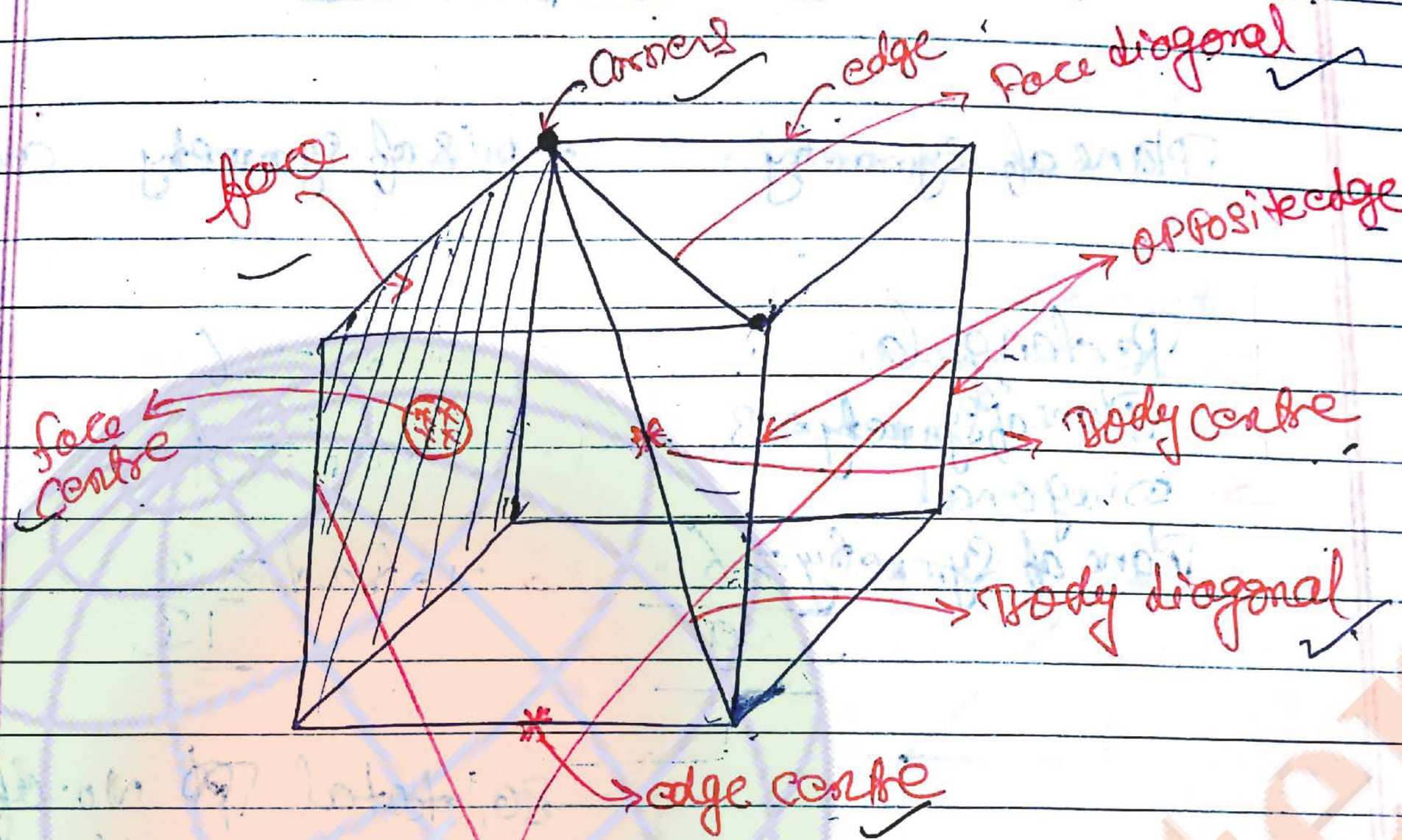
★ Cubic crystal :→



Corners → 8
edge - 12
face = 6
face diagonals 12
body diagonal = 4

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Law of Symmetry

- Plane of Symmetry
  - Rectangular
    Plane of Symmetry ⇒ 3
  - Diagonal
    Plane of Symmetry ⇒ 6
    9
- Axis of Symmetry
  - Diad ⇒ 6
  - Triad ⇒ 4
  - Tetrad ⇒ 3
    13
- Centre of Symmetry
    1

So, total No. of Symmetry in Cubic Crystal is (9+13+1) = 23

प्रश्न एवं :→ 3 6 6 4 3 1

otes:→ what is Bragg's equation is →

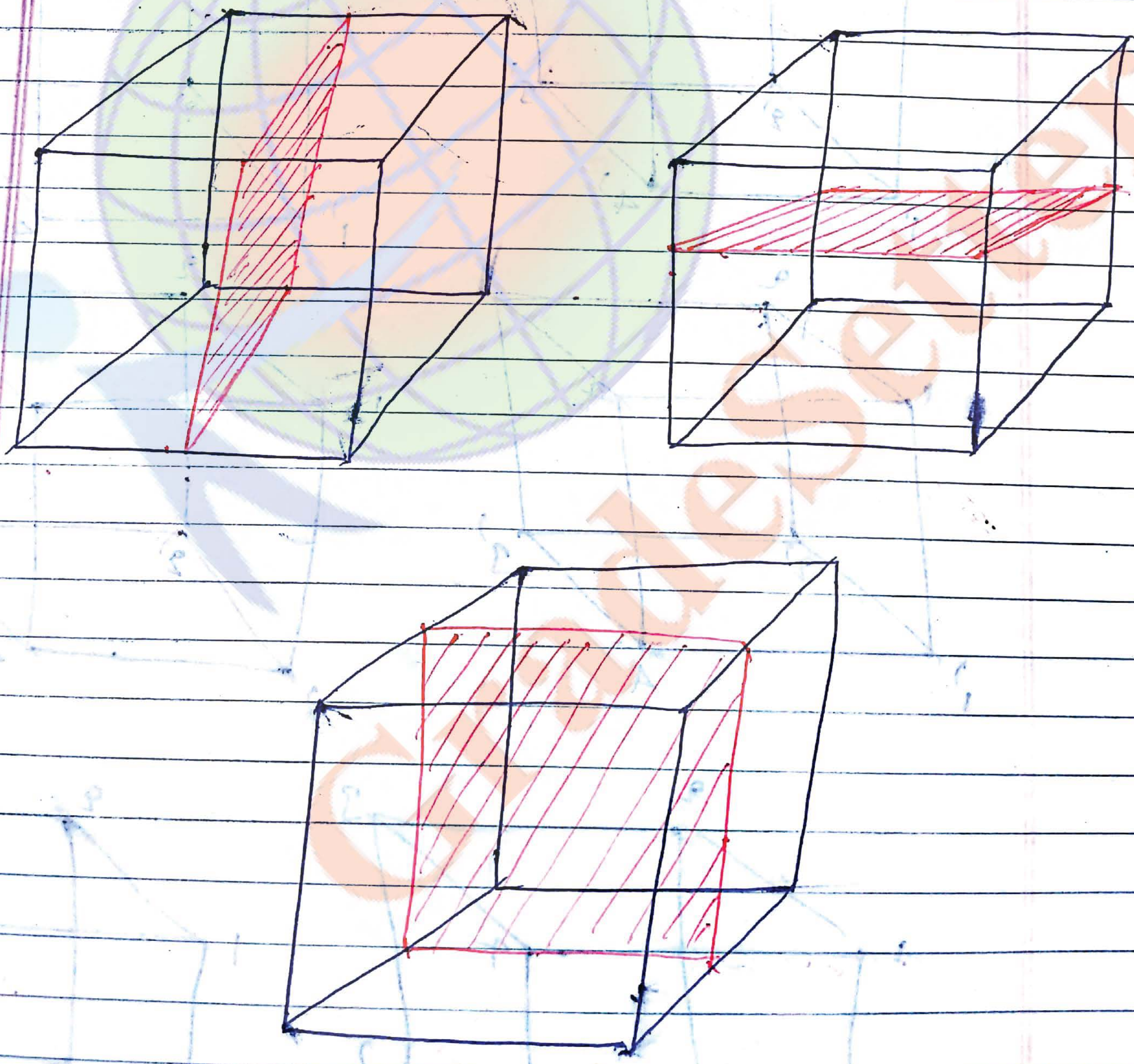
n:— Bragg's equation is $n\lambda = 2d\sin\theta$

★ Law's of Symmetry ⇒

1) Plane of Symmetry → There are two type of Plane of Symmetry

a) Rectangular Plane of Symmetry → By joining mid-point of opposite edges.

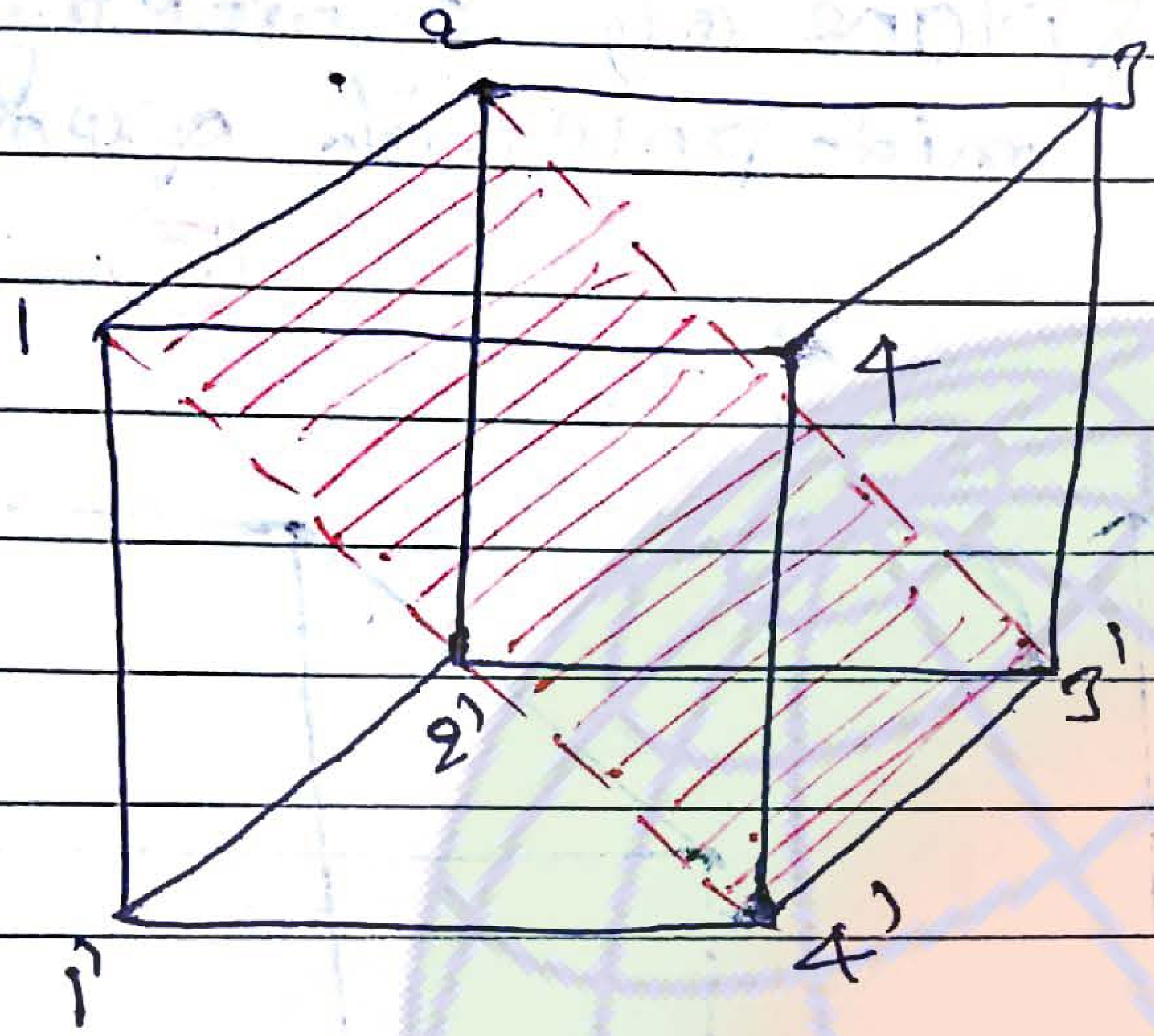
(3)

