

## Problem 30

The volume of Earth is on the order of  $10^{21} \text{ m}^3$ . (a) What is this in cubic kilometers ( $\text{km}^3$ )? (b) What is it in cubic miles ( $\text{mi}^3$ )? (c) What is it in cubic centimeters ( $\text{cm}^3$ )?

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### Solution

Cube the appropriate conversion factors to get volume.

$$10^{21} \text{ m}^3 = 10^{21} \text{ m}^3 \times \left( \frac{1 \text{ km}}{10^3 \text{ m}} \right)^3 = 10^{21} \cancel{\text{m}^3} \times \frac{1^3 \text{ km}^3}{10^9 \cancel{\text{m}^3}} = 10^{12} \text{ km}^3$$

$$10^{21} \text{ m}^3 = 10^{21} \text{ m}^3 \times \left( \frac{1250 \text{ ft}}{381 \text{ m}} \right)^3 \times \left( \frac{1 \text{ mi}}{5280 \text{ ft}} \right)^3 = 10^{21} \cancel{\text{m}^3} \times \frac{1250^3 \cancel{\text{ft}^3}}{381^3 \cancel{\text{m}^3}} \times \frac{1^3 \text{ mi}^3}{5280^3 \cancel{\text{ft}^3}} \approx 10^{11} \text{ mi}^3$$

$$10^{21} \text{ m}^3 = 10^{21} \text{ m}^3 \times \left( \frac{10^2 \text{ cm}}{1 \text{ m}} \right)^3 = 10^{21} \cancel{\text{m}^3} \times \frac{10^6 \text{ cm}^3}{1^3 \cancel{\text{m}^3}} = 10^{27} \text{ cm}^3$$