

Objective:

Calculate the percentage of Na₂CO₃ in the unknown sample:

Assuming that:

Part I (molarity of HCl by standardization):

- a) 1000mL of ~ 0.1 mol of HCl was prepared by diluting 12.06 **mol** concentrated HCl
- b) 0.1855 g of (dry/room temp.) Na₂CO₃ was weighted and used for titration.
- c) In average, 35.18 mL HCl was consumed to the end point of titration.
- d) Calculate the *exact* molarity of the HCl solution:

$$\frac{0.1855 \text{ g}}{106.0 \text{ g/mol}} \times \frac{2 \text{ mol HCl}}{1 \text{ mol Na}_2\text{CO}_3} \times \frac{1000 \text{ mL}}{35.18 \text{ mL}} = 0.0995 \text{ M}$$

Part II (determination of sodium carbonate in unknown)

- a) The consumed volume of HCl for the unknown sample = 43.20 mL (First titration)
- b) The mass of the dried unknown sample = 0.9113 g (First sample)

Solution:

$$(0.0995 \text{ mol}) / (1000 \text{ mL}) \times 43.20 \text{ mL} = 4.298 \times 10^{-3} \text{ mol HCl}$$

$$(1 \text{ mol Na}_2\text{CO}_3 / 2 \text{ mol HCl})(4.298 \times 10^{-3} \text{ mol HCl}) = 2.149 \times 10^{-3} \text{ mol Na}_2\text{CO}_3$$

Mass = mol × Molecular weight

$$\text{Mass of Na}_2\text{CO}_3 = (2.149 \times 10^{-3}) (106.0) = 0.2278 \text{ g}$$

The Na₂CO₃ % in the unknown sample for the first titration:

$$X_1 = [(0.2278 \text{ g Na}_2\text{CO}_3) / (0.9113 \text{ g unknown})] \times 100 = 24.99 \approx 25.0 \%$$

X₂ (for the second titration)

X_n (for the nth titration)

$$X_{\text{ave}} = (25.0 + X_2 + X_3 + \dots + X_n) / (\text{number of titrations})$$

Notes:

Standard Deviation: SD

$$\text{Relative Standard Deviation: } RSD = \frac{SD}{\text{mean}}$$

$$RSD (\text{ppm}) = RSD \times 1000$$

$$95\% \text{ CL} = \text{mean} \pm \frac{(t \times SD)}{\sqrt{n}}$$