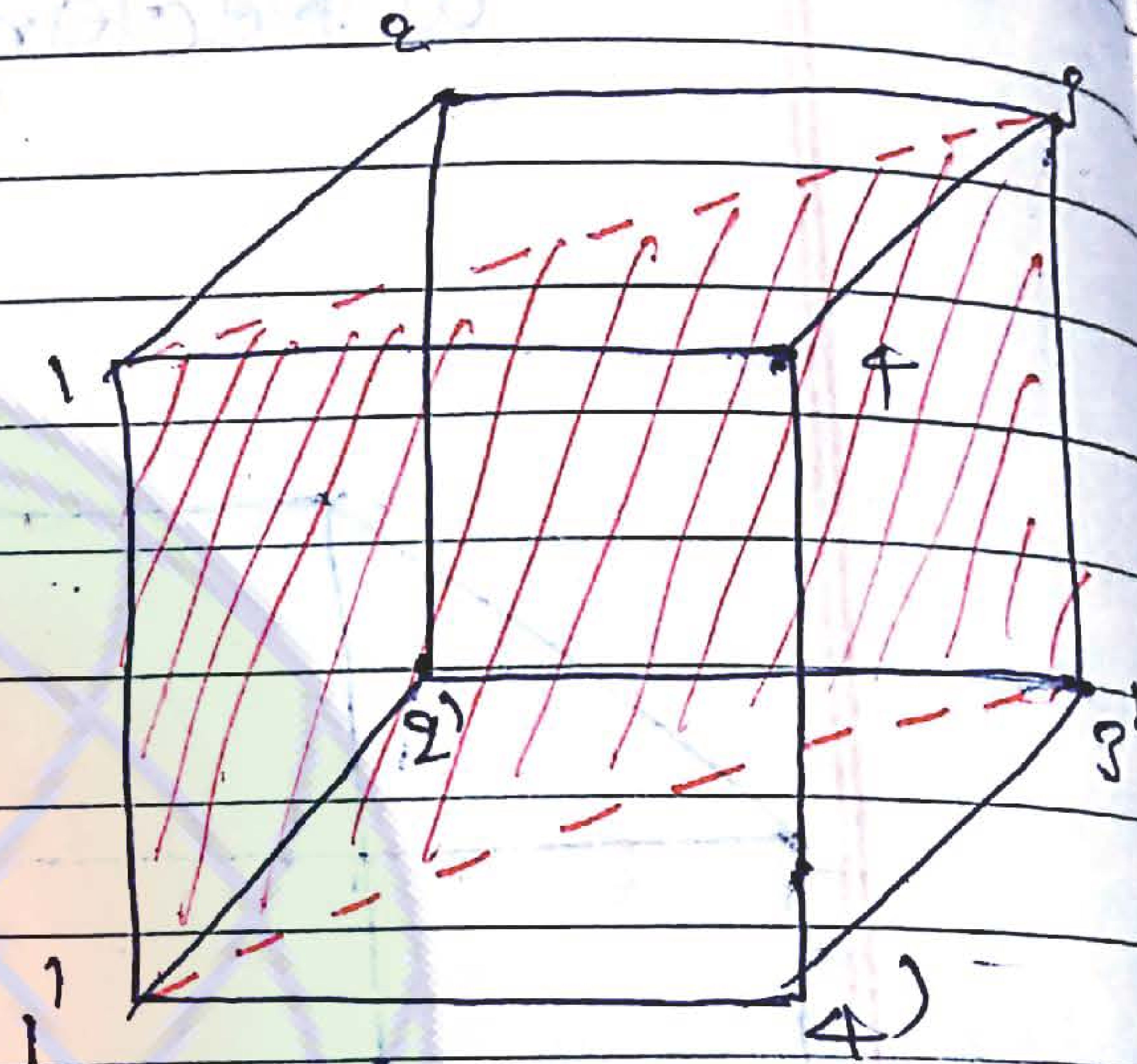


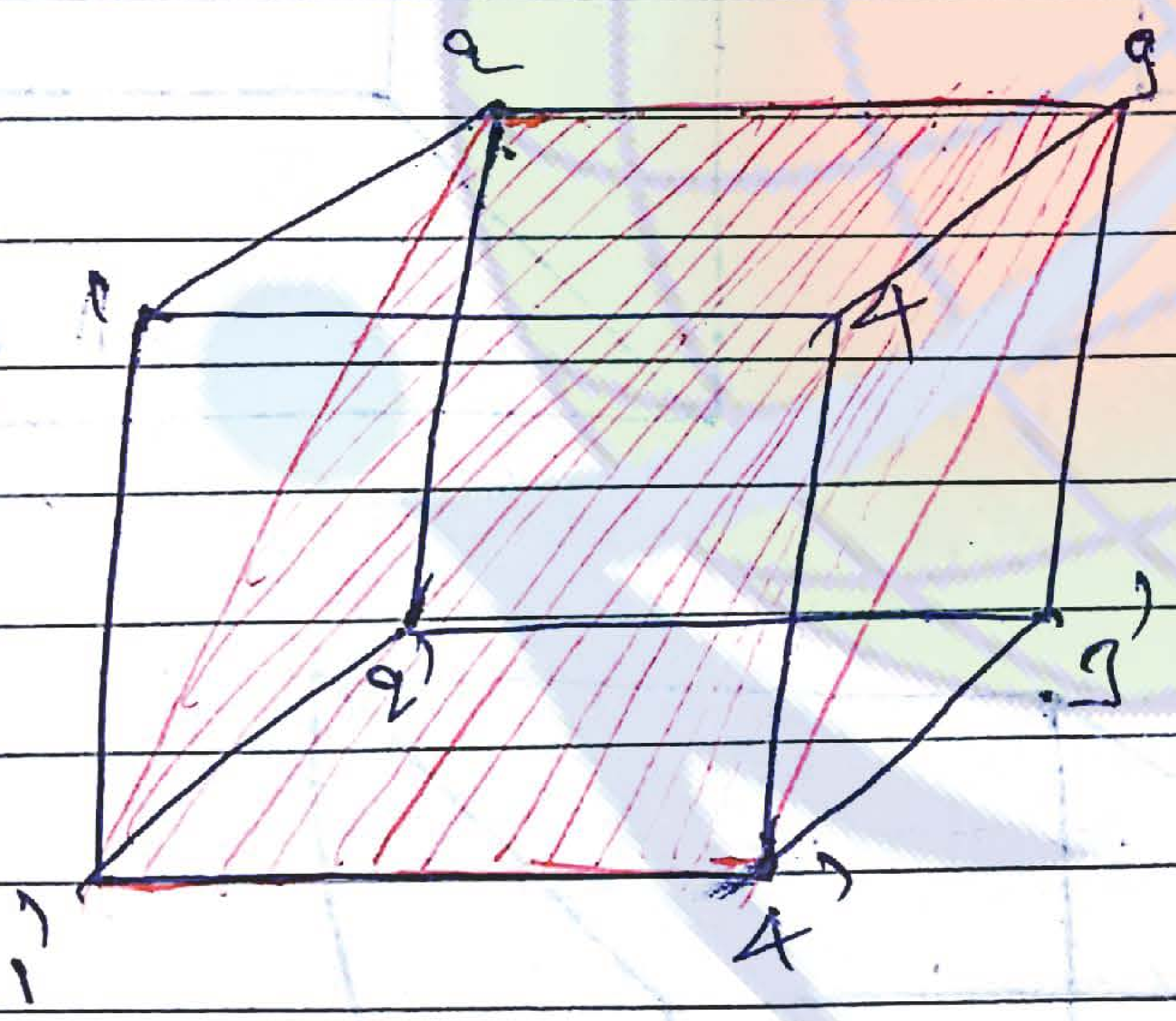
b) Diagonal Plane of Symmetry

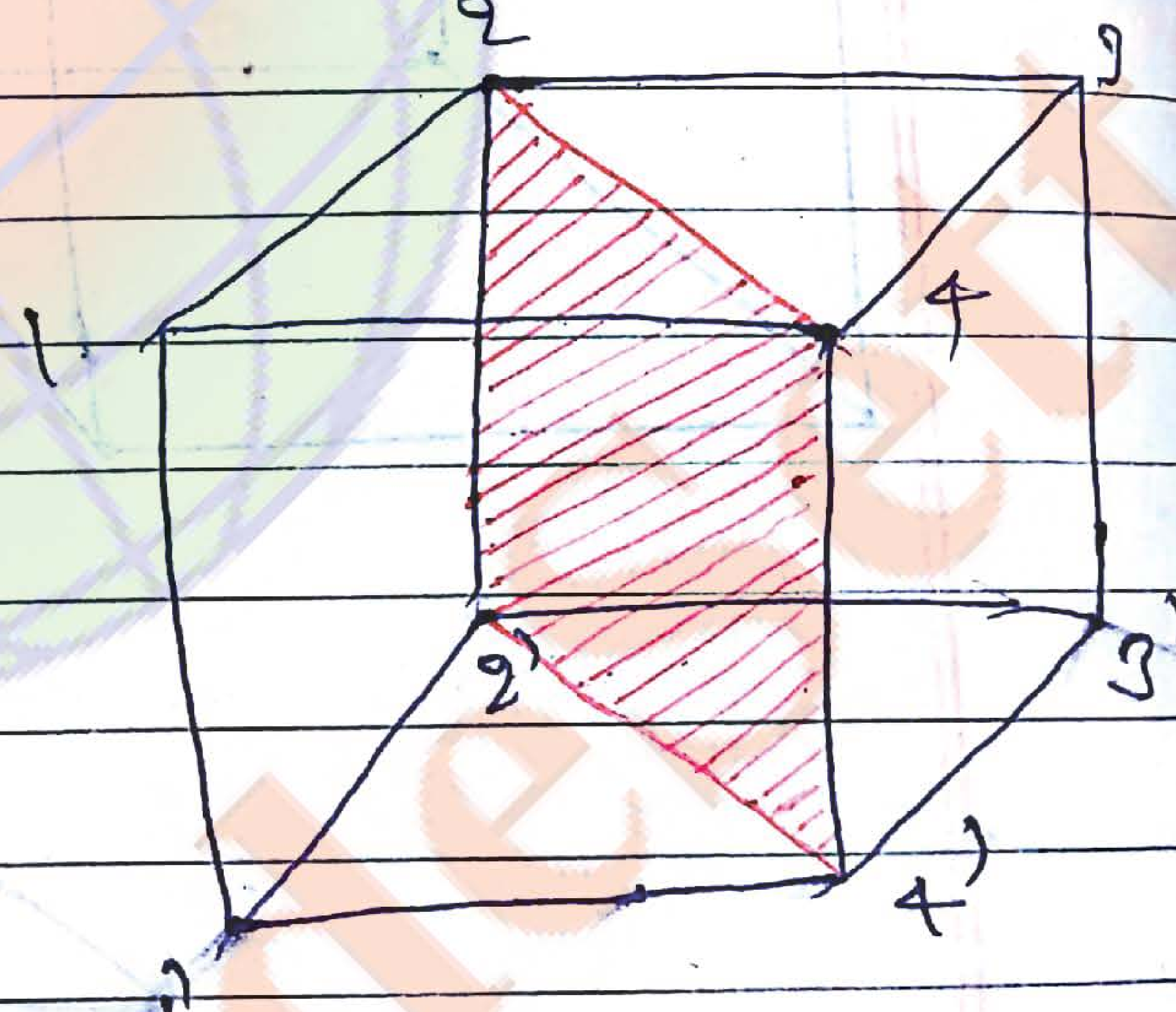
By joining diagonally opposite edges.

