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Analytical Chemistry

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Alkalinity of Seawater

Abstract:

Introduction:

Experimental Methods:

Inclusion of Raw Data:

Table I: Raw Collected Data

Results and Discussions:

Net Ionic Equations:

Na2CO3 dissolving in the acid:

$Na_2CO_3 + H + HSO_4^- \rightarrow CO_2 + 2Na^+ + SO_4^{2-} + H_2O$

1st End Point:

$2CO_3^{2-} + H^+ + HSO_4^- \rightarrow 2HCO_3^- + SO_4^{2-}$

2nd End Point:

$2HCO_3^- + H^+ + HSO_4^- \rightarrow 2CO_2 + SO_4^{2-} + 2H_2O$

<u>Part I: Indicator Titration:</u>

Table II: Part I Calculated Results

Calculations:

Mass of Na2CO3 = 105.9998g/mol

Molarity of Sulfuric Acid solution:

Trial 1: .0204g / 105.9998g/mol x 1/23.90mL x 1000mL / 1L = .00805M

Trial 2: .0207g / 105.9998g/mol x 1/23.40mL x 1000mL / 1L = .00835M

Average: (.00835M + .00805M) / 2 = .0082M

Indicator Titrations:

Concentration of CO_3^{2-} in Seawater based on Indicator:

Both trials is 0 considering the color of the sample did not change when the phenolphthalein was added.

Concentration of HCO_3^- in Seawater based on Indicator:

Trial 1:

14.50mL H_2SO_4 x 1L / 1000mL x .0082M x 2mol CO_3^{2-} / 1mol H_2SO_4 x 1 / .1L seawater = .002378M CO_3^{2-}

Trial 2:

14.10mL H_2SO_4 x 1L / 1000mL x .0082M x 2mol CO_3^{2-} / 1mol H_2SO_4 x 1 / .1L seawater = .0023124M CO_3^{2-}

Average Concentration: .002345M

Alkalinity based on Indicator Titration:

$[Alk] = [HCO_3^-] + 2x[CO_3^{2-}]$

$[Alk] = .002345M + 2x(0M) = .002345M$

Part I Discussions:

<u>Part II: pH Meter Titrations:</u>

Table III: Part II Calculated Results

pH Titrations:

pK1 and K1:

Na_2CO_3:

pK1: 5.2 / = 2.6mL, pH at 2.6mL is ~9.49

K1: $10^{-9.49} = 3.24 \times 10^{-10}$

Trial 1:

pK1 = 2.4 / 2 = 1.2 mL, pH at 1.2mL is 7.91

K1 = $10^{-7.91} = 1.23 \times 10^{-8}$

Trial 2:

pK1 = .9 / 2 = .45mL, pH at .4mL is 7.81

K1 = $10^{-7.81} = 1.55 \times 10^{-8}$

Average pK1 = (7.91 + 7.81) / 2 = 7.86

Average K1 = (1.23x10^-8 + 1.55x10^-8) / 2 = 1.39x10^-8

pK2 and K2:

Na2CO3:

pK2: (2.4 + 28.8) / 2 = 15.6mL, pH at 15.6mL = ~6.86

K2: 10^-6.86 = 1.38x10^-7

Trial 1:

pK2 = (2.4 + 7) / 2 = 4.7mL, pH at 4.7mL is 6.25

K2 = 10^-6.25 = 5.62x10^-7

Trial 2:

pK2 = (.9 + 6.9) / 2 = 3.9mL, pH at 3.9mL is 6.13

K2 = 10^-6.13 = 7.41x10^-7

Average pK2: (6.25 + 6.13) / 2 = 6.19

Average K2: (5.62x10^-7 + 7.41x10^-7) / 2 = 6.52x10^-7

Concentration of CO32- in Seawater:

Trial 1:

.0082M x 2mol CO32- / .05L x .0023L = .00105M

Trial 2:

.0082M x 2mol CO32- / .05L x .0009L = 2.952x10^-4M

Average Concentration: (.00105M + 2.952x10^-4M) / 2 = 6.726x10^-4M

Concentration of HCO3- in Seawater:

Trial 1:

7.7mL – 2.3mL = 5.4mL – 2.3mL = 3.1mL for 2nd eqv point.

.0082M x 2mol HCO3- / .05L x .0031L = .00102M

Trial 2:

7.5mL - .9mL = 6.6mL - .9mL = 5.7mL for 2nd eqv point.

.0082M x 2mol CO32- / .05L x .0057L = .00187M

Average Concentration: (.00102M + .00187) / 2 = .00145M

Alkalinity Calculation:

[Alk] = [HCO3-] + 2x[CO32-]

[Alk] = .00102M + 2(6.726x10^-4M) = .00237M

Part II Discussions:

Overall Experiment Discussions:

Conclusion: