CHEM1612 Worksheet 6 – Answers to Critical Thinking Questions

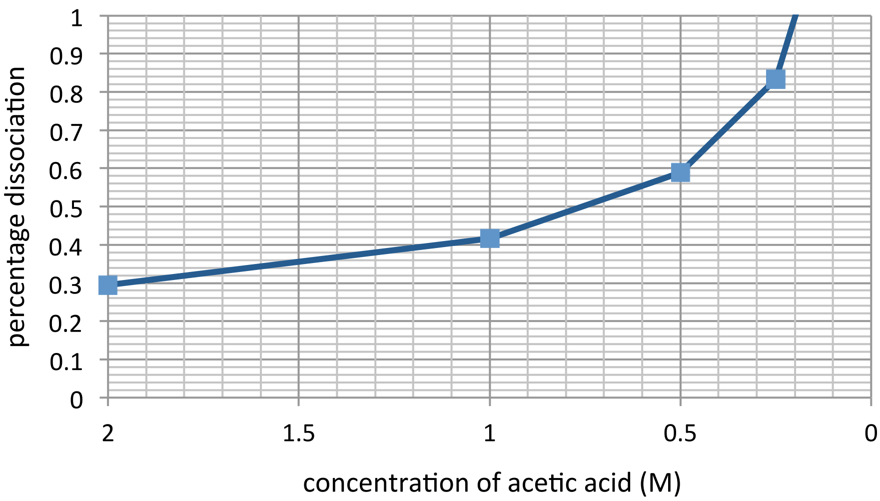
The worksheets are available in the tutorials and form an integral part of the learning outcomes and experience for this unit.

Model 1: Strong and Weak Acids

1. The major species present are $H_3O^+(aq)$, $Cl^-(aq)$ and $H_2O(l)$. There is essentially no "HCl(aq)".
2. The major species present are $CH_3COOH(aq)$ and $H_2O(l)$. The percentage ionization is very small and there is *very* little $H_3O^+(aq)$, $CH_3COO^-(aq)$.
3. $CH_3COO^-(aq)$ is the *dominant* species only at high pH.
4. $CH_3COOH(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + CH_3COO^-(aq)$ $K_a = \dfrac{[H_3O^+(aq)][CH_3COO^-(aq)]}{[CH_3COOH(aq)]}$
5. The *major* species present are $CH_3NH_2(aq)$ and $H_2O(l)$.
6. $CH_3NH_3^+(aq)$ is the *dominant* species only at low pH.
7. (a) Aspirin is absorbed in the stomach. In the intestine, it is deprotonated.
   (b) Amphetamine is absorbed in the intestine. In the stomach, it is protonated.

Model 2: A Solution Containing a Weak Acid

1. $[CH_3COOH(aq)]_{initial} = 2.0$ M and $[CH_3COOH(aq)]_{equilibrium} = 2.0 - x$.
   The small x approximation corresponds to the approximation:
   $$[CH_3COOH(aq)]_{equilibrium} = [CH_3COOH(aq)]_{initial}$$
2. $x = \sqrt{K_a \times [HA]_{initial}}$ or $pH = -\log_{10}(\sqrt{K_a \times [HA]_{initial}})$
3. (a) pH = 2.229, % dissociation = 0.30
   (b) pH = 2.380, % dissociation = 0.42
   (c) pH = 2.531, % dissociation = 0.59
   (d) pH = 2.681. % dissociation = 0.83
4. See below.



5. The *degree* of dissociation *increases* as the weak acid is diluted, even though the *amount* of dissociated acid *decreases*.
6. $H_2O(l)$ and $CH_3COOH(aq)$. The amount of dissociation is very small (< 1%) and so the amount of $CH_3COO^-(aq)$ and $H_3O^+(aq)$ is tiny.

Model 3: Addition of Strong Base to a Solution of a Weak Acid

1. pH = 4.158

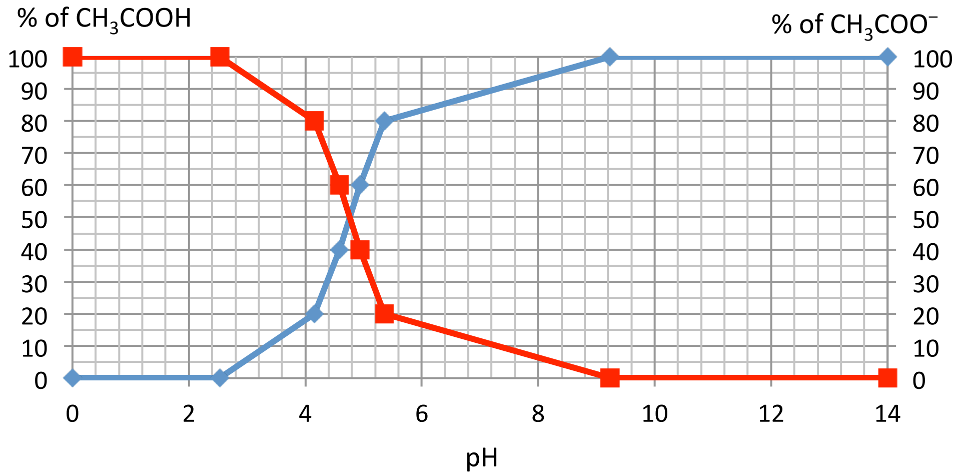
2. See table below.

Amount of NaOH(s) added (mol)	0.000	0.100	0.200	0.300	0.400	0.500
[CH_3COOH(aq)] (M)	0.500	0.400	0.300	0.200	0.100	0.000
[CH_3COO^-(aq)] (M)	0.000	0.100	0.200	0.300	0.400	0.500
pH	**2.5**	**4.2**	**4.6**	**4.9**	**5.4**	**9.2***

* This value is calculated using Model 4.

3. pH = 4.8

4. See below.



Model 4: Neutralizing a Weak Acid

1. [CH_3COO^-(aq)] = 0.500 M.

2. pH = 9.23