Part II (2)

2. Calculate the total, carbonate, and non-carbonate hardness of the water (include contributions made by iron and manganese).

$Ca^{2+} = 120 \text{ mg/L} \left(\frac{50}{40/2}\right) = 300 \text{ mg/L as } CaCO_3$

$Mg^{2+} = 39 \text{ mg/L} \left(\frac{50}{24/2}\right) = 162.5 \text{ mg/L as } CaCO_3$

$Fe^{2+} = 6.2 \text{ mg/L} \left(\frac{50}{56/2}\right) = 11.07 \text{ mg/L as } CaCO_3$

$Mn^{2+} = 0.3 \text{ mg/L} \left(\frac{50}{55/2}\right) = 0.55 \text{ mg/L as } CaCO_3$

Total Hardness = $Ca^{2+} + Mg^{2+} + Fe^{2+} + Mn^{2+}$ → in mg/L as $CaCO_3$

$= 300 + 162.5 + 11.07 + 0.55$

$= 474.12 \text{ mg/L as } CaCO_3$

Carbonate hardness = 347.93 mg/L = Alkalinity in 1. because in this water alkalinity is less than hardness.

non-carbonate hardness = total hardness − carbonate hardness

$= 474.12 - 347.93$

$= 126.19 \text{ mg/L as } CaCO_3$

3. How many mL of 0.02 NH_2SO_4 would be required to neutralize the bicarbonate alkalinity in a 50 mL sample?

bicarbonate alkalinity = 345.90 mg/L as $CaCO_3$ → from 1.

Since $\text{Alkalinity} = \frac{(\text{mL acid}) \times N \times 50000}{\text{mL sample}}$

$345.90 \text{ mg/L as } CaCO_3 = \frac{\text{mL acid} \times 0.02 \times 50000}{50}$

$\text{mL acid} = \frac{345.90 \times 50}{0.02 \times 50000} = 17.3 \text{ mL}$