Example 2-2: Calculating equivalents How many grams of calcium will be required to combine with 90 g of carbonate to form calcium carbonate?

SOLUTION

1. Carbonate (CO_3^{2-}) is a radical composed of carbon and oxygen. In this particular combination, carbon has an atomic mass of 12 and a valence of +4, while oxygen has an atomic mass of 16 and a valence of −2. Therefore, the radical has a total valence of −2 and an equivalence of 2. One equivalent of carbonate is

$$\frac{12 + 3(16)}{2} = 30 \text{ g/equiv}$$

2. The calcium ion has an atomic mass of 40 and a valence of +2; therefore, one equivalent of calcium is

$$\frac{40}{2} = 20 \text{ g/equiv}$$

3. The number of equivalents of calcium must equal the number of equivalents of carbonate, therefore

$$\frac{90 \text{ g}}{30 \text{ g/equiv}} = 3 \text{ equiv of carbonate}$$

Therefore, 3 equiv × 20 g/equiv = 60 g of calcium, and that amount will be required to react with 90 g of carbonate.

Example 2-3: Determining equivalent concentrations What is the equivalent calcium carbonate concentration of (*a*) 117 mg/L of NaCl and (*b*) 2×10^{-3} mol of NaCl?

SOLUTION

(*a*) 1. One equivalent of calcium carbonate is

$$\frac{40 + 12 + 3(16)}{2} = 50 \text{ g/equiv} = 50{,}000 \text{ mg/equiv} = 50 \text{ mg/mequiv}$$

2. One equivalent of sodium chloride is

$$\frac{23 + 35.5}{1} = 58.5 \text{ g/equiv} = 58.5 \text{ mg/mequiv}$$

3. By Eq. (2-2)

$$\frac{117 \text{ mg/L}}{58.5 \text{ mg/mequiv}} \times 50 \text{ mg/mequiv} = 100 \text{ mg/L of NaCl as } CaCO_3$$

(*b*) 1. One mole of a substance divided by its valence is one equivalent

$$\frac{2 \times 10^{-3} \text{ mol/L}}{1 \text{ mol/equiv}} = 2 \times 10^{-3} \text{ equiv/L}$$

2. Thus, 2×10^{-3} equiv/L × 50,000 mg/equiv = 100 mg/L

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