3.18 This problem calls for us to compute the atomic radius for Mg. In order to do this we must use Equation 3.5, as well as the expression which relates the atomic radius to the unit cell volume for HCP; from Problem 3.6 it was shown that

$$V_C = 6R^2c\sqrt{3}$$

In this case $c = 1.624a$, but, for HCP, $a = 2R$, which means that

$$V_C = 6R^2(1.624)(2R)\sqrt{3} = (1.624)(12\sqrt{3})R^3$$

And from Equation 3.5, the density is equal to

$$\rho = \frac{nA_{\text{Mg}}}{V_C N_{\text{A}}} = \frac{nA_{\text{Mg}}}{(1.624)(12\sqrt{3})R^3 N_{\text{A}}}$$

And, solving for R from the above equation leads to the following:

$$R = \left[\frac{nA_{\text{Mg}}}{(1.624)(12\sqrt{3})\,\rho\, N_{\text{A}}}\right]^{1/3}$$

$$= \left[\frac{(6 \text{ atoms/unit cell})(24.31 \text{ g/mol})}{(1.624)(12\sqrt{3})(1.74 \text{ g/cm}^3)(6.023 \times 10^{23} \text{ atoms/mol})}\right]^{1/3}$$

$$= 1.60 \text{ x } 10^{-8} \text{ cm} = 0.160 \text{ nm}$$