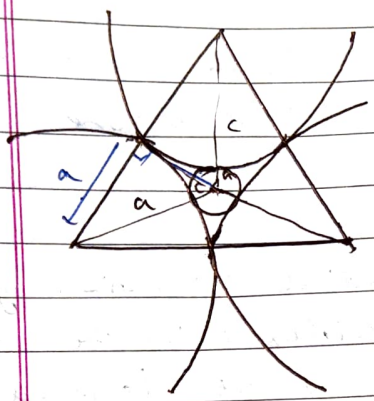
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Q) For a closed packed structure, a cation is usually 12-fold coordinated by same size of anion $\left(\frac{Rc}{Ra} = 1\right)$.

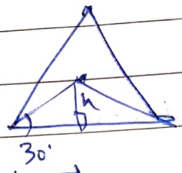
Estimate the cation to anion radius ratio, $\frac{Rc}{Ra}$, for an ideal 3 fold and 6 fold cation coordination.

3-fold coordination



Each side

$s = 2a$



$\tan 30° = \frac{h}{a}$

$\frac{1}{\sqrt{3}} = \frac{h}{a}$

$h = \frac{a}{\sqrt{3}}$

$a^2 + \left(\frac{a}{\sqrt{3}}\right)^2 = (a+c)^2$

$= a^2 + c^2 + 2ac$

$\Rightarrow$

$\frac{a^2}{3} = c^2 + 2ac$

$\div a^2$

$\frac{c}{a} \cdot \frac{1}{3} = \left(\frac{c}{a}\right)^2 + \frac{2ac}{a^2}$

$\frac{1}{3} = \alpha^2 + 2\alpha$

$1 = 3\alpha^2 + 6\alpha$

$3\alpha^2 + 6\alpha - 1 = 0$

$$\alpha = \frac{-6 \pm \sqrt{36+12}}{6}$$

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$$= \frac{-6 \pm 4\sqrt{3}}{6}$$

$$= \frac{-6+4\sqrt{3}}{6} = \frac{2\sqrt{3}-3}{3}$$

$$= \frac{2 \times 1.732 - 3}{3}$$

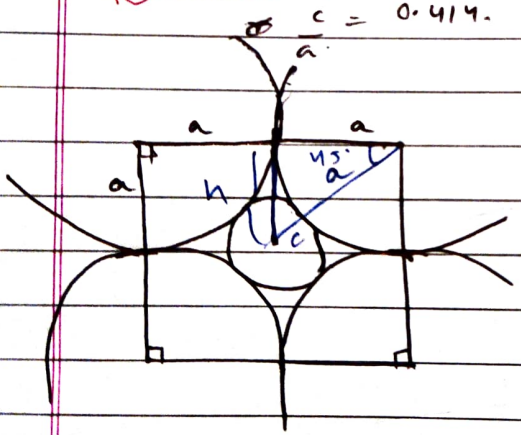
$$= \frac{3.464 - 3}{3}$$

$$= \frac{0.464}{3}$$

$$0.464 \times 10^{-3}$$

$$\frac{Rc}{Ra} = 0.155$$

Octahedral :- 6 fold coordination.



$$h = a$$

$$a^2 + a^2 = (a+c)^2$$

$$\sqrt{2}a = a + c$$

$$(\sqrt{2}-1)a = c$$

$$\frac{c}{a} = \sqrt{2}-1$$

$$= 1.414 - 1$$

$$= 0.414$$

$$\frac{Rc}{Ra} = 0.414$$