

## AP Chemistry Chapter 14 Answers – Zumdahl

### 14.27

a.

$\text{HClO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_3\text{O}^+(\text{aq}) + \text{ClO}_4^-(\text{aq})$ . Only the forward reaction is indicated since  $\text{HClO}_4$  is a strong acid and is basically 100% dissociated in water. For acids, the dissociation reaction is commonly written without water as a reactant. The common abbreviation for this reaction is:  $\text{HClO}_4(\text{aq}) \rightarrow \text{H}^+(\text{aq}) + \text{ClO}_4^-(\text{aq})$ . This reaction is also called the  $K_a$  reaction as the equilibrium constant for the reaction is called  $K_a$ .

b.

Propanoic acid is a weak acid, so it is only partially dissociated in water. The dissociation reaction is:  $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_3\text{O}^+ + \text{CH}_3\text{CH}_2\text{CO}_2^-(\text{aq})$  or  $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}(\text{aq}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{CH}_3\text{CH}_2\text{CO}_2^-(\text{aq})$ .

c.

$\text{NH}_4^+$  is a weak acid. Similar to propanoic acid, the dissociation reaction is:



### 14.29

An acid is a proton ( $\text{H}^+$ ) donor and a base is a proton acceptor. A conjugate acid-base pair differs by only a proton ( $\text{H}^+$ ).

	Acid	Base	Conjugate Base of Acid	Conjugate Acid of Base
a.	$\text{H}_2\text{CO}_3$	$\text{H}_2\text{O}$	$\text{HCO}_3^-$	$\text{H}_3\text{O}^+$
b.	$\text{C}_5\text{H}_5\text{NH}^+$	$\text{H}_2\text{O}$	$\text{C}_5\text{H}_5\text{N}$	$\text{H}_3\text{O}^+$
c.	$\text{C}_6\text{H}_5\text{NH}^+$	$\text{HCO}_3^-$	$\text{C}_6\text{H}_5\text{N}$	$\text{H}_2\text{CO}_3$

### 14.31

Strong acids have a  $K_a \gg 1$  and weak acids have  $K_a < 1$ . Table 14.2 in the text lists some  $K_a$  values for weak acids.  $K_a$  values for strong acids are hard to determine so they are not listed in the text. However, there are only a few common strong acids so if you memorize the strong acids, then all other acids will be weak acids. The strong acids to memorize are  $\text{HCl}$ ,  $\text{HBr}$ ,  $\text{HI}$ ,  $\text{HNO}_3$ ,  $\text{HClO}_4$ , and  $\text{H}_2\text{SO}_4$ .

a.

$\text{HClO}_4$  is a strong acid.

b.

$\text{HOCl}$  is a weak acid ( $K_a = 3.5 \times 10^{-8}$ ).

c.

$\text{H}_2\text{SO}_4$  is a strong acid.

d.

$\text{H}_2\text{SO}_3$  is a weak diprotic acid with  $K_{a1}$  and  $K_{a2}$  values less than one.

### 14.33

The  $K_a$  value is directly related to acid strength. As  $K_a$  increases, acid strength increases. For water, use  $K_w$  when comparing the acid strength of water to other species. The  $K_a$  values are:



# Modern Chemistry Answer Key Review

**Eugene Meyer**



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