

12.7 This problem asks that we compute the atomic packing factor for the rock salt crystal structure when  $r_C/r_A = 0.414$ . From Equation 3.2

$$\text{APF} = \frac{V_S}{V_C}$$

With regard to the sphere volume,  $V_S$ , there are four cation and four anion spheres per unit cell. Thus,

$$V_S = (4)\left(\frac{4}{3}\pi r_A^3\right) + (4)\left(\frac{4}{3}\pi r_C^3\right)$$

But, since  $r_C/r_A = 0.414$

$$V_S = \frac{16}{3}\pi r_A^3 [1 + (0.414)^3] = (17.94) r_A^3$$

Now, for  $r_C/r_A = 0.414$  the corner anions in Table 12.2 just touch one another along the cubic unit cell edges such that

$$\begin{aligned} V_C &= a^3 = [2(r_A + r_C)]^3 \\ &= [2(r_A + 0.414r_A)]^3 = (22.62)r_A^3 \end{aligned}$$

Thus

$$\text{APF} = \frac{V_S}{V_C} = \frac{(17.94) r_A^3}{(22.62) r_A^3} = 0.79$$