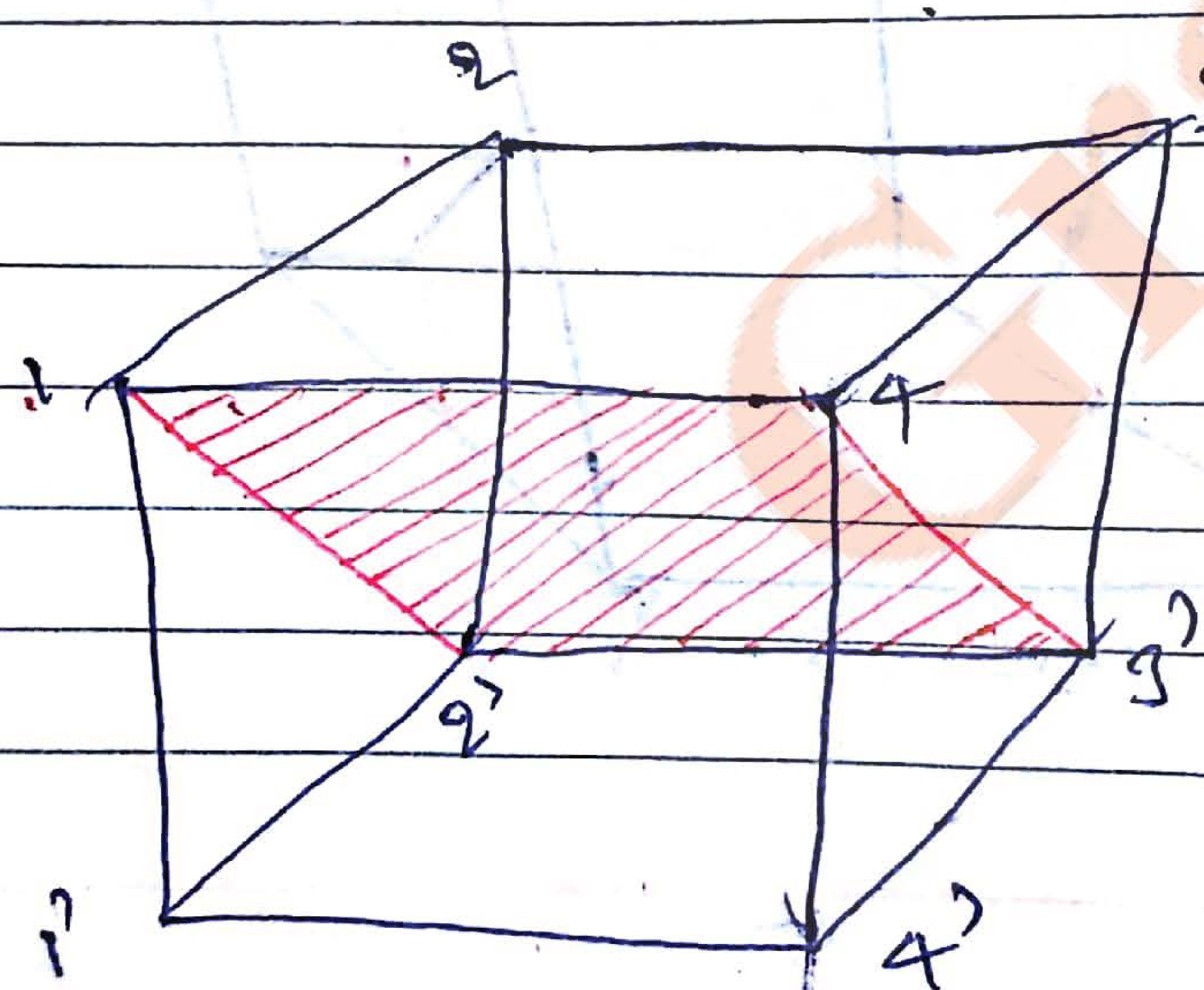
"6"

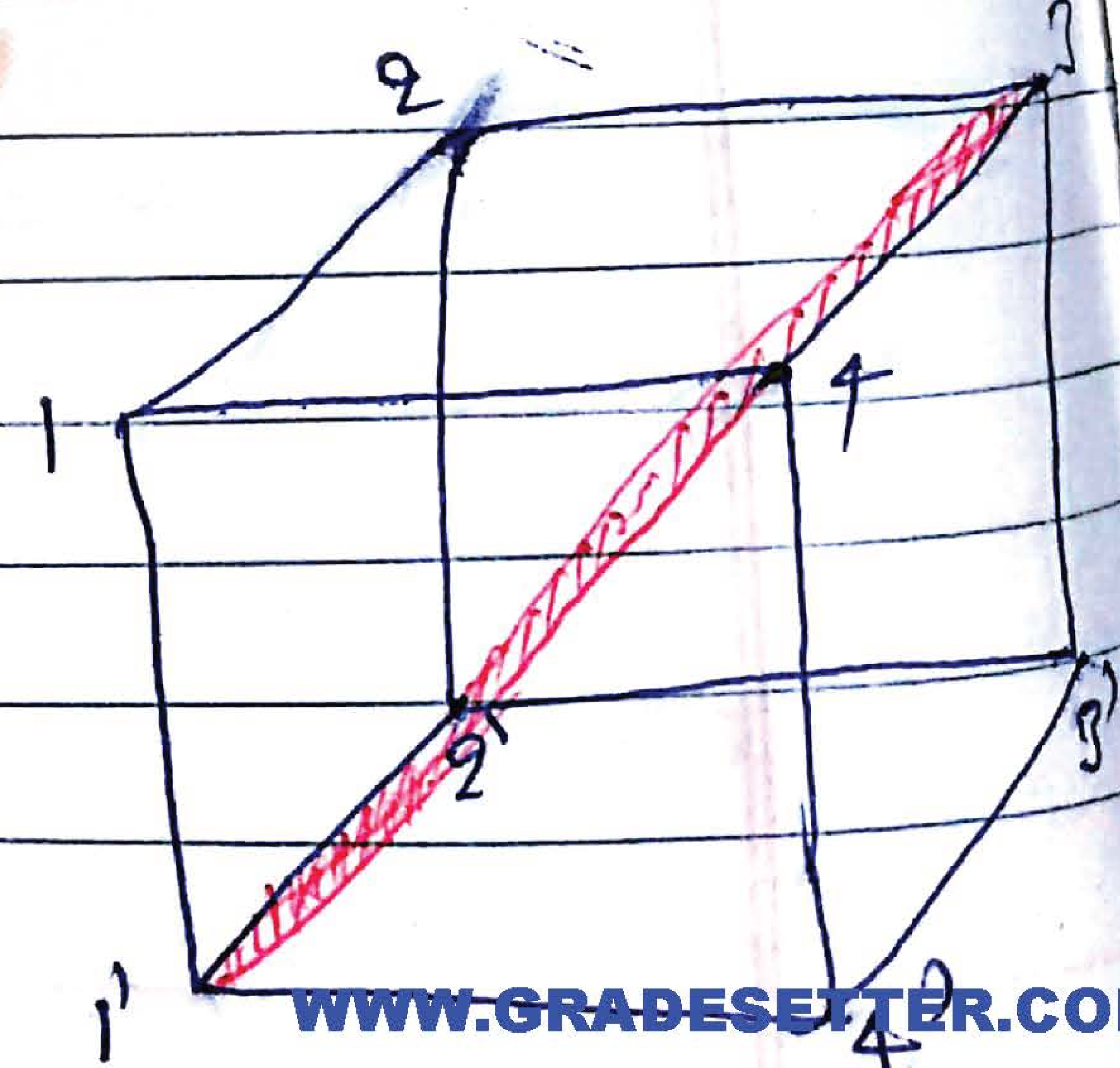












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2.) Axis of Symmetry → (on the basis of rotation)

Their are three axis of symmetry :-

a) Diad (two fold axis of symmetry) → (θ = 180)
   - By joining mid point of diagonally opp. edges → 6
   - original appearance is repeated twice in one rotation

c (triad)
diad
f
t (tetrad)

b) Triad (Three fold axis of symmetry) → (θ = 120)
   - By joining diagonally opp. corner → 4
   - original appearance is repeated thrice in one rotation

c) Tetrad four fold axis of symmetry → (θ = 90°)
   - By joining mid-point of opp. faces → 3
   - original appearance is repeated four times in one rotation

Note! → Centre of Symmetry = 1
only simple cubic system have one centre of symmetry other system have no

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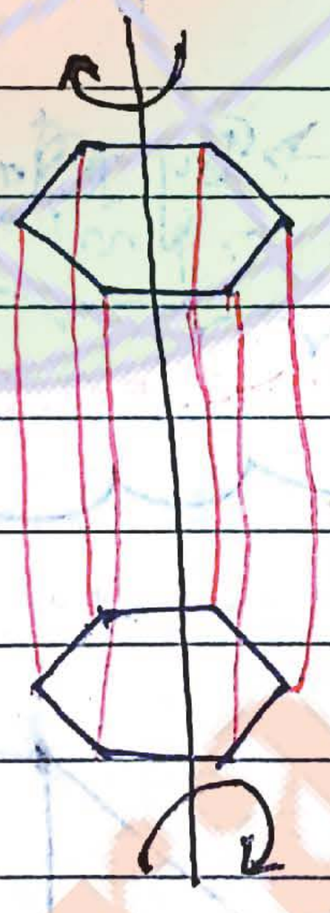
Eg,

Total elementary Symmetry :-

= 9 Plane of Symmetry
= 13 Axis of Symmetry
= 1 Centre of Symmetry
= 23 elements of Symmetry

Note →

* In Hexagonal Structure :- Four fold Symmetry (Hexad) are also present.



Number ⇒ "1"

$\theta = 60$

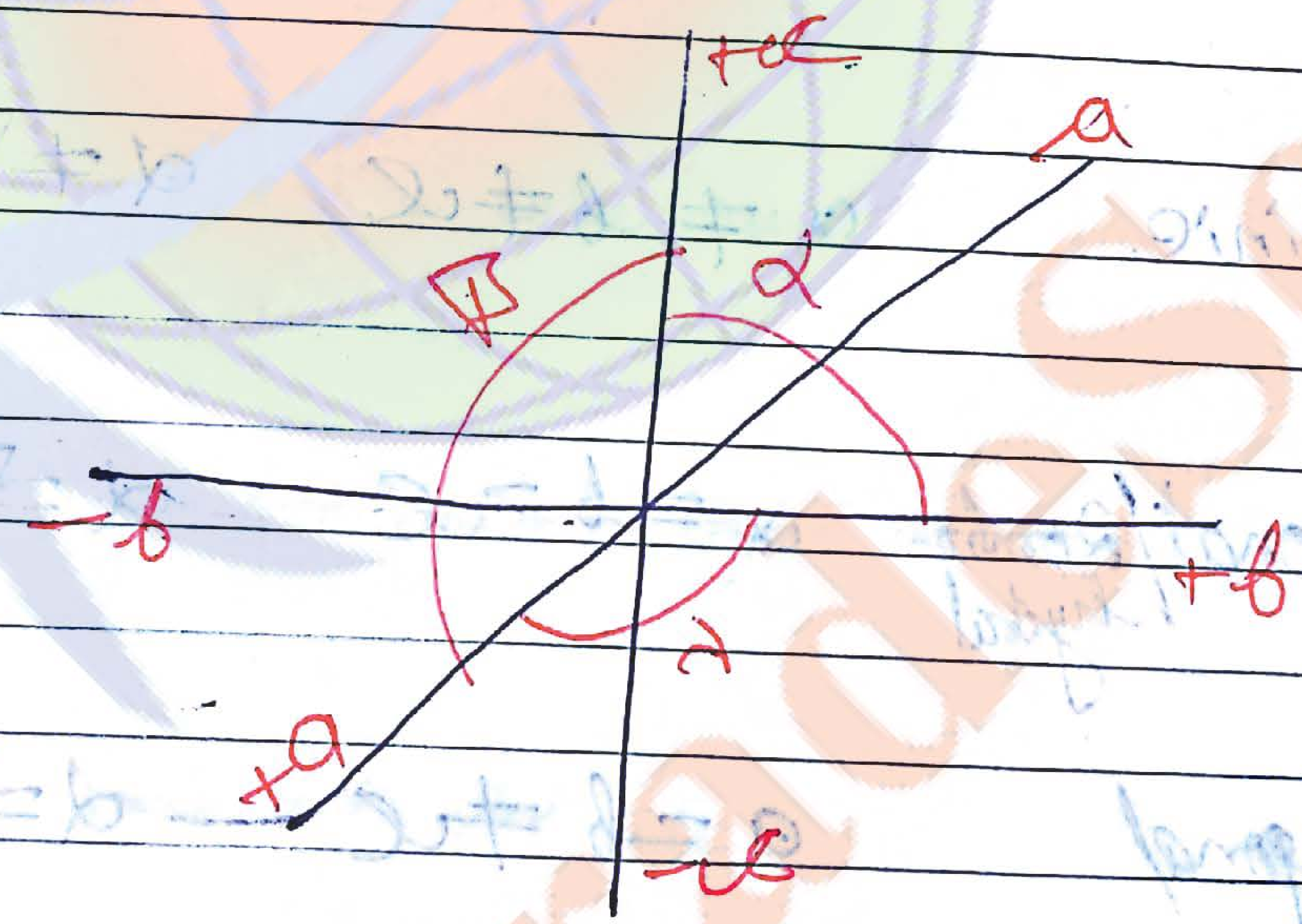
It means original appearance is repeated six times (60°) in one rotation of 360°.

Attention → One fold Symmetry is not found in crystal.

