CONCEPT: PARTS PER MILLION (PPM)

- Extremely dilute solution concentrations are expressed in *parts per* _____ *(ppm)* or *parts per* _____ *(ppb).*
  - □ Units can be mass or volume based.

Parts per Million (ppm)

- Represents the number of parts (_____ or _____) per one million (10^6) parts.
  - □ In aqueous solutions: 1 ppm = 1 mg/L.

Parts per Million: [mass]

$$\text{ppm} = \frac{\text{of solute}}{\text{of solution}} \times 10^6$$

OR

Parts per Million: [volume]

$$\text{ppm} = \frac{\text{of solute}}{\text{of solution}} \times 10^6$$

EXAMPLE: What is the concentration in parts per million of DDT (nonbiodegradable pesticide) in 2.0 mg in 1.0 kg needlefish tissue?

Parts per Billion (ppb)

- Represents the number of parts (grams or mL) per one billion (10^9) parts.
  - □ In aqueous solutions: 1 ppb = 1 µg/L.

Parts per Billion: [mass]

$$\text{ppb} = \frac{\text{of solute}}{\text{of solution}} \times 10^9$$

OR

Parts per Billion: [volume]

$$\text{ppb} = \frac{\text{of solute}}{\text{of solution}} \times 10^9$$

EXAMPLE: A 2.4 L sample of an aqueous solution contains 0.012 mL of NH_3. What is the concentration of NH_3 in the solution, expressed as parts per billion?

A) 1500 ppb B) 5000 ppb C) 2000 ppb D) 500 ppb

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PRACTICE: A 5.12 L sample of solution contains 0.230 g of potassium sulfate, K_2SO_4. Determine the concentration of K_2SO_4 in ppm if the density of the solution is 1.30 g/mL.

a. 34.6 ppm b. 28.9 ppm c. 22.3 ppm d. 43.6 ppm

PRACTICE: Calculate the concentration in parts per billion of the following aqueous solution: 0.91 mg of caffeine in a total volume of 131 mL.

a. 0.14 ppb b. 0.0069 ppb c. 140 ppb d. 6900 ppb

PRACTICE: Glucose makes up about 0.102% by mass of human blood. Calculate this concentration in ppm.

a. 102 ppm b. 0.102 ppm c. 0.00102 ppm d. 1020 ppm

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PRACTICE: The average human body contains about 5,000 grams of blood. What mass of arsenic is present in the body if the amount in blood is 0.86 ppb?

a. 5.8×10^{12} g b. 4.3×10^{12} g c. 4.3×10^{-6} g d. 5.8×10^{-6} g

PRACTICE: A water sample contains the pollutant chlorobenzene with a concentration of 16 ppm (by volume). What volume of this water contains 5.01×10^{2} mL of chlorobenzene?

a. 3.1×10^{7} mL b. 3.2×10^{4} mL c. 1.6×10^{6} mL d. 8.0×10^{10} mL