Silicates:

- Silicates are the compounds in which the anions present are either discrete SiO_4^{4-} tetrahedra or a no. of tetrahedra units joined together by sharing corners but not edges.
- Silicates are more important in glass, ceramics, cement industry.

Classification of Silicates:

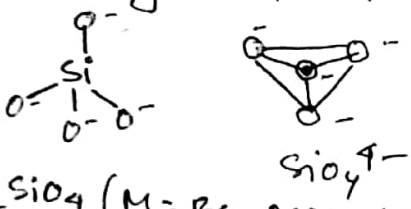
On the basis of corners (0, 1, 2, 3, 4) silicates are classified as.

1) Ortho silicates (SiO_4^{4-}) - (Niso-silicates):

i) Discrete SiO_4^{4-}

ii) No sharing 'O' atom.

iii) Str:



SiO_4^{4-}

iv) $\overset{II}{M}_2SiO_4$ (M = Be, Mg, Mn, Fe, Zn)

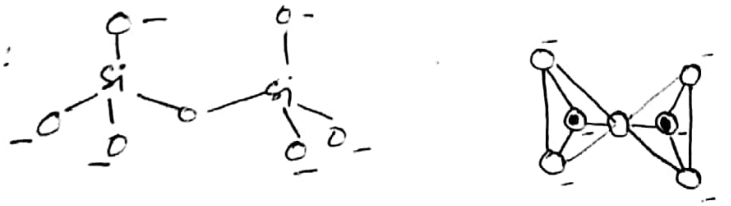
Ex- Zircon $MSiO_4$ (M = Zr)

2) Pyrosilicates ($Si_2O_7^{6-}$) - (Soro silicates, disilicates)

i) Two SiO_4^{4-} units joined together by sharing one 'O' atom at one corner

ii) One sharing 'O' atom.

iii) Str:



iv) Thortveitite $Sc_2(Si_2O_7)$

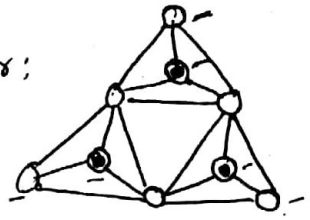
Hemimorphite $Zn_4(OH)_2(Si_2O_7)\cdot H_2O$.

Ex- Hemimorphite.

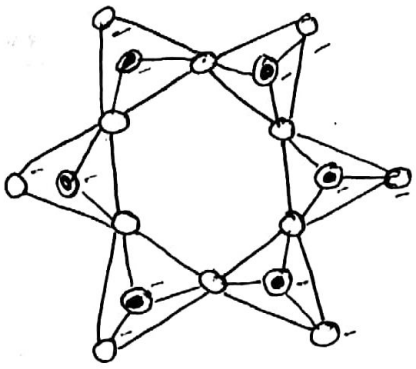
③ cyclic silicates or Ring silicates ($Si_3O_9^{6-}$, $Si_6O_{18}^{12-}$)

i) Two 'o' atoms per tetrahedron are shared to form closed ring structure with general formulae $(SiO_3)_n^{2n-}$.

ii) Str:



$Si_3O_9^{6-}$



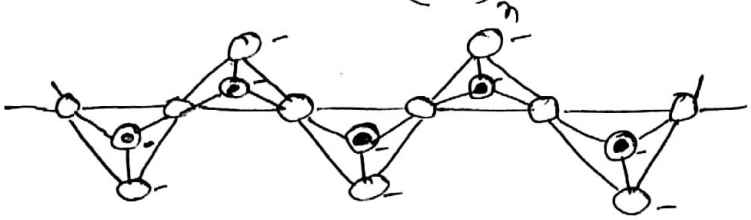
$Si_6O_{18}^{12-}$

Ex- Beryl $[Be_3Al_2(Si_6O_{18})]$

④ Single Chain silicates (Ino silicates or pyroxenes) $(SiO_3)_n^{2n-}$ — 1D-silicate

i) Two 'o' atoms per tetrahedron are shared to form chain silicates with general formulae $(SiO_3)_n^{2n-}$

ii)



