FLINN SCIENTIFIC

Name_____

Student Worksheet

Record the color of each solution then refer to the indicator chart to determine the pH range for each of the added indicators.

Data Table

		Cl_3CCOOH	$ClCH_2COOH$	CH_3COOH
Methyl Red	Color			
	pH			
Bromphenol Blue	Color			
	pH			
Orange IV	Color			
	pH			
Universal Indicator "Rainbow Acid"	Color			
	pH			

Indicator Chart

Indicator		Acid Color	Transition Color	Base Color
Methyl Red	Color	Red	Peach or Orange	Yellow
	pH	<4.8	4.8–6.0	>6.0
Bromphenol Blue	Color	Yellow	Olive Green	Blue/Violet
	pH	<3.0	3.0–4.6	>4.6
Orange IV	Color	Red	Peach or Orange	Yellow
	pH	<1.4	1.4–2.8	>2.8
Universal Indicator	Color	See Chart		
	pH	1–7		

Questions

1. Based on your observations, what range of pH values does the half-neutralized acetic acid solution fall into? What is the range for the half-neutralized chloroacetic acid solution? For the half-neutralized trichloroacetic acid solution?

2. For a weak acid (HA), K_a, the dissociation constant, is equal to:

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

The pH of a weak acid solution can be expressed as the Henderson-Hasselbach equation:

$$pK_a + \log \frac{[A^-]}{[HA]} \qquad \textit{Equation 2}$$

For weak acids with K_a values of 1×10^{-2} or less, at half-neutralization the conjugate base concentration, $[A^-]$, is essentially equal to the weak acid concentration, [HA]. Equation 2 becomes

$pH = pK_a + \log(1)$ or
$pH = pK_a$

The pK_a for the 3 weak acids are:

	$\mathbf{pK_a}$
Acetic acid	4.75
Chloroacetic acid	2.85
Trichloroacetic acid	0.70

Do your pH range estimations agree with these values? If not, what are some possible explanations?