

Silicates → O & Si are most abundant element on earth crust and they form different structures called silicates.

- All silicates are derived from basic structure SiO_4^{4-}
- All have fundamental structure unit eg glass, cement, sand, stones etc.
- The hyb of Si atom is sp^3 and oxidation state of Si is +4 and that of oxygen atom is -2.

Types of silicates

ortho silicates

Pyro silicates

Single Chain silicates → (Pyroxene)

cyclic silicates

Double chain silicate → (Amphibole)

Sheet silicates (2-D)

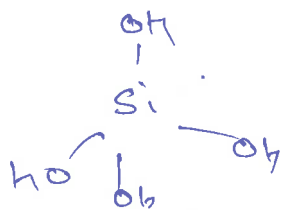
3-D silicates

① Ortho silicate

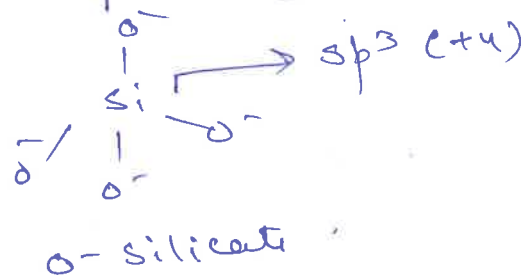
o-silicic acid

NaOH

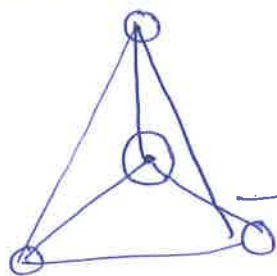
o-silicate



OH^-



Representation



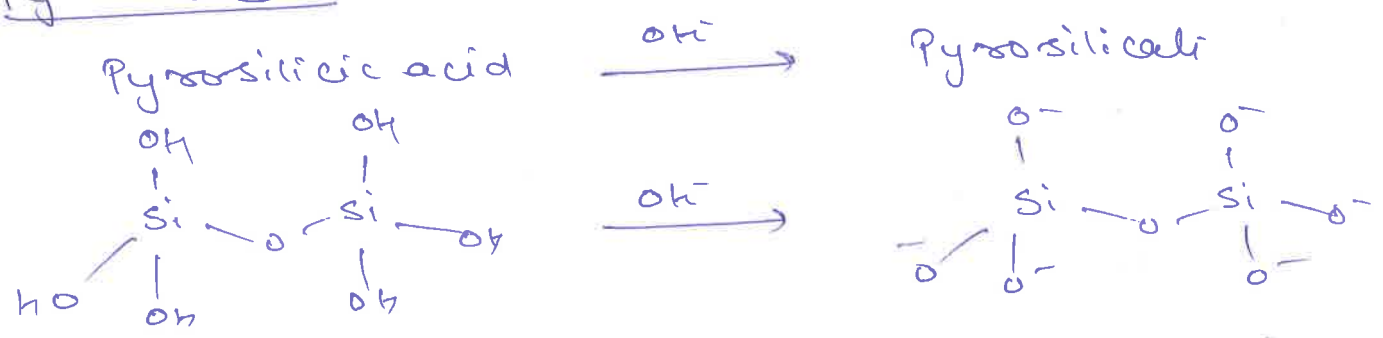
Basic fundamental unit of silicates

- → Si atom
- → oxygen atom.

mineral in which SiO_4^{4-} ions are present called orthosilicate minerals.

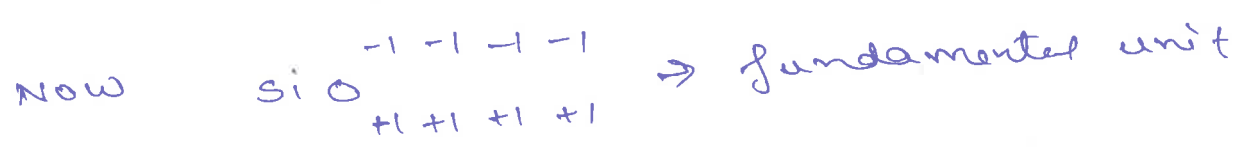
eg/- Zircon (ZrSiO_4) $\rightarrow$ artificial diamond.

