Brainbox learn easy

Unit 1

The Solid State

Packing efficiency:

The percentage of total space filled by the particles is known as Packing efficiency.

Calculation of packing efficiency:

a) **In CCP (Cubic Close Packing):**

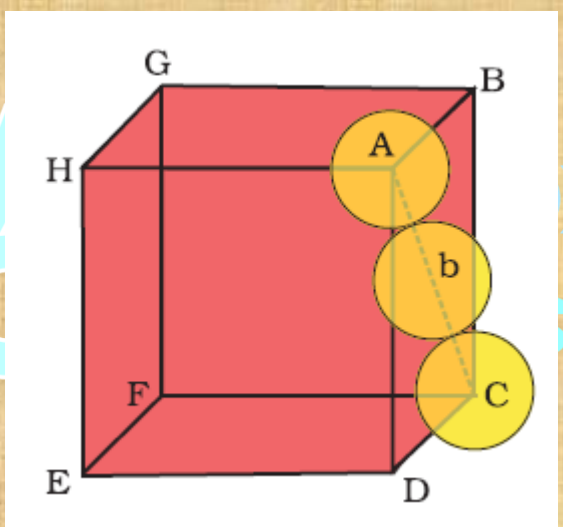

Fig. Cubic close packing other sides are not provided with spheres for sake of clarity.

In CCP particles meet along face diagonal let edge length of the unit cell ‘a’ and face diagonal of the unit cell ‘b’.

In ΔABC,

$$AC^2 = AB^2 + BC^2$$

$$\Rightarrow b^2 = a^2 + a^2$$

$$\Rightarrow b^2 = 2a^2 \Rightarrow b^2 = \sqrt{2}\,a$$

If 'r' is radius of sphere,

$$b = 4r = \sqrt{2}\,a$$

$$\Rightarrow a = \frac{4\pi}{\sqrt{2}} = 2\sqrt{2}\,r$$

$$\Rightarrow \boxed{a = 2\sqrt{2}\,r}$$

No of particles in CCP $= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 1 + 3 = 4$

$$\therefore \text{ Packing efficiency} = \frac{\text{No of particles} \times \text{Volume of sphere}}{\text{The volume of the unit cell}} \times 100$$

$$= \frac{4 \times \frac{4}{3}\pi r^3}{\left(2\sqrt{2}\,r\right)^3} \times 100 = 74\%$$