FLINN SCIENTIFIC

Name_____

Pre-Laboratory Assignment

Phosphoric acid is a triprotic acid (three ionizable hydrogens). The values of its stepwise ionization constants are $K_{a1} = 7.5 \times 10^{-3}$, $K_{a2} = 6.2 \times 10^{-8}$, and $K_{a3} = 4.2 \times 10^{-13}$.

1. Write the chemical equation for the first ionization reaction of phosphoric acid with water.

2. Write the equilibrium constant expression (K_{a1}) for this reaction.

3. What would be the pH of a solution when $[H_3PO_4] = [H_2PO_4^-]$? *Note:* pH = $-\log[H_3O^+]$.

4. Phenolphthalein would not be an appropriate indicator to use to determine K_{a1} for phosphoric acid. Why not? Choose a suitable indicator from the following color chart.

Indicator	**pH**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Phenolphthalein	Colorless							Pink		Red	
Methyl Red	Red				Orange		Yellow				
Orange IV	Orange		Peach		Yellow						

Data Table

Unknown	Trial	pH	pH (average)	pK_a	Unknown Identity
A	Sample 1				
	Sample 2				
B	Sample 1				
	Sample 2				
C	Sample 1				
	Sample 2				
D	Sample 1				
	Sample 2				
E	Sample 1				
	Sample 2				

Post-Laboratory Review Questions

1. Average the pH readings for each trial (samples 1 and 2) to calculate the average pK_a value for the unknown weak acids and enter answers in the Data Table.

2. Comment on the precision (reproducibility) of the pK_a determinations. Describe sources of experimental error and their likely effect on the measured pK_a (pH) values.

3. The following table lists the identities of the unknowns in this experiment. Complete the table by calculating the pK_a value for each acid. *Note:* $pK_a = -\log K_a$.

Acid	Formula	K_a	pK_a
Potassium dihydrogen phosphate	KH_2PO_4	K_{a2} of $H_3PO_4 = 6.2 \times 10^{-8}$	
Potassium hydrogen sulfate	$KHSO_4$	K_{a2} of $H_2SO_4 = 1.0 \times 10^{-2}$	
Potassium hydrogen phthalate	$KHC_8H_4O_4$	K_{a2} of $H_2C_8H_4O_4 = 3.9 \times 10^{-6}$	
Potassium hydrogen tartrate	$KHC_4H_4O_6$	K_{a2} of $H_2C_4H_4O_6 = 4.6 \times 10^{-5}$	
Acetylsalicylic acid	$2\text{-}CH_3CO_2C_6H_4COOH$	$K_a = 3.2 \times 10^{-4}$	

4. Compare the experimental pK_a value for each unknown with the literature values reported in question 3. Determine the probable identity of each unknown and enter the answers in the Data Table.

5. Write separate equations for each unknown potassium salt dissolving in water and for the ionization reaction of the weak acid anion that each of these salts contains. (See Equations 7 and 8.)

6. Why was it not necessary to know the exact mass of each acid sample?

7. Why was it not necessary to know the exact concentration of the sodium hydroxide solution?

8. Why was it necessary to measure the exact volume of distilled water used to dissolve the acid, as well as the exact volume of solution transferred from the beaker to the Erlenmeyer flask?