* **Space lattice** ⇒ The regular arrangement of constituent particle in three dimensional space is known as space lattice
eg:- चित्र

* **Unit cell** ⇒ The smallest unit of space lattice which on repeation gives space lattice and tell's us about all the properties of space lattice is known as unit cell
eg → ईंट

★ **Types of crystal on the basis of Intercept on crystallographic axis and Angle b/w them** ⇒



Z और y-axis के बिच α-angle बनाता है
याद रखें → x और y-axis के बिच β-angle बनाता है
और z और x '' '' γ - '' बनाता है

Zyα, → xyβ, → Zxγ

Different arrangement of Particles.

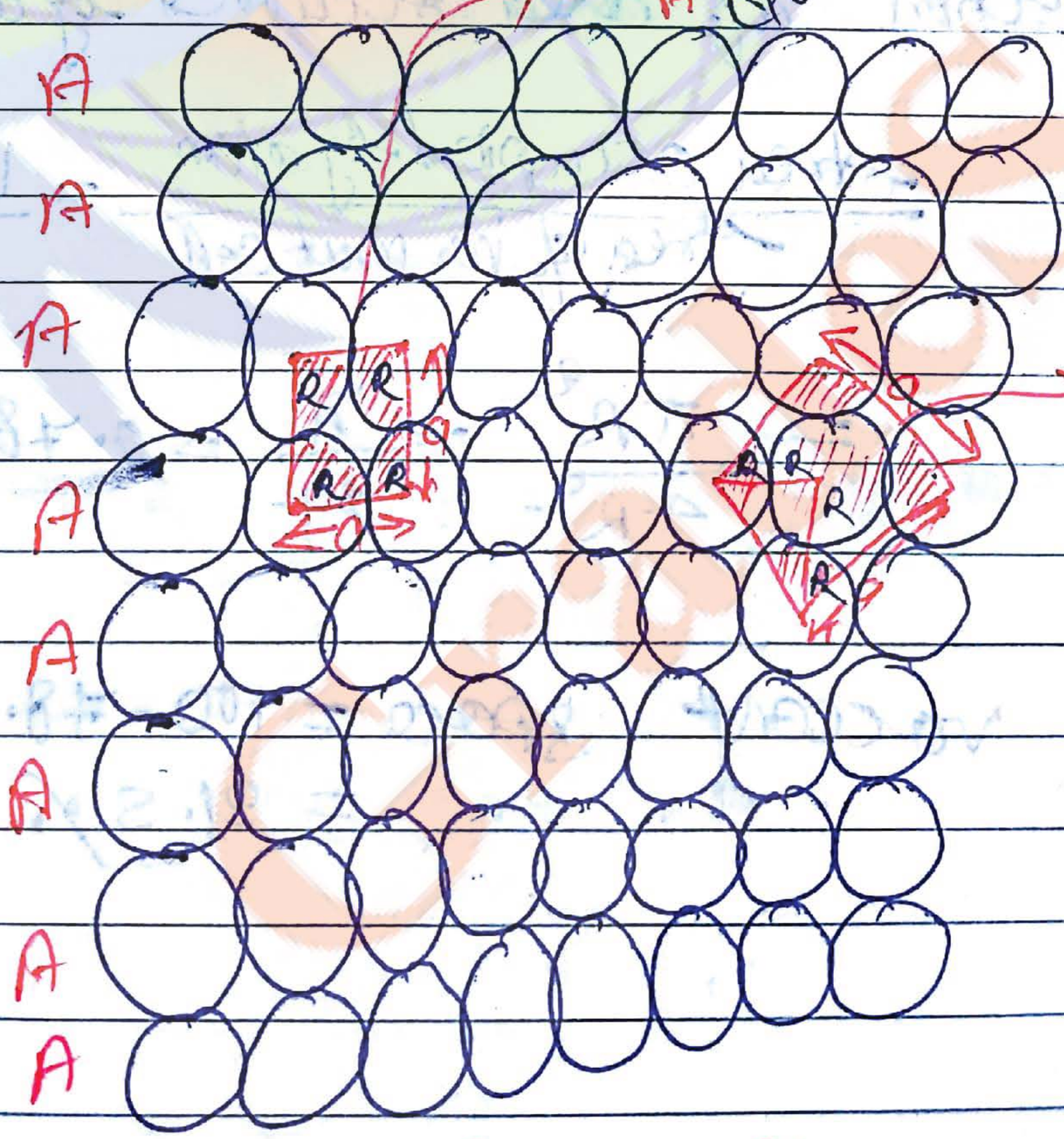
⇒ Two dimensional arrangement.

The definite arrangement of constituent Particles in a plane is known as two dimensional arrangement.

There are two types of two dimensional arrangement. ✓

1) Square arrangement → Primitive or simple unit cell
                      ↳ centered unit cell
2) Hexagonal arrangement.

Square arrangement →



2D-Square arrangement.

Primitive or Simple Unit cell

1) No. of atoms per unit cell (N)

$$N = 4 \times \frac{1}{4} = 1$$

2) Relation b/w edge length (a) and R

$$a = 2R$$

3) Co-ordination Number (N) = 4

4) Area occupied by the atom per unit cell $= 1 \times \pi R^2$

5) Fraction of area occupied by atom =

$$\frac{\text{Area occupied by atom}}{\text{Area of Per unit cell}} = \frac{1 \times \pi R^2}{a^2}$$

$$= \frac{\pi R^2}{4R^2} = \frac{\pi}{4} = 0.785 \text{ or } 78.5\%$$

6) % vacant space $= 100 - 78.5$

$= 21.5\%$

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Centered unit cell →

1) No of atom's Per unit cell (N)

$$N = 4 \times \frac{1}{4} + 1 = 2$$

2.) Relation b/w edge length(a) and R

$$a^2 = (2R)^2 + (2R)^2 \quad , \quad \boxed{a = 2\sqrt{2}R}$$

3.) Co-ordination no. (Z) = 4

4.) Area occupied by the atom = $2 \times \pi R^2$
Per unit cell

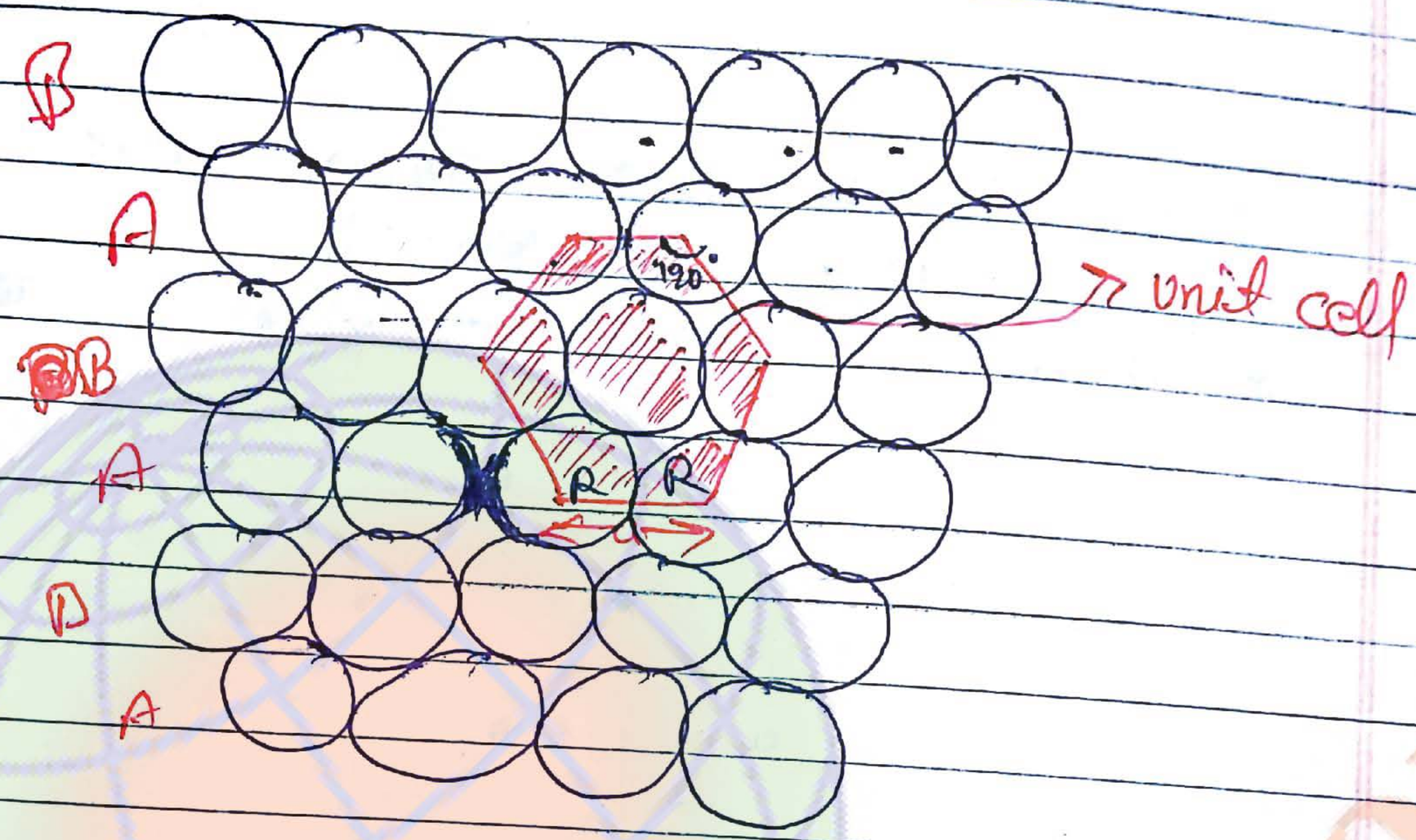
5.) fraction of area occupied by atom's =

$$= \frac{\text{Area occupied by atom}}{\text{Area of unit cell}} = \frac{2 \times \pi R^2}{a^2}$$

$$= \frac{2\pi R^2}{8R^2} = \frac{\pi}{4} \text{ or } 0.78.5\%$$

6) % vacant Space = 100 − 78.5
= 21.5%

★ Hexagonal arrangement →



2D-Hexagonal arrangement.

1) No. of atom per unit cell(n) $= 6 \times \frac{1}{3} + 1 \times 1 = 3$

2) Relation b/w a and R

$$\boxed{a = 2R}$$

3) Co-ordination (Z) = 6

4) Area occupied by atom's $= 3\pi R^2$

5) Area efficiency $= \frac{3 \times \pi R^2}{\text{area of hexagon}} = \frac{3\pi R^2}{6 \times \text{Area of } \Delta}$

$$\frac{3\pi R^2}{6 \times \frac{\sqrt{3}}{4} a^2} = \frac{\pi}{2\sqrt{3}} = 0.906 = 90.6\%$$

6) % vacent area = 9.4%

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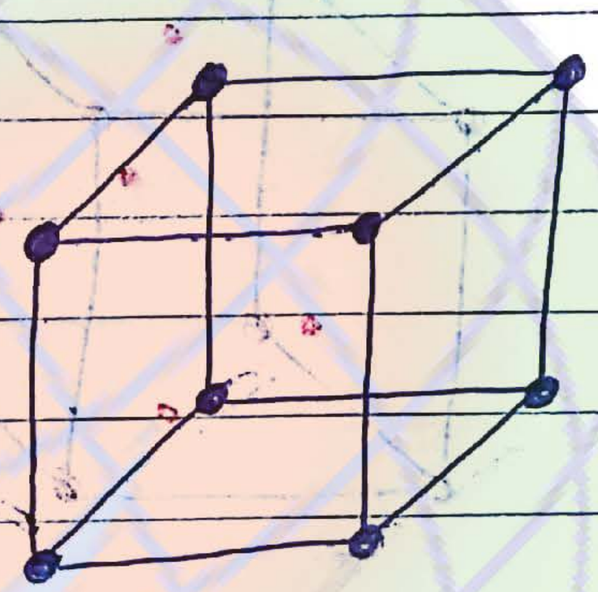
★ 3D-arrangement ⟹ (Cubic crystal) →

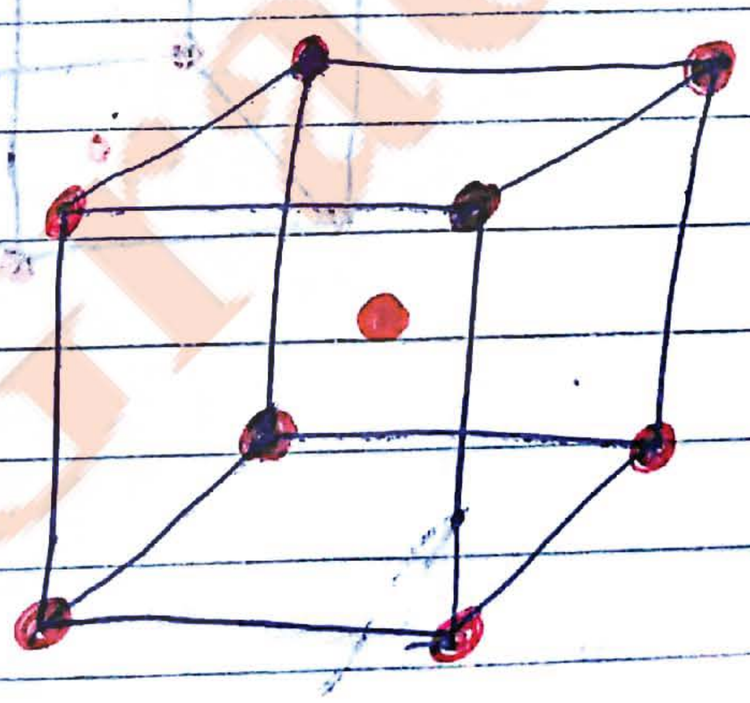
1) → Type of unit cell :→

1) Simple cubic unit cell (S.C) ⇒ In this type of unit cell atom's are present only at the corner of a cube



2) ~~Base Cent~~ Body centred Cubic (BCC) →

In this type of unit cell atom's are present at each corner of the unit cell and one atom is present at body centre of a cube.