② Pyrosilicate

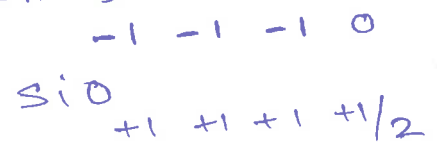


- ① one oxygen atom shared between two fundamental unit -
- ② Total 6 monovalent oxygen atoms are present.
- ③ 1 divalent oxygen atom are present -
- ④ charge on divalent oxy atom = 0
- ⑤ charge on monovalent oxy atom = -1

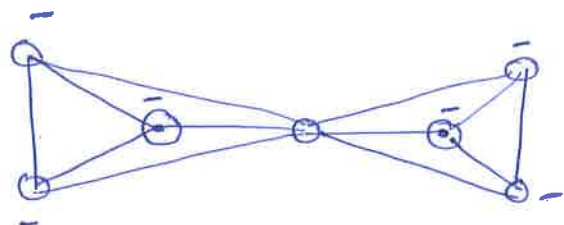
Now gen. formula for pyrosilicate can be calculated as.



In pyrosilicate - one fundamental unit share 1 oxygen atom.

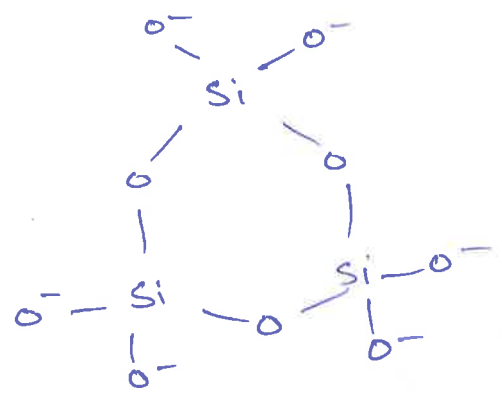


$\therefore \text{SiO}_{3.5}^{-3} \times 2 \Rightarrow \boxed{\text{Si}_2\text{O}_7^{-6}}$



③ Linear or Ring Silicates

$n=3$

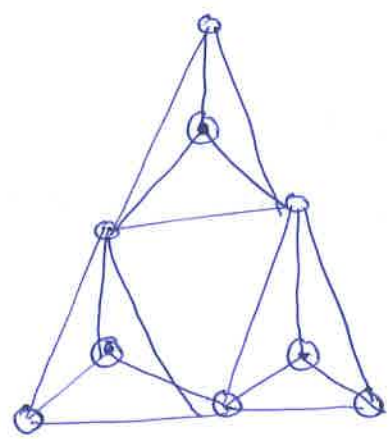


No of o atom shared per fundamental unit = 2

$$\left(\text{SiO}^{-1-1}_{+1+1+1/2+1/2} \right)_3$$

$$\left(\text{SiO}_3^{-2} \right)_3$$

$$\left[\text{Si}_3\text{O}_9^{-6} \right]$$



$n=4$, $n=5$, $n=6$
 $\downarrow$ $\downarrow$ $\downarrow$
 $\text{Si}_4\text{O}_{12}^{8-}$ $\text{Si}_5\text{O}_{15}^{10-}$ $\text{Si}_6\text{O}_{18}^{12-}$

