

## Quiz 1 Solutions

- A. Lead levels as high as 150 parts per billion (ppb) by weight have been found in the tap water of DC residents. If the average resident drinks one glass (0.3 L) of tap water per day, estimate the annual consumption of lead, in grams per year.

$$\left[ \frac{0.3 \text{ L}}{\text{d}} \right] \left[ \frac{1000 \text{ g}_{\text{H}_2\text{O}}}{\text{L}} \right] \left[ \frac{150 \text{ g}_{\text{Pb}}}{10^9 \text{ g}_{\text{H}_2\text{O}}} \right] \left[ \frac{365 \text{ d}}{\text{y}} \right] = 0.016 \frac{\text{g}_{\text{Pb}}}{\text{y}}$$

## Quiz 1 Solutions

- B. Ten percent of ingested lead is retained in the body; the remainder is excreted very quickly. The average residence time of lead retained in the body is 5 years. Based on your answer to part A, estimate the stock of lead in the average body.

$$S = \tau F = [5 \text{ y}] \left[ \frac{0.016 \text{ g}_{\text{Pb}}}{\text{y}} \right] [0.1] = 0.0082 \text{ g}_{\text{Pb}} \approx 0.008 \text{ g}_{\text{Pb}}$$

## Quiz 1 Solutions

- C. What key assumption did you make in part B? Under what conditions would this be true?

- The calculation assumes the stock is in equilibrium—that is, that the flow of lead into the body is equal to the flow of lead out of the body.
- This would be true if the person had been ingesting lead at a roughly constant annual rate for a period much longer than 5 years.

## Quiz 1 Solutions

- D. Levels of lead in the blood greater than 50  $\mu\text{g}$  per 100 mL have been associated with clinical effects in adults. Convert this into ppb.

$$\left[ \frac{50 \mu\text{g}_{\text{Pb}}}{100 \text{ mL}_{\text{H}_2\text{O}}} \right] \left[ \frac{\text{mL}_{\text{H}_2\text{O}}}{1 \text{ g}_{\text{H}_2\text{O}}} \right] \left[ \frac{10^{-6} \text{ g}}{\mu\text{g}} \right] = 5 \cdot 10^{-7} \frac{\text{g}_{\text{Pb}}}{\text{g}_{\text{H}_2\text{O}}} = 500 \text{ ppb}$$

- E. If the stock of lead in part B is uniformly distributed throughout the body, what is the concentration of lead in body tissues? Assume the average man weighs 70 kg:

$$c = \frac{0.0082 \text{ g}_{\text{Pb}}}{70,000 \text{ g}} = 1.2 \cdot 10^{-7} \frac{\text{g}_{\text{Pb}}}{\text{g}} = 120 \text{ ppb}$$