$(SiO_3)_n^{2n-}$

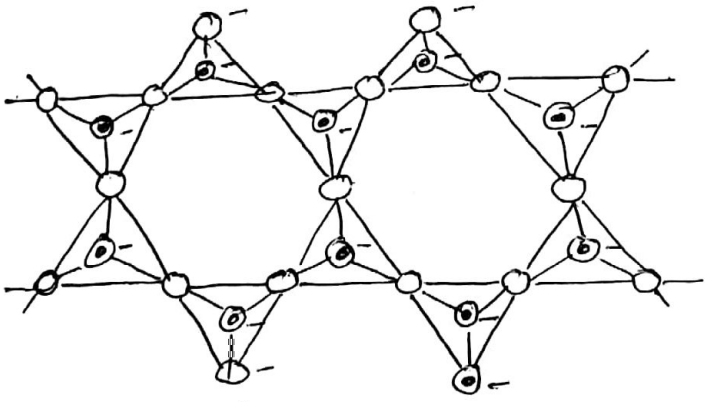
Spodumin $[LiAl(SiO_3)_2]$

Diapside $[CaMg(SiO_3)_2]$

⑤ Double chain silicates (Amphiboles) $(Si_4O_{11})_n^{6n-}$

i) When two simple chain silicates are joined together by shared 'O'.

ii)



$(Si_4O_{11})_n^{6n-}$

Blue Asbestos $[Na_2Fe_5(OH)_2(Si_4O_{11})_2]$

Grey Asbestos $[(Mg,Fe)(OH)_2(Si_4O_{11})_2]$

White Asbestos

v.vi Ex: Asbestos

(6) Phylosilicates (2D-Silicates / Sheet Silicates) $(Si_2O_5)_n^{2n-}$

i) 3 'o' atoms per tetrahedron are shared to form 2D sheet str./ layer str. with general formulae $(Si_2O_5)_n^{2n-}$

ii) Ex Mica, clay

Kaolenite $[Al_2(OH)_4Si_2O_5]$

Fallok $[Mg(OH)_2(Si_2O_5)_2]$

Whiteasbestos $[Mg(OH)_4(Si_2O_5)]$

(7) Tectosilicates (3D - Silicates)

i) 4 'o' atoms per tetrahedron are shared to form 3D - str. with general formulae $(SiO_3)_n$

ii) These are Aluminosilicates as SiO_4^{4-} unit is replaced by AlO_4^{5-} unit.

iii) It is neutral Silicate

iv) Ex Quartz, zeolite, Feldspar $(KAlSi_3O_8)$, tridymite, Cristobalite, Silica (SiO_2), ultramarine $[Na_8(AlSiO_4)_6S_2]$

1) Zeolites is used to describe Teetosilicates.
2) Zeolite can be custom made by manipulating the str. by change in silica-alumina ratio $[(Al, Si)O_2]_n$ Pore size, Density structure enclosi

Q. What is Zeolites & their uses?

1) Zeolites are 3D Aluminosilicates with a framework (2-11Å) cavities occupied by large ions & water molecules both of which have considerable freedom of movement, permitting ion exchange & reversible dehydration.

ii) proof by Magic angle NMR Spectroscopy.

iii) There is an alternate bet'n Al & Si on tetrahedral unit.

iv) Zeolites are called Molecular Sieves as the cavities trapped by molecules of appropriate sizes by electrostatic force of attraction & vanderwaals force

v) Large molecule will not be absorbed.

vi) Straight chain hydrocarbon is absorbed but not branched ,, ,,

vii) Some Si in SiO_2 are replaced by Al^{3+} forming Al-O-Si to maintain charge neutrality. $Na^+/K^+/Ca^{2+}$ in presence of 3D Aluminosilicate is called Zeolite.

Uses (i) used in heterogeneous Catalytic rxn.

(ii) Synthetic Zeolites in the preparat'n of ZSM-5 which is widely used in selective synthesis of o-xylene which is used as an octane booster in gasoline