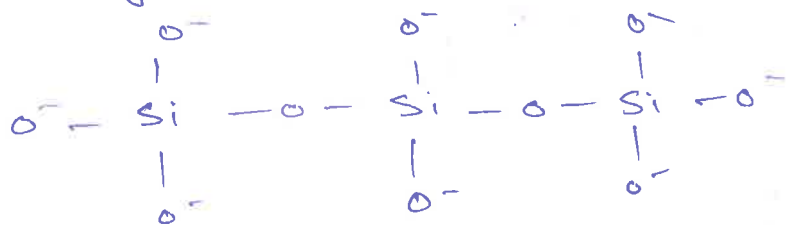
for any cyclic silicate

(i) Gen formula. $\left[\text{SiO}_3 \right]_n^{-2n}$

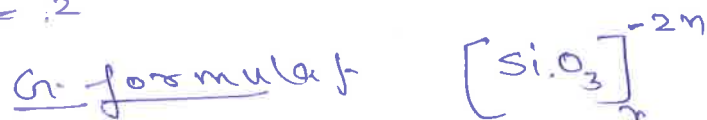
(ii) No of oxygen atom shared per tetrahedron = 2
 Total no of oxygen shared = n

4) Chain silicate

(i) single chain silicate (Pyroxene)



No of oxygen atom shared per tetrahedron
= 2



Note - In single chain silicate restricted from both ends then



No of oxygen shared = $n-1$

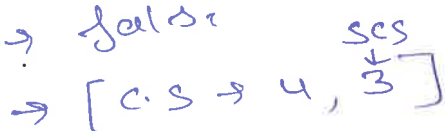
Q) True false

1) formula of cyclic silicate (C.S) and single chain silicate (SCS) are same

→ True

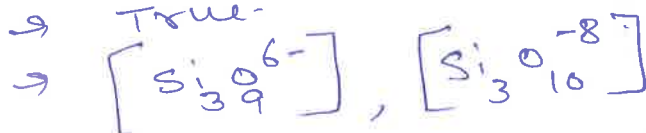
2) Total no of oxygen shared in 4 membered cyclic silicate and 4 member SCS is same

→ false



3) formula of 3 membered cyclic silicate and 3 member SCS are different

→ True

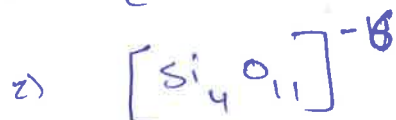
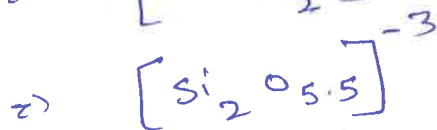
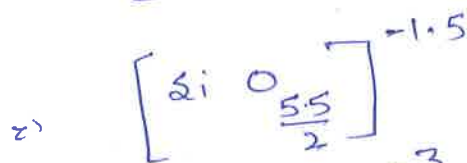
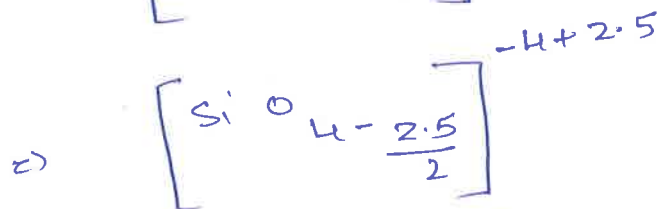


4B) Double chain silicates (Amphibole silicate)

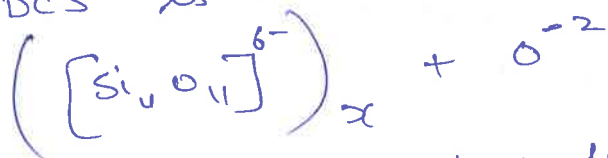
⑤

In D.C.S alternate 2 & 3 oxygen atoms are shared, or In D.C.S fundamental units shared 2 & 3 oxygen atom alternatively, so on an average per tetrahedron shared 2.5 oxygen atom.

