

# Calculations Involving Acidic Solutions

Chapter 8.4

# Strong Acids

- Since strong acids almost completely ionize in water, we can assume that the concentration of hydrogen ions is equal to the concentration of the acid.
- Ex: A solution of hydrochloric acid has a concentration of 0.1mol/L. Calculate:
  - a)  $[H^+]$
  - b)  $[OH^-]$
  - c) pH
  - d) pOH

# Weak Acids and Percent Ionization

- Percentage ionization is the percentage of a solute that ionizes when it dissolves in a solvent

$$\text{percentage ionization} = \frac{\text{concentration of ionized acid}}{\text{initial concentration of acid}} \times 100 \%$$



$$\text{percentage ionization} = \frac{[\text{H}^+(\text{aq})]}{[\text{HA(aq)}]} \times 100 \% \quad \text{OR} \quad [\text{H}^+(\text{aq})] = \frac{\text{percentage ionization}}{100 \%} \times [\text{HA(aq)}]$$

# Example

- Calculate the  $K_a$  of hydrofluoric acid,  $\text{HF}_{(\text{aq})}$ , if a  $0.100\text{mol/L}$  solution at equilibrium has a percent ionization of  $7.8\%$ .

# Using $K_a$ to find pH

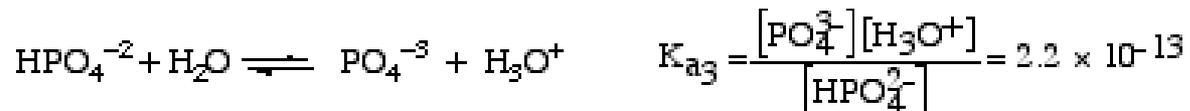
- Calculate the pH of a 0.10mol/Lacetic acid solution.  $K_a$  for acetic acid is  $1.8 \times 10^{-5}$ .

# Using pH to find $K_a$

- A student prepares a 0.20mol/L aqueous solution of ascorbic acid, and measures its pH as 2.40. Based on this evidence, what is the  $K_a$  of ascorbic acid?

# Polyprotic Acids

- A **monoprotic acid** is an acid that possesses only one ionizable (acidic) hydrogen atom
- A polyprotic acid is an acid that possesses more than one ionizable (acidic) hydrogen atom



- Notice that the value of  $K_{a1}$  is much greater than the value of  $K_{a2}$

# Polyprotic Acids

Acid	Formula	$K_{a1}$	$K_{a2}$	$K_{a3}$
oxalic acid	$\text{H}_2\text{C}_2\text{O}_4(\text{aq})$	$5.4 \times 10^{-2}$	$5.4 \times 10^{-5}$	–
ascorbic acid	$\text{H}_2\text{C}_6\text{H}_6\text{O}_6(\text{aq})$	$7.9 \times 10^{-5}$	$1.6 \times 10^{-12}$	–
sulfuric acid	$\text{H}_2\text{SO}_4(\text{aq})$	very large	$1.0 \times 10^{-2}$	–
hydrosulfuric acid	$\text{H}_2\text{S}(\text{aq})$	$1.1 \times 10^{-7}$	$1.3 \times 10^{-13}$	–
phosphoric acid	$\text{H}_3\text{PO}_4(\text{aq})$	$7.1 \times 10^{-3}$	$6.3 \times 10^{-8}$	$4.2 \times 10^{-13}$
arsenic acid	$\text{H}_3\text{AsO}_4(\text{aq})$	$5 \times 10^{-3}$	$8 \times 10^{-8}$	$4.0 \times 10^{-12}$
carbonic acid	$\text{H}_2\text{CO}_3(\text{aq})$	$4.4 \times 10^{-7}$	$4.7 \times 10^{-11}$	–

$$K_{a1} > K_{a2} > K_{a3}$$

# Practice

- Calculate the pH of a 1.00mol/L solution of sulfuric acid,  $\text{H}_2\text{SO}_{4(\text{aq})}$ .

# HOMework

## Required Reading:

p. 512-525

(remember to supplement your notes!)

## Questions:

p. 513 #1,2

p. 516 #1,2

p. 520 #1,2

p. 521 #1,2

p. 524 #1,2

p. 525 #1-10a

Silent labs, difficult labs

All with math, all with graphs

Observations of colors and smells

Calculations and graph curves like bells

Memories of tests that have past

Oh, how long will chemistry last?

Silent labs, difficult labs

All with math, all with graphs

Lots of equations that need balancing

titration problems that make my head ring

Santa Chemistry's on his way

Oh, Please Santa bring me an 'A'.