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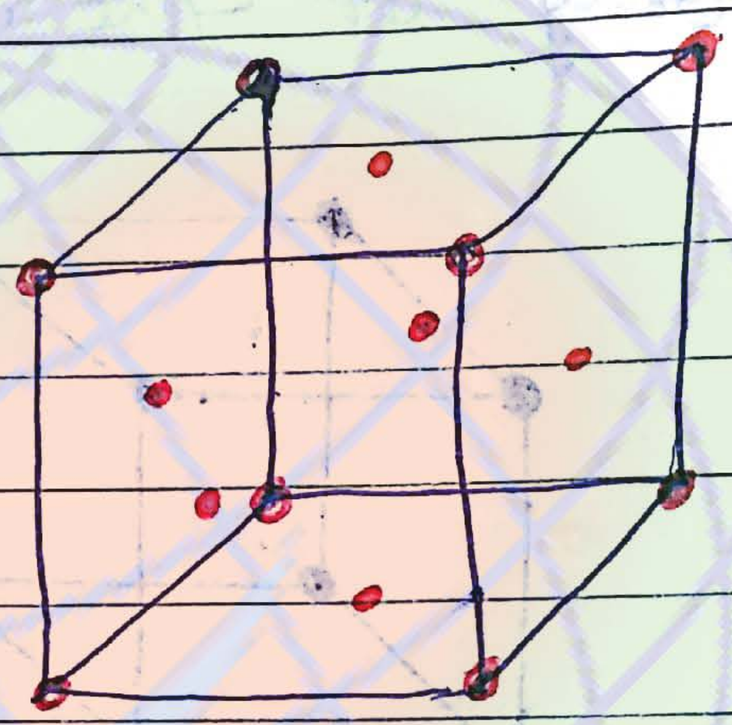
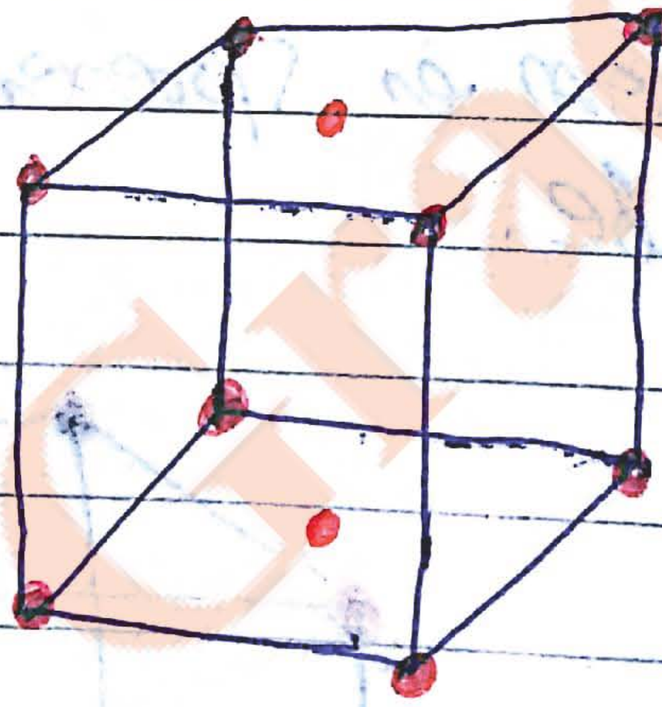
3) Face-centre cubic (FCC) →

In this type of unit cell atoms are present at each corner of the cube and at each base centre of a cube



4) End centred cubic (ECC) →



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3.) No. of atom's per unit cell ⟶

S.C ⇒ $N = 8 \times \frac{1}{8} = 1$

(corner)

BCC ⇒ $N = 8 \times \frac{1}{8} + \frac{1}{1} \times 1 = 2$

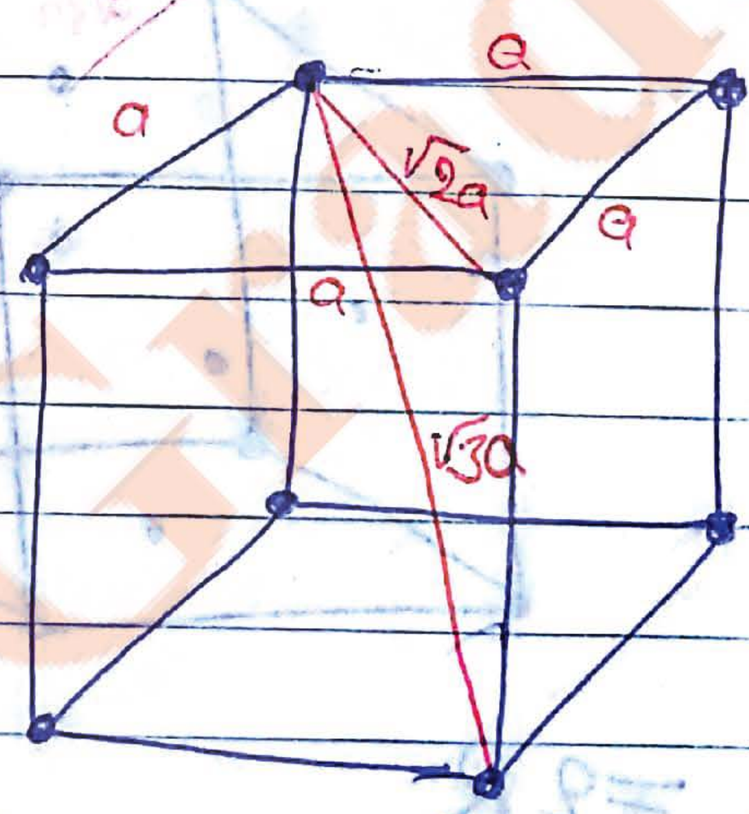
(corner, centre)

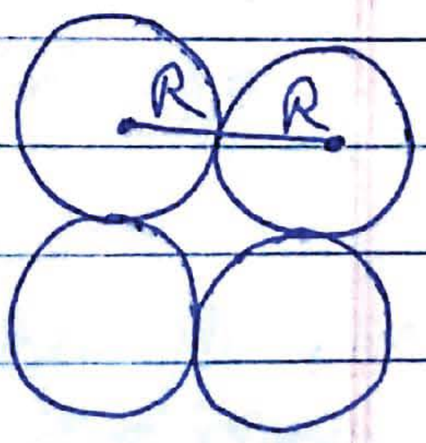
FCC ⇒ $N = 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

(corner, face centre)

★ Relation b/w edge length "a" and atomic radius "r" ⟶ नोट:⟶ Concept मात्र रखें "a" और "R" का Relation दो closest atom के बीच में निकालते हैं। फ्रोक structural packing में closed atom में ही formula लगाएँ