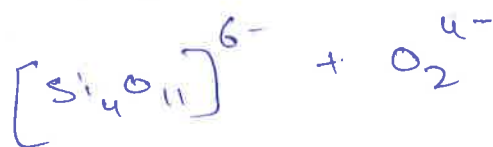
formulas



5] If DCS is restricted from one end

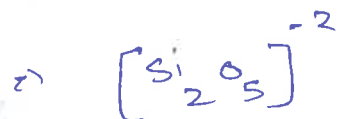
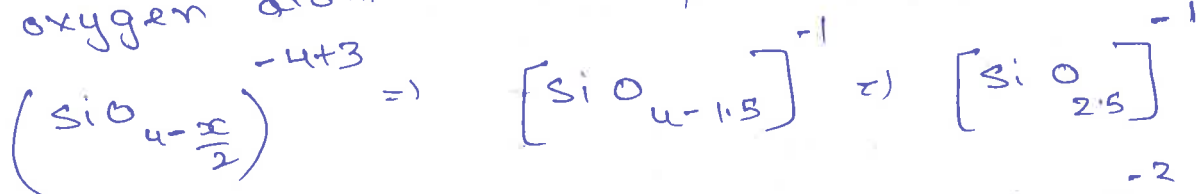


If DCS is restricted from 2 ends



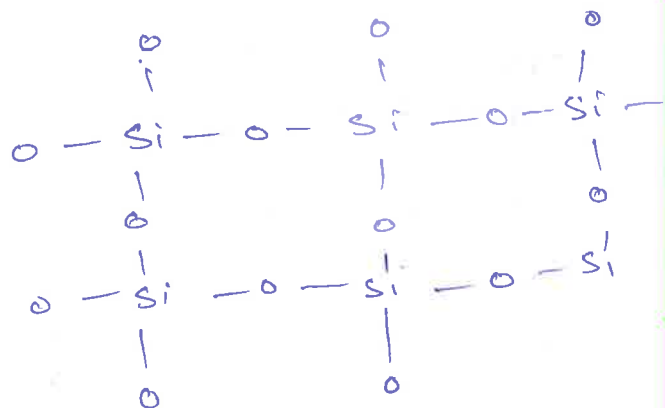
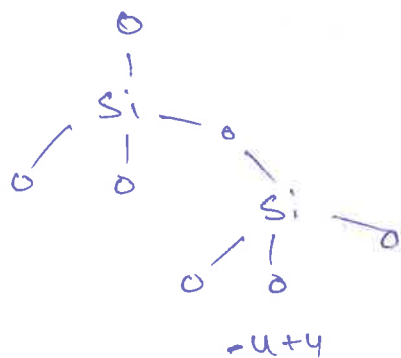
5] Sheet silicates (2-D silicates)

No of oxygen atom shared per tetrahedron = 3



6) 3-D Silicates (Tectosilicate)

6



$$\left[\text{SiO}_{4-\frac{4}{2}} \right]^{-4+4} \Rightarrow (\text{SiO}_2)_n$$

Q) find value of n in



$\Rightarrow 2 \times n + 3 \times 2 + 6 \times 4 + 18 \times (-2) = 0$

$n = 3$

Q) Beryl and Emerald both are having same m.f. $\text{Be}_3 \text{Al}_2 \text{Si}_6 \text{O}_{18}$ but emerald is green in colour while beryl is colourless or light yellow in colour.

Ans: This is because of impurity Cr^{+3} (1 to 3%)



$2n + 2 \times 3 + 8 \times 4 + 22(-2) = 0$

$n = 3$

(Now identify type of silicate)

$\left[\text{Si}_8 \text{O}_{22} \right]^{-12} = \text{SiO}_{4-\frac{x}{2}}$

$\text{SiO}_{\frac{22}{8}} = \text{SiO}_{4-\frac{x}{2}}$

$4 - \frac{x}{2} = \frac{22}{8}$

$\frac{x}{2} \Rightarrow 4 - \frac{22}{8}$

$x \Rightarrow 2.5$ (double chain silicate)

No of monovalent oxygen = 12
No of divalent oxygen atom = 10