4.25 This problems asks that we compute the unit cell edge length for a 90 wt% Fe-10 wt% V alloy. First of all, the atomic radii for Fe and V (using the table inside the front cover) are 0.124 and 0.132 nm, respectively. Also, using Equation 3.5 it is possible to compute the unit cell volume, and inasmuch as the unit cell is cubic, the unit cell edge length is just the cube root of the volume. However, it is first necessary to calculate the density and average atomic weight of this alloy using Equations 4.10a and 4.11a. Inasmuch as the densities of iron and vanadium are 7.87g/cm^3 and 6.10 g/cm^3, respectively, (as taken from inside the front cover), the average density is just

$$\rho_{ave} = \frac{100}{\frac{C_V}{\rho_V} + \frac{C_{Fe}}{\rho_{Fe}}}$$

$$= \frac{100}{\frac{10 \text{ wt\%}}{6.10 \text{ g/cm}^3} + \frac{90 \text{ wt\%}}{7.87 \text{ g/cm}^3}}$$

$$= 7.65 \text{ g/cm}^3$$

And for the average atomic weight

$$A_{ave} = \frac{100}{\frac{C_V}{A_V} + \frac{C_{Fe}}{A_{Fe}}}$$

$$= \frac{100}{\frac{10 \text{ wt\%}}{50.94 \text{ g/mole}} + \frac{90 \text{ wt\%}}{55.85 \text{ g/mol}}}$$

$$= 55.32 \text{ g/mol}$$

Now, V_C is determined from Equation 3.5 as

$$V_C = \frac{nA_{ave}}{\rho_{ave} N_A}$$

$$= \frac{(2 \text{ atoms/unit cell})(55.32 \text{ g/mol})}{(7.65 \text{ g/cm}^3)(6.023 \times 10^{23} \text{ atoms/mol})}$$