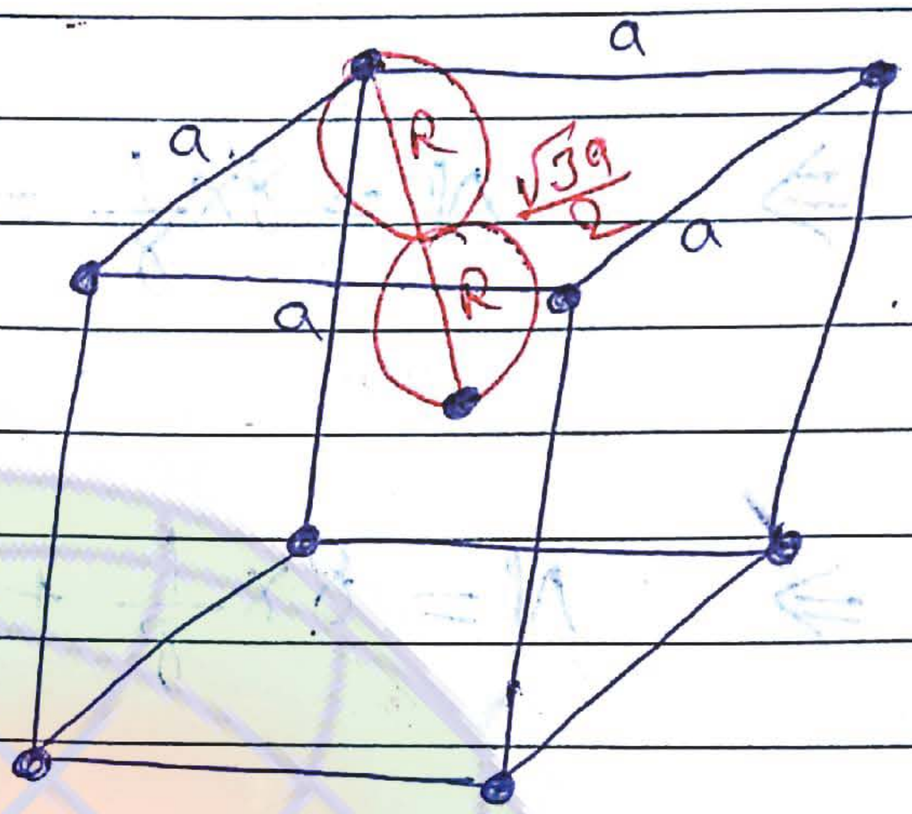
⟶ S.C





$a = 2R$

$\Rightarrow$ BCC

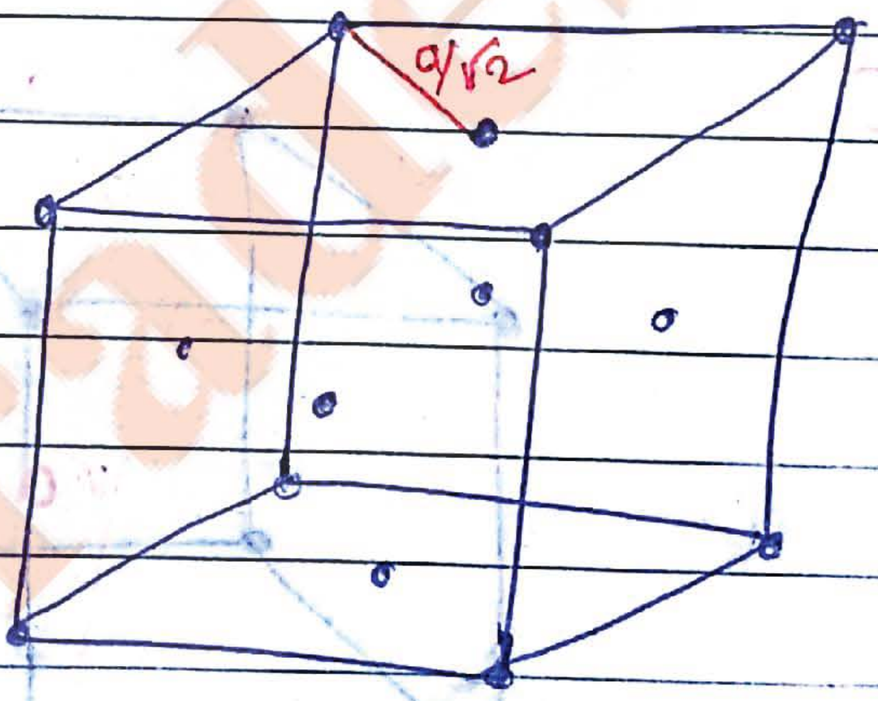


$$\frac{\sqrt{3}a}{2} = 2R$$

$$\sqrt{3}a = 4R$$

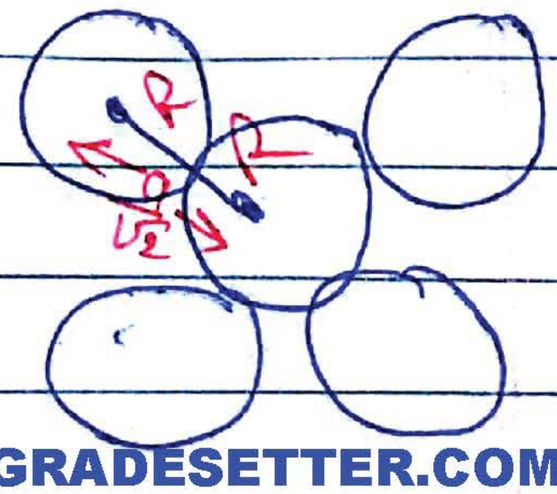
$\Rightarrow$ FCC

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



$$\frac{a}{\sqrt{2}} = 2R$$

$$a = 2\sqrt{2}R$$



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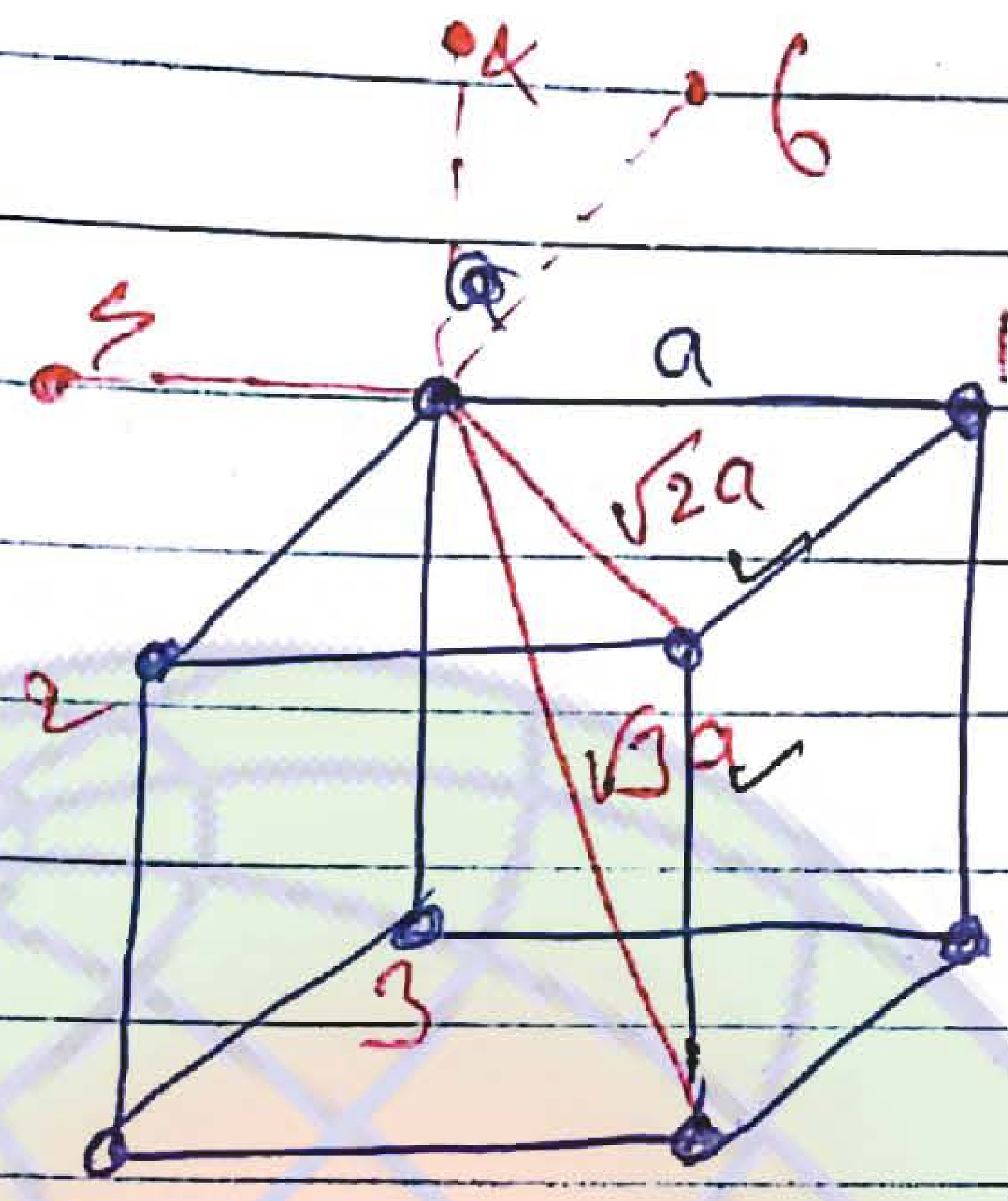
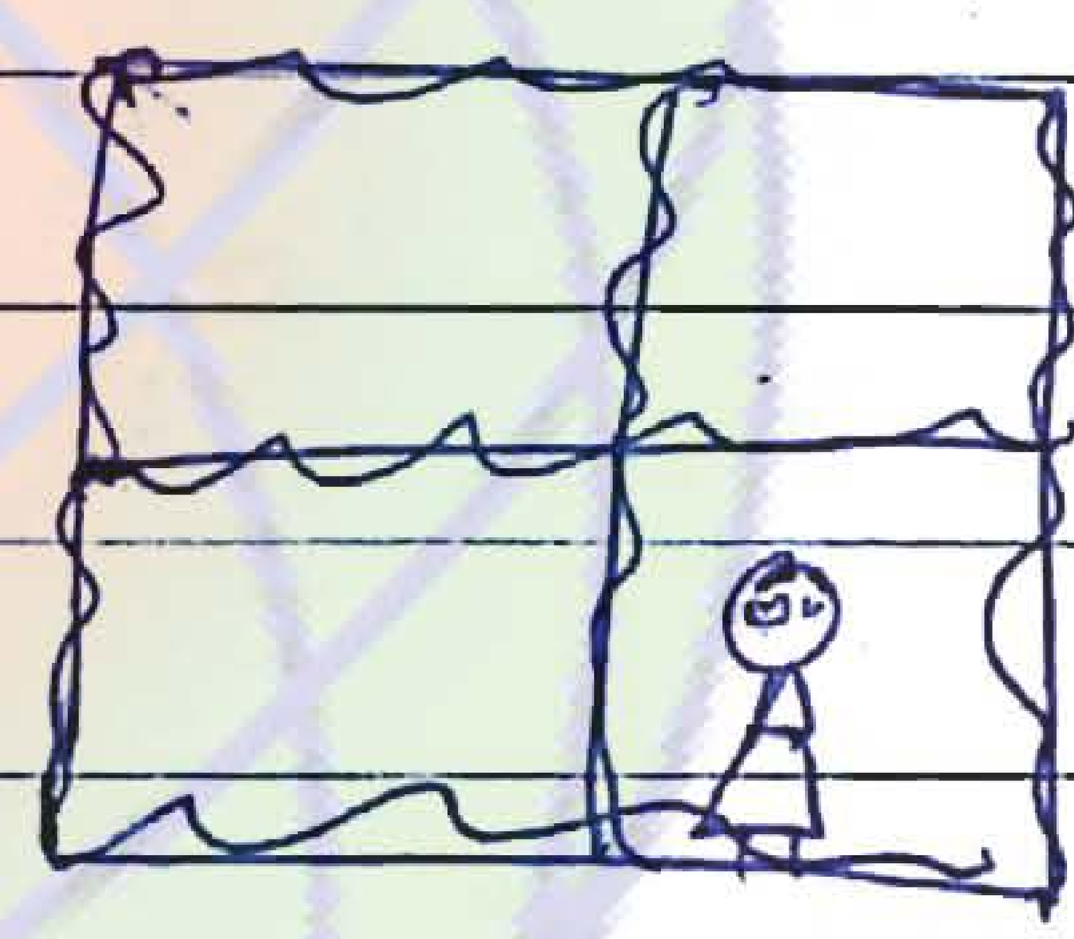
4) Co-ordination number →

⇒ S.C



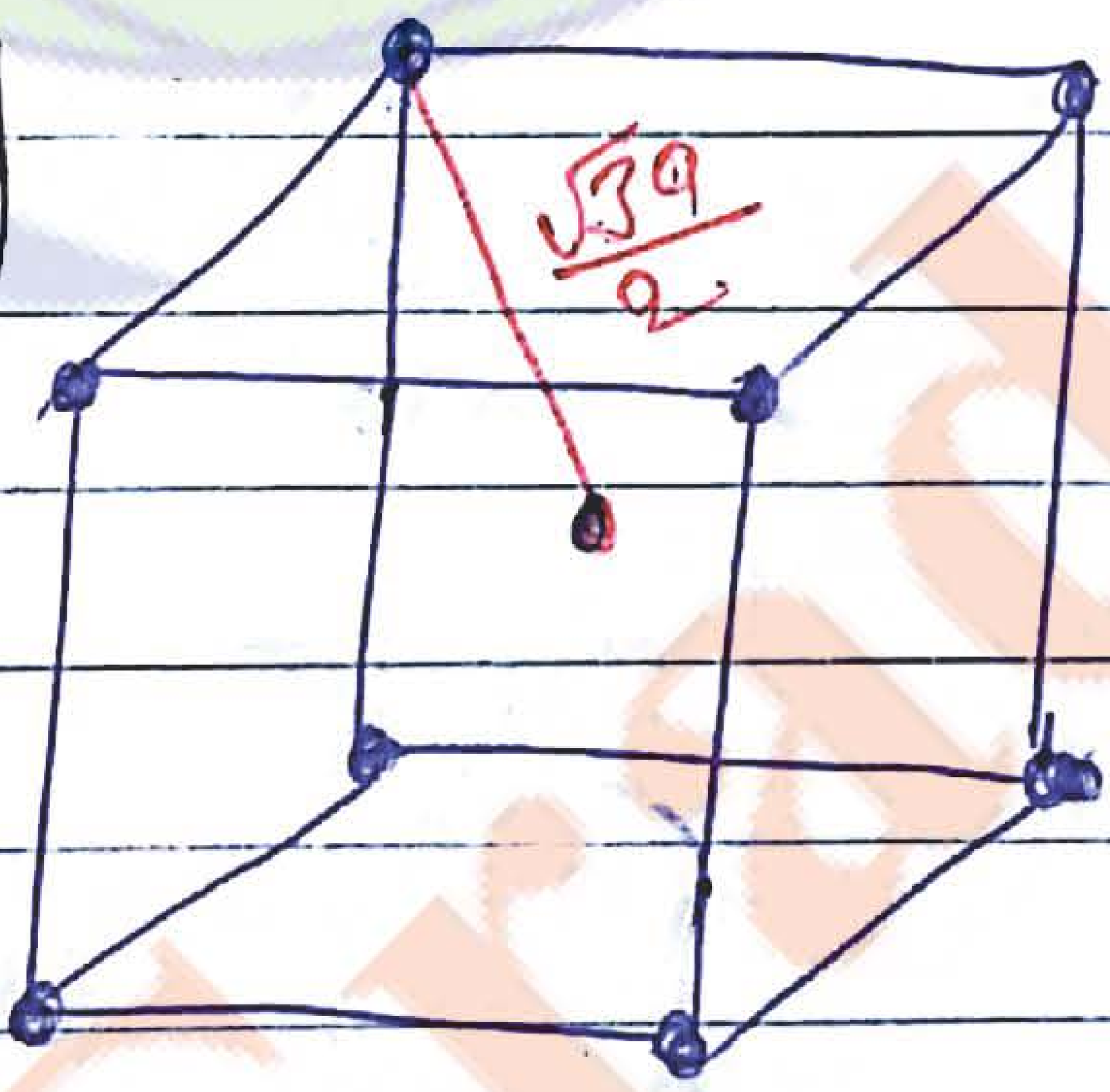
Z = 6

जैसे हम room में के तरह पास-पास आगे पीछे किस का सम्पर्क पता करते → ये ही simple cubic में कुछ आधार पर पता चलेगा कि उसके अगल-बगल में भी atom है (जो √2a की दूरी पर) वह कितने atom से मिल सकता है और वही उसका co-ordination number होगा।



