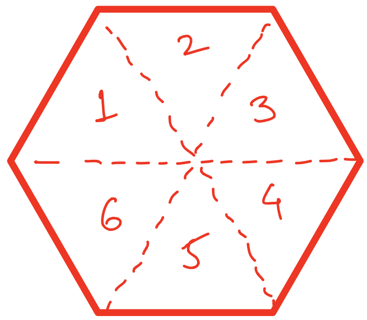
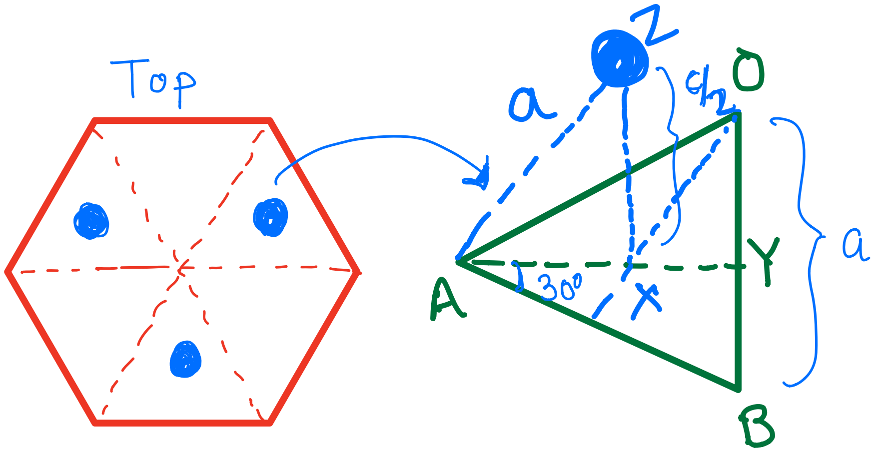
This has six equilateral Δ's.





In Δ ABY,

$$\cos 30^\circ = \frac{AY}{AB}$$

$$AY = AB\cos 30^\circ = a\cos 30^\circ = \frac{a\sqrt{3}}{2}$$

$$(AZ)^2 = (AX)^2 + (ZX)^2 \quad \text{------} \quad (1)$$

Now,

In Δ AXZ,

$$AX = \frac{2}{3}AY$$

$$\boxed{\begin{array}{l} AY = \text{median} \\ X = \text{centroid} \end{array}}$$

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

$$\boxed{AX = \frac{a}{\sqrt{3}}}$$

put this value in equ^n (1)

$$a^2 = \frac{a^2}{3} + \frac{c^2}{4} \qquad \because \quad 2x = \frac{c}{2}$$

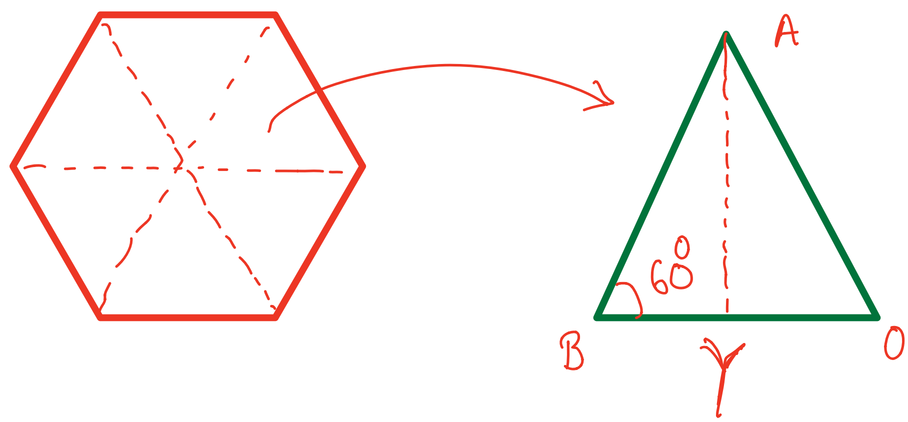
$$\Rightarrow \frac{c^2}{4} = \frac{2a^2}{3}$$

$$\frac{c^2}{a^2} = \frac{8}{3} \qquad \Rightarrow \boxed{\frac{c}{a} = \sqrt{\frac{8}{3}}}$$

APF in the HCP structure

$$APF = \frac{n \times \text{volume of one atom}}{\text{volume of unit cell}} = \frac{n \times V_a}{V_s}$$

V_s = Area of the base $\times$ height



$$\text{Area of } \Delta AOB = \frac{1}{2} \times (BO)(AY)$$

$$= \frac{1}{2} \times a \times \frac{a\sqrt{3}}{2}$$

$$= \frac{a^2\sqrt{3}}{4}$$

$$\text{Area of the base} = 6 \times \frac{a^2\sqrt{3}}{4}$$

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

$$\therefore \text{volume of the unit cell} = \frac{3}{2} a^2\sqrt{3} \times c$$

$$APF = \frac{6 \times \frac{4}{3} \pi r^3}{\frac{3}{2} a^2 \sqrt{3} \cdot c}$$

$$= \frac{8\pi \left(a/_2\right)^3}{\frac{3}{2} a^2 \sqrt{3} \cdot c} \qquad \because a = 2r$$

$$= \frac{2\pi}{3\sqrt{3}} \sqrt{\frac{3}{8}} \qquad \because \frac{c}{a} = \sqrt{\frac{8}{3}}$$

$$= \frac{\pi}{3\sqrt{2}}$$

APF = 0.74 = 74%