Titration Curves Worksheet

As you work through the steps in the lab procedure, record your experimental values and the results on this worksheet. Use the exact values you record for your data to make later calculations.

Part B - Titration of KHP with NaOH

Complete the following table.

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

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}.

What is the percent difference between your theoretical and experimental equivalence volumes? (% Difference = ((Calculated − Measured) · 100)/Calculated.)

Complete the following table.

Table B. Calculated vs Measured pHs for KHP Titration

mL of 0.20 *M* NaOH added	**Calculated pH (from prelab)**	**Measured pH (from titration curve)**
0.00		
10.00		
15.00		
20.00		
22.00		

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? Label the pK_a on each copy of your KHP titration curve.

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?

Based on your endpoint indicated by the phenolphthalein and the equivalence point determined by the titration curve for your KHP titration using the pH electrode, which of the following are true? (Select all that apply.) (*Note: The order of these options may be different in the WebAssign question.*)

- The phenolphthalein changed color rapidly as the pH changed rapidly.
- The phenolphthalein was not necessary since the pH change indicated the equivalence point.
- The phenolphthalein was necessary; otherwise the equivalence point would have been missed.
- The phenolphthalein changed color rapidly after the pH changed rapidly.
- The endpoint and the equivalence point occurred together.
- The phenolphthalein changed color rapidly before the pH changed rapidly.

Part C - Titration of Na_2CO_3 with HCl

Complete the following table.

Table C. Titration of Na_2CO_3

Concentration of Na_2CO_3 solution	*M*
Volume of Na_2CO_3 solution titrated	mL
Concentration of HCl solution	*M*
Calculated first V_{eq} of HCl solution	mL
Calculated second V_{eq} of HCl solution	mL

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.
first V_{eq}

second V_{eq}

What is the percent difference between your theoretical and experimental equivalence volumes? (% Difference = ((Calculated − Measured) · 100)/Calculated.)
% difference first V_{eq}

% difference second V_{eq}

Complete the following table.

Table D. Calculated vs Measured pHs for Na_2CO_3 Titration

mL of 0.20 *M* HCl added	**Calculated pH (from prelab)**	**Measured pH (from titration curve)**
0.00		
5.00		
10.00		
15.00		
20.00		
22.00		

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? Label the pK_a's on each copy of your Na_2CO_3 titration curve.

pK_{a1}

pK_{a2}

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 differences?
% difference pK_{a1}

% difference pK_{a2}

Based on your endpoint indicated by the methyl orange and the equivalence points determined by the titration curve for your Na_2CO_3 titration using the pH electrode, which of the following are true? (Select all that apply.) (*Note: The order of these options may be different in the WebAssign question.*)

- The methyl orange was not necessary since the pH change indicated the first equivalence point.
- The endpoint and the first equivalence point occurred together.
- The methyl orange was necessary; otherwise the second equivalence point would have been missed.
- The methyl orange was not necessary since the pH change indicated the second equivalence point.
- The endpoint and the second equivalence point occurred together.
- The methyl orange changed color rapidly as the pH changed rapidly at the first equivalence point.
- The methyl orange changed color rapidly as the pH changed rapidly at the second equivalence point.