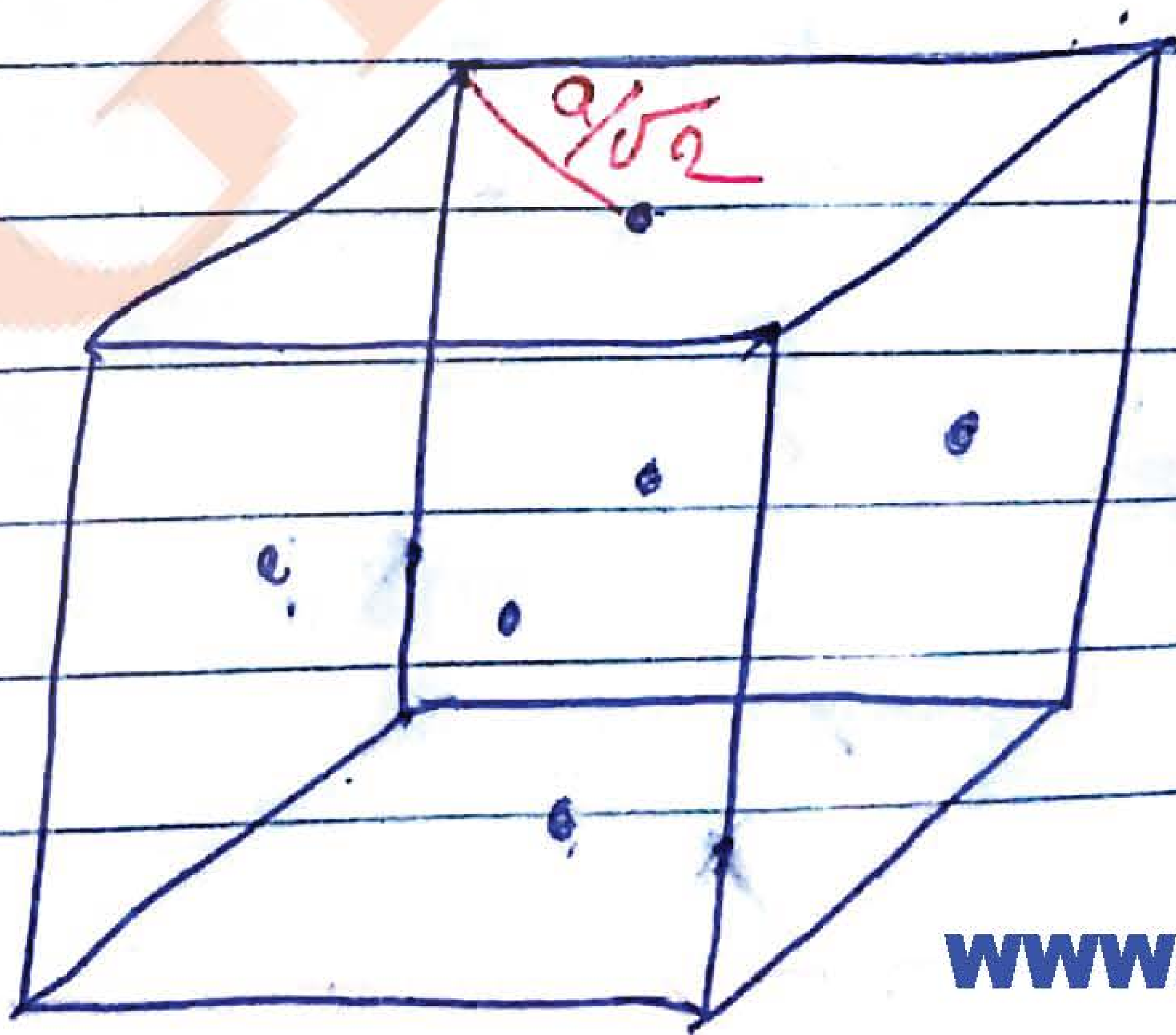
⇒ BCC

↓ इसी प्रकार हम सभी का भी निकाल सकते हैं।



Z = 8 $\left(\frac{1\times 8}{1}\right)$

⇒ FCC



Z = 12 $\left(\frac{3\times 8}{2}\right)$

4 in it's plane
4 above and 4 below

"N" से number of atom per unit cell दर्शाया है और "Z" से co-ordination संख्या को दिखाते हैं।

5) Calculation of density for different type of cubic structure.

Density = mass / volume

शार्टकट — किसी भी solution में इसे लिखना ना भूलें क्योंकि solution इसके बिना गलत है सकता है इसलिए इस भगवान मानें।

$$d = \frac{N \times M}{a^3 \times N_A \times 10^{-30}} \ g/cm^3$$

N = no. of atom per unit cell

(in g/mole) ← M = molecular weight / Atomic wt.

$N_A = 6.023 \times 10^{23}$

a = edge length (is in pm)

$\because$ 1 pm = 10^{-10} cm

80,

SC :→ (VVI)

$$d = \frac{1 \times M}{N_A \times a^3} \quad \{a = 2R\}$$

BCC → (VVI)

$$d = \frac{2 \times M}{N_A \times a^3} \quad \{\sqrt{3}a = 4R\}$$

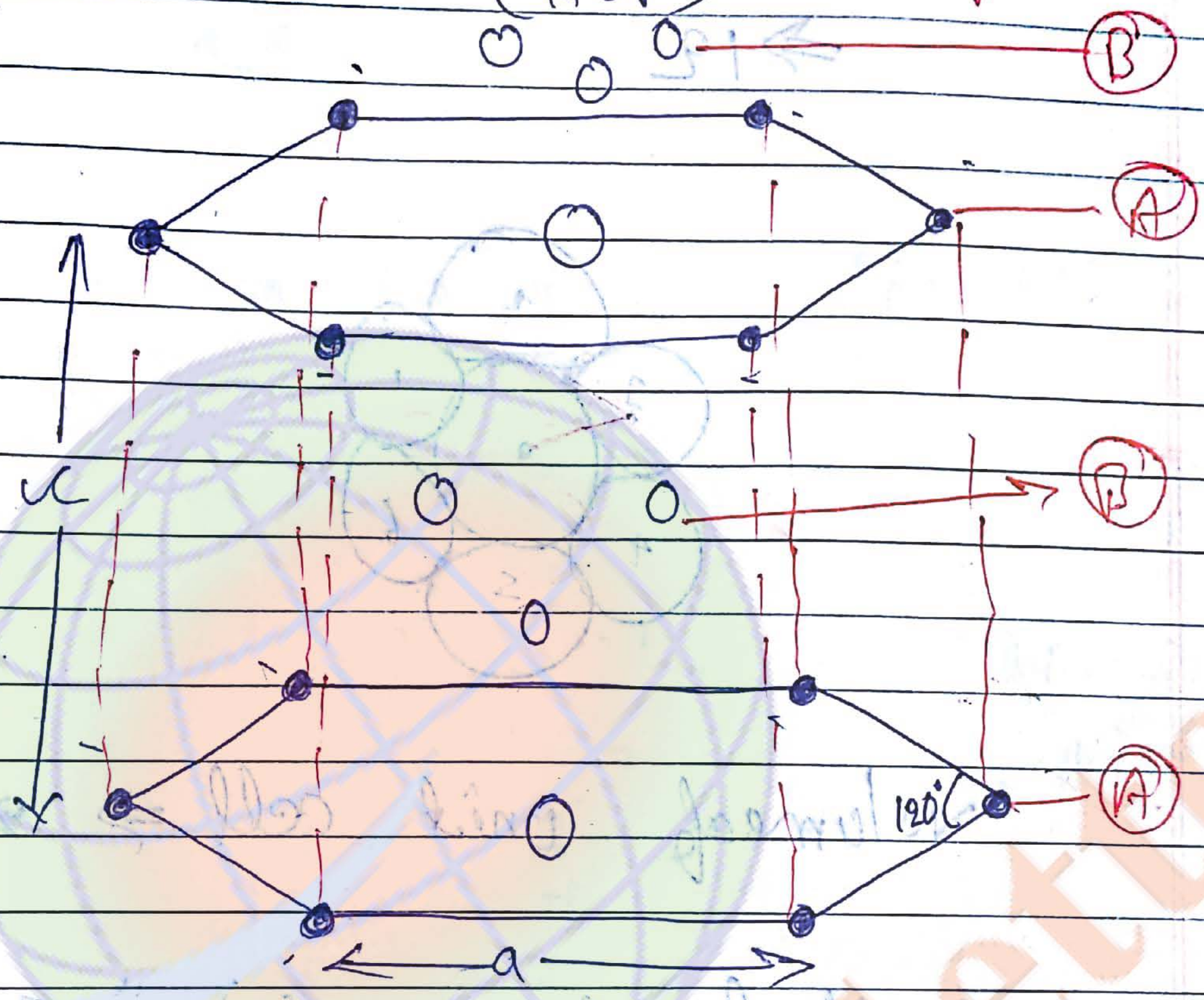
face centred cubic → FCC → (VVI) or CCP → Cubical closed Packing

याद रखें दोनों में double "C" है। और "F" और "P" also same दिखते हैं।

$$d = \frac{4 \times M}{N_A \times a^3} \quad \{a = 2\sqrt{2}R\}$$

Hexagonal closed Packing (HCP)

(ABAB ---- Pattern)



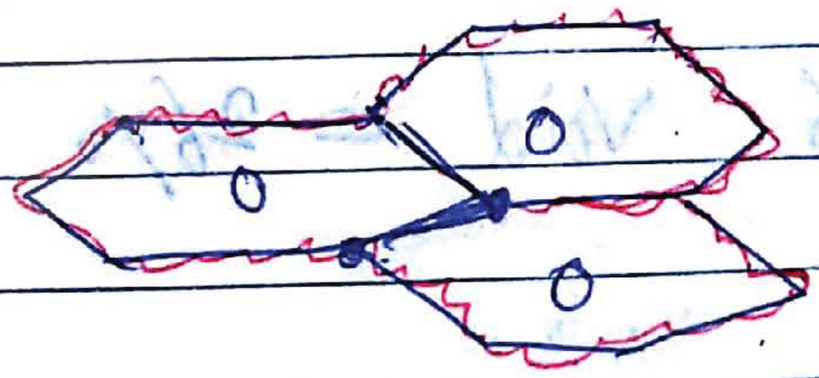
1) Relation b/w "a" and "R"

$$a = 2R$$

2) No. of atom per unit cell (N)

(corner)

$$N = 12 \times \frac{1}{6} + 2 \times \frac{1}{2} + 3 \times 1 = 6$$



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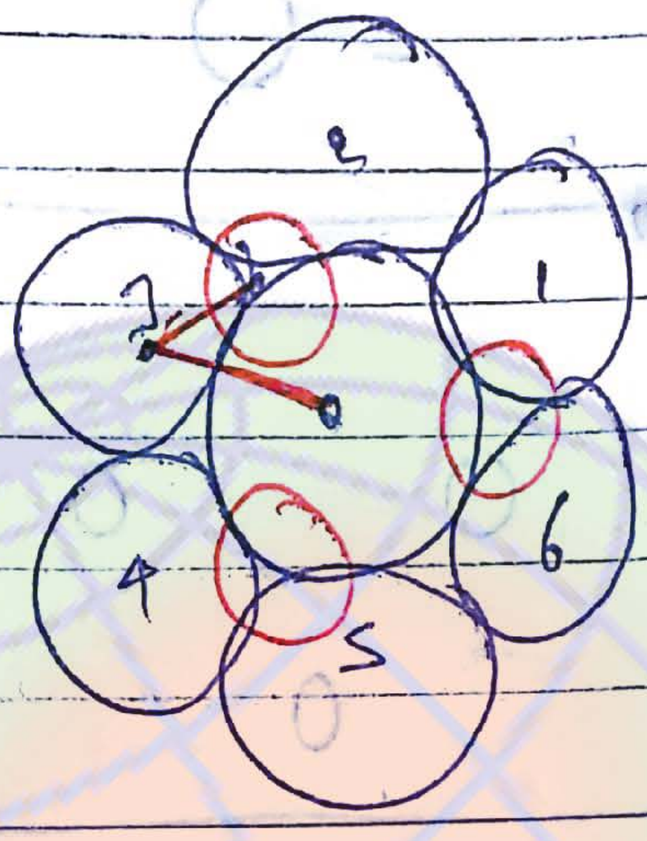
3.) C.No (Z) → Co-ordination number

