

$$\rho = \frac{(2 \text{ atoms/unit cell})(52.00 \text{ g/mol})}{\left[\frac{(4)(1.25 \times 10^{-8} \text{ cm})}{\sqrt{3}} \right]^3 / \text{unit cell} (6.023 \times 10^{23} \text{ atoms/mol})}$$

$$= 7.18 \text{ g/cm}^3$$

The value given in the table is 7.19 g/cm^3 .

Copper has an FCC crystal structure; therefore,

$$\rho = \frac{(4 \text{ atoms/unit cell})(63.55 \text{ g/mol})}{\left[(2)(1.28 \times 10^{-8} \text{ cm})(\sqrt{2}) \right]^3 / \text{unit cell} (6.023 \times 10^{23} \text{ atoms/mol})}$$

$$= 8.89 \text{ g/cm}^3$$

The value given in the table is 8.94 g/cm^3 .

Cobalt has an HCP crystal structure, and from Problem 3.7,

$$V_C = \frac{3\sqrt{3}a^2c}{2}$$

and, since $c = 1.623a$ and $a = 2R = 2(1.25 \times 10^{-8} \text{ cm}) = 2.50 \times 10^{-8} \text{ cm}$

$$V_C = \frac{3\sqrt{3}(1.623)(2.50 \times 10^{-8} \text{ cm})^3}{2} = 6.59 \times 10^{-23} \text{ cm}^3/\text{unit cell}$$

Also, there are 6 atoms/unit cell for HCP. Therefore the theoretical density is

$$\rho = \frac{nA_{\text{Co}}}{V_C N_A}$$

$$= \frac{(6 \text{ atoms/unit cell})(58.93 \text{ g/mol})}{(6.59 \times 10^{-23} \text{ cm}^3/\text{unit cell})(6.023 \times 10^{23} \text{ atoms/mol})}$$

$$= 8.91 \text{ g/cm}^3$$

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