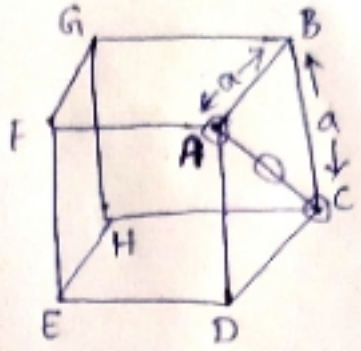
packing efficiency in Face centered cubic structure



In ΔABC,

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

$b^2 = a^2 + a^2$

$b = \sqrt{2}\,a$ — (1)

Let r be the radius of the sphere

$AC = r + 2r + r = 4r$ — (2)

from (1) & (2)

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

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

$$\text{Packing efficiency} = \frac{Z \times \text{Volume occupied by atoms} \times 100}{\text{Volume of unit cell}}$$

$$= \frac{4 \times \frac{4}{3}\pi r^3 \times 100}{a^3}$$

$$= \frac{\frac{16}{3} \times \pi r^3 \times 100}{16\sqrt{2}\,r^3}$$

$$= \frac{100\pi}{3\sqrt{2}} = 74\%$$

The packing efficiency of FCC is 74%.
Thus 26% volume is empty space.