⇒ 12



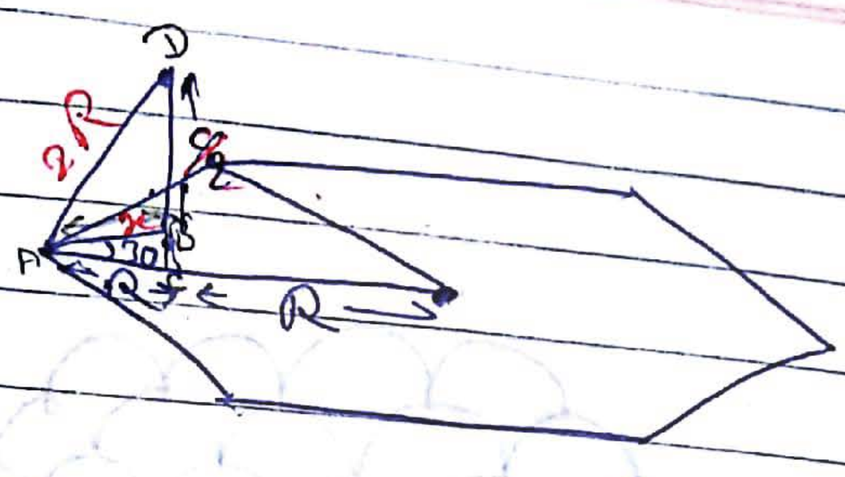
4.) volume of unit cell ⇒ $24\sqrt{2}\,R^3$

5.) Height of hexagon $(c) = \frac{4\sqrt{2}}{\sqrt{3}} R$

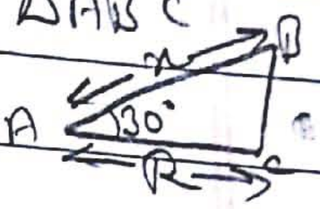
6.) $$\eta = \frac{6 \times \frac{4}{3}\pi R^3}{6 \times \frac{\sqrt{3}}{4} a^2 \times c}$$

$$= \frac{6 \times \frac{4}{3}\pi R^3}{6 \times \frac{\sqrt{3}}{4} \times 4R \times \frac{4\sqrt{2}R}{\sqrt{3}}} = \frac{\pi}{3\sqrt{2}} = 0.74 \text{ or } 74\%$$

7.) % Void = 26%



$$\cos 30^\circ = \frac{R}{x}$$

(from $\triangle ABC$ 

)

$$x = \frac{R}{\sqrt{3}/2} = \frac{2R}{\sqrt{3}}$$

from $\triangle ABC$ 

$$\rightarrow (2R)^2 = \left(\frac{C}{2}\right)^2 + x^2$$ (By Pythagoras theorem)

$$4R^2 = \frac{C^2}{4} + \frac{4R^2}{3}$$

$$\frac{C^2}{4} = \frac{8R^2}{3}$$

$$C^2 = \frac{32R^2}{3}$$

$$C = \frac{4\sqrt{2}}{\sqrt{3}} R$$

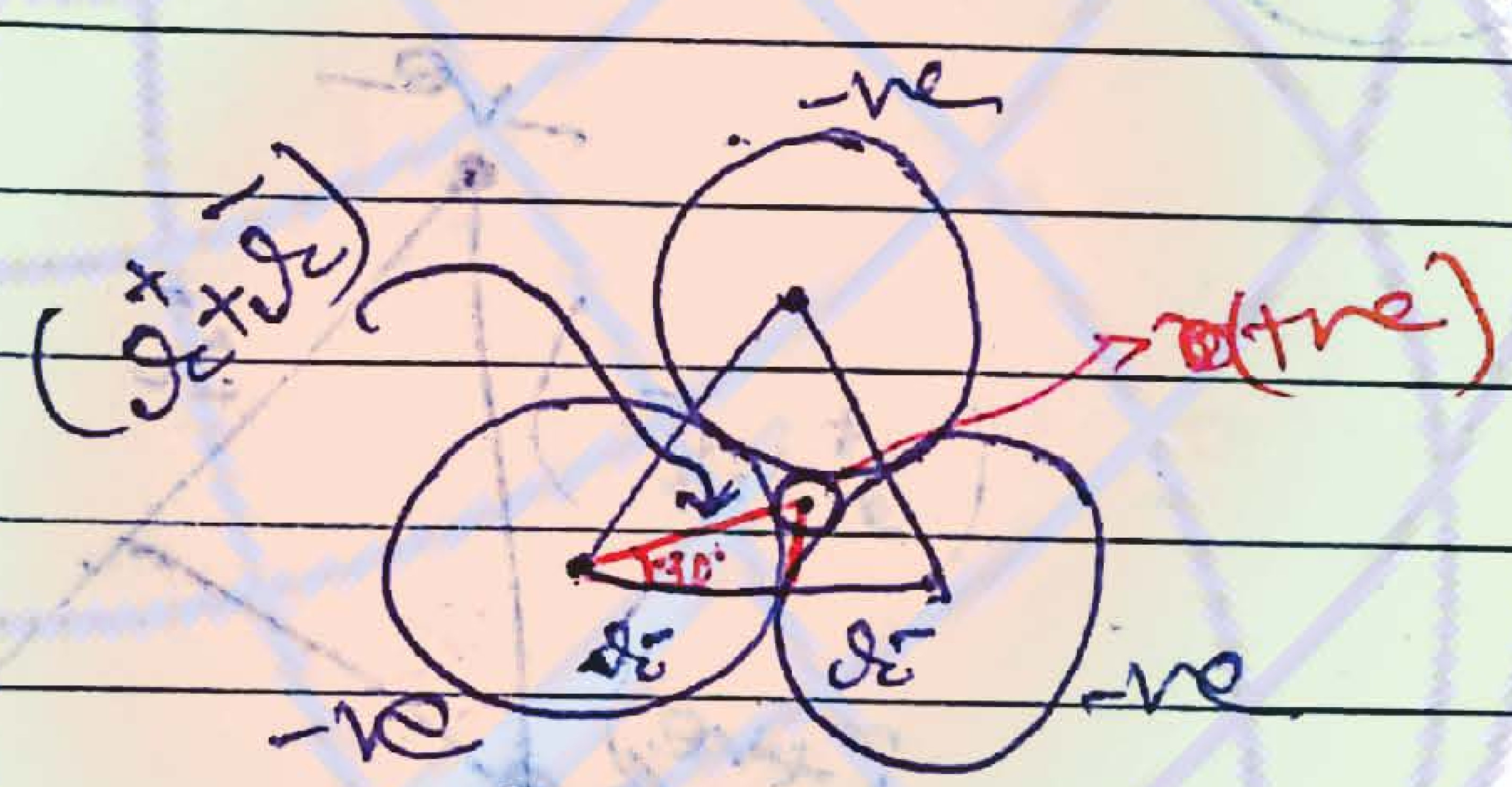
Notes:

FCC — ABCABC ---- Pattern
HCP — ABAB ---- Pattern
SC — AAAA ---- Pattern

☆ Study of Ionic crystal →

1.) Calculation of $\frac{r^+}{r^-}$ for different types of void's →

a) Triangular void (2D, 3 co-ordinate) → C.No ⇒ 3



यहाँ "-ve" atom का Radius "r^-" और "+ve" atom का radius "r^+" consider किये हैं।

इस बात का ध्यान रखें यहाँ -ve atom बड़ा है और +ve atom छोटा है

$$\cos 30^\circ = \frac{r^-}{r^+ + r^-}$$

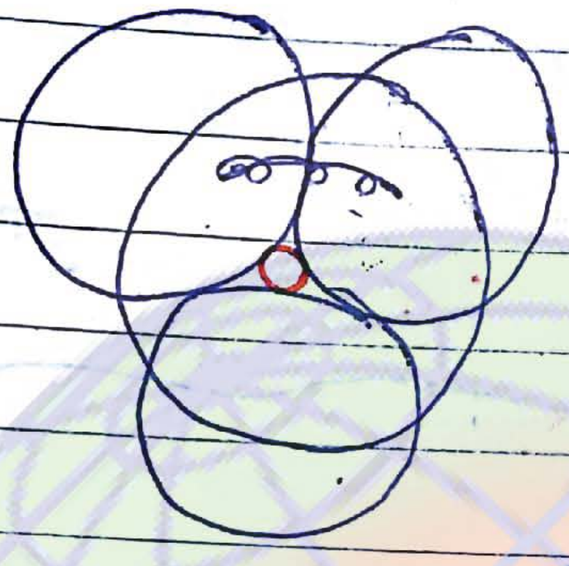
$$\frac{\sqrt{3}}{2} = \frac{r^-}{r^+ + r^-}$$

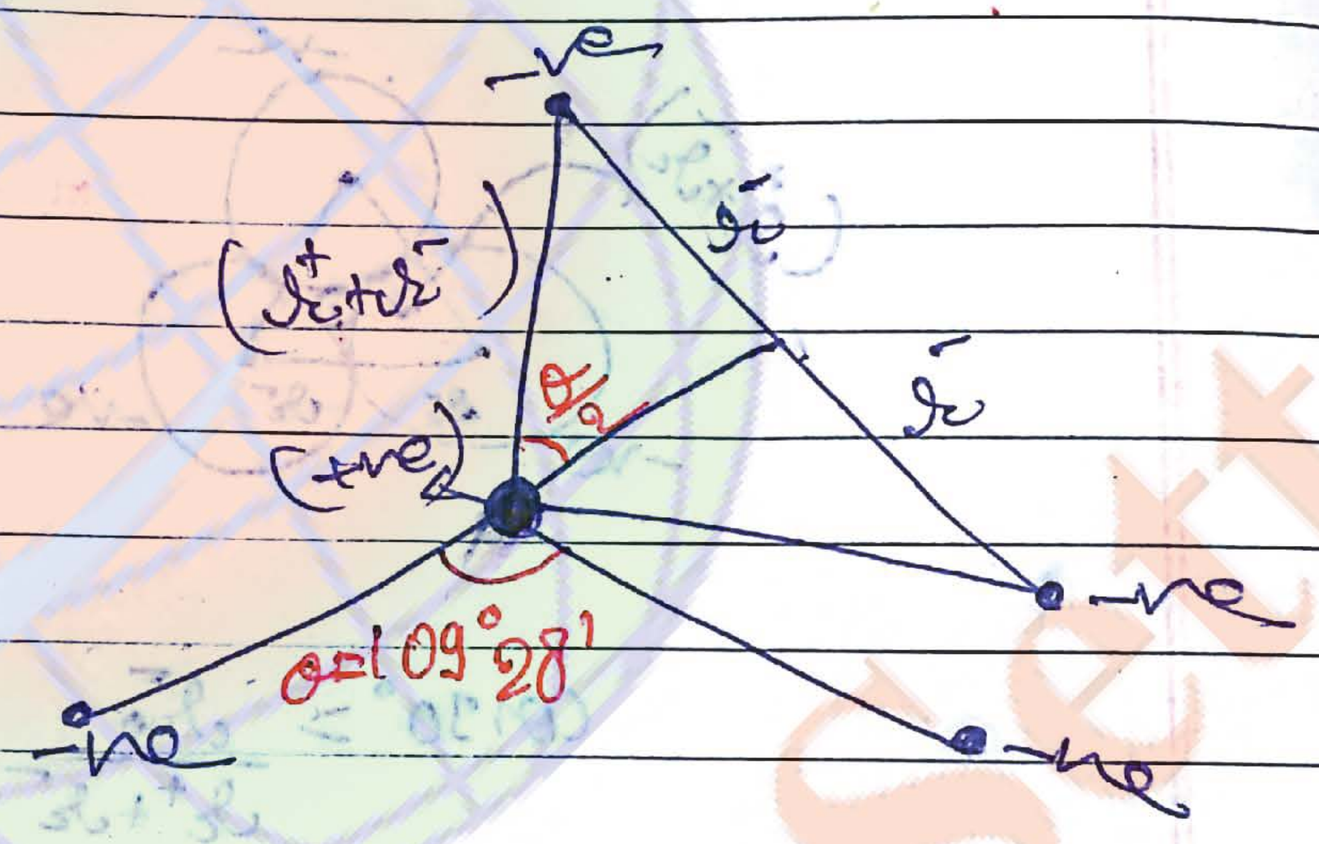
$$\boxed{\frac{r^+}{r^-} = 0.155}$$

a)

b) Tetrahedral void (T-void)

3D, C.No = 4)





$$\frac{\sin \frac{109°28'}{2}}{} = \frac{r^-}{r^+ + r^-}$$

(चूंकी $\frac{\theta}{2}$)

$$0.8155 = \frac{r^-}{r^+ + r^-}$$

$$\frac{r^+}{r^-} = 0.225$$