Name _____ Lab Partner _____

TA Name _____ Section _____ Date _____

Titration Curves Worksheet

As you work through the steps in the lab procedures, record your experimental values and the results on this worksheet.

Table A: Titration of KHP

Concentration of KHP solution	M
Volume of KHP solution titrated	mL
Concentration of NaOH solution	M
Calculated V_{eq} of NaOH solution	mL

1. From the values in Data Table A, calculate the theoretical equivalence volume (V_{eq}) for your KHP titration. Record this value in Data Table A.

Table B: Volume of Titrant Added to KHP vs pH

Volume NaOH added (mL)	pH	Observations	Volume NaOH added (mL)	pH	Observations

2a. From your titration curve, what is the experimental V_{eq} for your KHP titration? Label the V_{eq} on each copy of your KHP titration curve. Do not forget to subtract the initial buret reading when determining your V_{eq}.

2b. How do your theoretical and experimental equivalence volumes compare? What is their percent error?

$$\%\text{error} = \frac{\text{calculated - measured}}{\text{calculated}} \text{ x } 100$$

Table C: Titration of Na_2CO_3 with HCl

mL of 0.20 M NaOH added	Calculated pH (From prelab)	Measured pH (From titration curve)	% Difference
0.00			
10.00			
15.00			
20.00			
22.00			

3a. What is the experimental pK_a value for hydrogen phthalate (HP^- or $HC_8H_4O_4^-$) that you found at the midpoint of your KHP titration curve?

3b. The accepted value for the pK_a of HP^- is 5.408. How does this compare to your experimental value? What is their percent difference?

4. How did the endpoint indicated by the phenolphthalein compare to the equivalence point determined by the titration curve?

What conclusion can you make about the need for an indicator in a pH titration?

Table D: Titration of Na_2CO_3

Concentration of Na_2CO_3solution	M
Volume of Na_2CO_3solution titrated	mL
Concentration of HCl solution	M
Calculated first V_{eq} of HCl solution	mL
Calculated second V_{eq} of HCl solution	mL

5. From the values in Data Table D, calculate the theoretical first and second equivalence volumes (V_{eq}'s) for your Na_2CO_3 titration.

Table E: Volume of Titrant Added to Na_2CO_3 vs pH

Volume HCl added (mL)	pH	Observations

Volume HCl added (mL)	pH	Observations

6a. From your titration curve, what are the experimental first and second V_{eq}'s for your Na_2CO_3 titration? Label both V_{eq}'s on each copy of your Na_2CO_3 titration curve. Do not forget to subtract the initial buret reading when determining your V_{eq}'s.

6b. How do your theoretical and experimental equivalence volumes compare? What are their percent error?

Table F: Calculated vs Measured pH's for Na_2CO_3 Titration

mL of 0.20 M HCl added	Calculated pH (From prelab)	Measured pH (From titration curve)	% Difference (Calculated = actual)
0.00			
5.00			
10.00			
15.00			
20.00			
22.00			

7a. What are the experimental pK_a values for carbonic acid (H_2CO_3) and hydrogen carbonate (HCO_3^-) that you found at the midpoints of your Na_2CO_3 titration curve?

7b. The accepted values for the pK_a's of H_2CO_3 and HCO_3^- are 6.352 and 10.329, respectively. How do these compare to your experimental values? What are their percent error?

8. How did the endpoint indicated by the methyl orange compare to the equivalence points determined by the titration curve? What conclusion can you make about the need for an indicator in a pH titration?