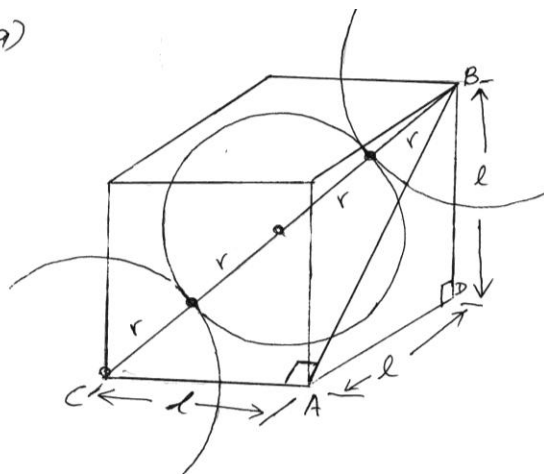
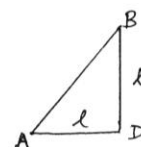
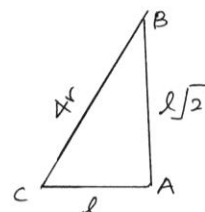


Q7 (a)

Body-centered cubic
(bcc)

$$AB^2 = l^2 + l^2 = 2l^2$$

$$AB = l\sqrt{2}$$



$$BC^2 = l^2 + (l\sqrt{2})^2$$

$$BC^2 = l^2 + 2l^2 = 3l^2$$

$$\therefore BC = l\sqrt{3} = 4r$$

$$4r = l\sqrt{3}$$

$$\therefore r = \frac{l\sqrt{3}}{4}$$

$$= \frac{2.87\sqrt{3}}{4}$$

$$r = 1.24 \text{ \AA} \text{ (Ans) .}$$

Q7 (b)

$$\text{Cell Volume} = l^3$$

$$= \left(\frac{4r}{\sqrt{3}}\right)^3$$

$$\left(\frac{1}{8} \times 8\right) + 1 = 2$$

$$l\sqrt{3} = 4r$$

$$\therefore l = \left(\frac{4r}{\sqrt{3}}\right)$$

1 unit cell = 2 atom Fe

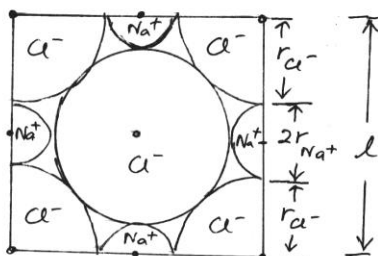
$$\therefore \text{Volume of 2 atom Fe} = 2 \times \frac{4}{3} \pi r^3$$

$$\% \text{ space occupied by Fe atom} = \frac{(2 \times \frac{4}{3} \pi r^3)}{\left(\frac{4r}{\sqrt{3}}\right)^3} \times 100 \quad \text{----- (i)}$$

$$= 68.02 \%$$

$$\% \text{ empty space} = 31.98 \%$$

(i.e. This empty space does not depend on the radius of the atom) - according to the equation (1).



face-centered cubic
(fcc)

Given: $r_{Na^+} = 0.99 \text{ \AA}$

$r_{Cl^-} = 1.81 \text{ \AA}$

$$\begin{aligned}
 l &= r_{Cl^-} + 2r_{Na^+} + r_{Cl^-} \\
 &= 2r_{Cl^-} + 2r_{Na^+} \\
 &= 2(1.81) + 2(0.99) \\
 &= (3.62 + 1.98) \text{ \AA} \\
 l &= 5.60 \text{ \AA} \text{ (Ans)}
 \end{aligned}$$

Each Na^+ ion is surrounded by 6 Cl^- ions and each Cl^- ion is surrounded by 6 Na^+ ions. So the coordination number = 6.