**19.1: Properties of Acids and bases**

|  |  |
| --- | --- |
| ACIDS | BASES |
| Sour |  |
|  | Slippery |
|  | Turns litmus blue |
| Reacts with and corrodes metals |  |
| Lemon juice, vinegar | Soaps, cleaning supplies |

**- The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Model:**

**- Acids**

- \_\_\_\_ is the first element in a formula

- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in aqueous solutions to form \_\_\_\_\_ ions (or hydronium ion \_\_\_\_\_\_)

- Increases the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of H+ ions

- Hydrolysis: dissolving in water to form H3O+ ions

- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: a hydrogen atom that transfers from an acid

- Monoprotic acids: contain \_\_\_\_ acidic hydrogen. ex)

- Diprotic acids: contain \_\_\_\_ acidic hydrogens. ex)

- Triprotic acids: contain \_\_\_\_ acidic hydrogens. ex)

- Polyprotic acids: contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_ acidic hydrogens

**- Bases**

- produces hydroxide ions (\_\_\_\_\_\_\_\_) when it dissolves in water

- simplest: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (like NaOH) containing (\_\_\_\_\_\_\_)

**19.2: Strength of Acids and Bases**

- Strength is not concentration

- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ : compare the ***strengths*** of acids and bases

- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ : describe the ***concentration*** of solutions.

- The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ determines the behavior or the solution

**- Strong Acids and Bases**

- Completely \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in water - Dissociates =

Mg(OH)2(aq)→ HCl(aq)→

|  |  |
| --- | --- |
| **List of Strong Acids and Bases** | |
| **Strong Acids** | **Strong Bases** |
| HCl – hydrochloric acid  HBr - hydrobromic acid  HI – hydroiodic acid  HNO3 – nitric acid  H2SO4 – sulfuric acid  HClO4 – perchloric acid | Groups 1 & 2  NaOH  KOH  LiOH  RbOH  CsOH  Ca(OH)2  Ba(OH)2  Sr(OH)2 |

**- Weak Acids and Bases**

- Reaches \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

- Most molecules don’t \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

- Acetic acid (HC2H3O2); HCHO2 - Ammonia (NH3); Al(OH)3; Fe(OH)3

- **Brønsted-Lowry model**

- **Acid**: a proton (H+) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - after donating H+, a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is formed

- **Base**: a proton (H+) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - after accepting H+, a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is formed

- Conjugate-acid base pair

Acid → conjugate base Base → conjugate acid

- Identify Conjugate Acid-Base pairs:

- ex1) HClO2(aq) + H2O(l) ↔ H3O+(aq) + ClO2-(aq)

- ex2) NH4+(aq) + OH-(aq) ↔ NH3(aq) + H2O(l)

- ex3) CO32-(aq) + H2O(l) ↔ HCO3-(aq) +OH-(aq)

- ex4) HSO4-(aq) + H2O(l) ↔ H3O+(aq) +SO42-(aq)

**19.3: pH**

- Self-ionization of water: H2O(l) H+(aq) + OH-(aq) or 2H2O(l) H3O+(aq) + OH-(aq)

Kw =

- Ionic or basic?

- When [H+] \_\_\_\_\_ [OH-], the solution is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

- When [H+] \_\_\_\_\_ [OH-], the solution is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

- When [H+] \_\_\_\_\_ [OH-], the solution is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

- Practice finding [H+] & OH-]: The concentration of either the H+ ion or OH- ion is given. For each solution, calculate [H+] or [OH-]. State whether the solution is acidic, basic, or neutral.

ex1) [H+] = 1.0x10-5*M*

ex2) [H+] = 1.0x10-13*M*

ex3) [OH-] = 1.0x10-7*M*

ex4) [OH-] = 1.0x10-3*M*

- Measuring pH

**-pH measures** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ turn different colors at different pHs

- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ measure the exact pH of a solution

**- pH:**

- a mathematical scale

- measures \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of hydronium ion (H3O+ or H+) in solutions

- Range: - pH \_\_\_\_\_ 7 is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

- pH \_\_\_\_\_ 7 is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ lower numbers = more acidic, less basic

- pH \_\_\_\_\_ 7 is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ higher numbers = more basic, less acidic

- pH scale: shows \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

- pOH scale: shows \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

- Relationship between pH and pOH:

**- Calculating pH and pOH from [H+]**

- ex5) If a carbonated soft drink has a hydrogen ion concentration of 7.3 x 10–4*M*, what are the pH and pOH of the soft drink?

-Practice: Calculate the pH and the pOH of each of the following ion concentrations:

Ex6) [OH-] = 1.0x10-6*M*

Ex7) [OH-] = 6.5x10-4*M*

Ex8) [H+] = 3.6x10-9*M*

Ex9) [H+-] = 0.025 *M*

**- Calculating ion concentrations from pH**

[H+] = [OH-] =

- ex10) What are [H+] and [OH–] in a solution with a pH of 9.70?

-Practice: The pH is given for three solutions. Calculate [H+] and [OH-] in each solution.

ex11) pH = 2.37

ex12) pH = 11.05

ex13) pH = 6.50

**-Calculating pH of strong acids and bases :**

-Remember, strong acids and bases completely break into their ions in water

HCl(aq)→

-For every HCl molecule, 1 H+ ion is produced. So, [H+] = \_\_\_\_\_\_\_\_\_\_

Mg(OH)2(aq)→

-For every Mg(OH)2 molecule, 2 OH- ions are produced. So, [Mg(OH)2] = \_\_\_\_\_\_\_\_\_\_

-Practice calculating pH of strong acids and bases:

-ex14) 1.0 *mol/L* HI

-ex15) 0.050 *mol/L* HNO3

-ex16) 1.0 *M* KOH

-ex17) 2.4x10-5 *M* Mg(OH)2

**19.4 : Neutralization**

- Neutralization reaction : the reaction of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_ → \_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_ → \_\_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_

- **Acid-base \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_:** The process of determining the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an acid or a base through the use of an acid-base reaction.

-Reactant: \_\_\_\_\_\_\_\_\_\_\_\_ molarity + \_\_\_\_\_\_\_\_\_\_\_\_ molarity →

- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_:Solutions of known molarity used in titrations.

- The known reactant molarity is used to find the unknown molarity of the other solution.

- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: A substance used to “locate” the equivalence point of a titration.

- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: the point in the reaction where stoichiometrically equal amounts of acid and base have been added

- For weak base-strong acid reaction, mixing equal moles of acid and base \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ produce a neutral solution.

- Calculations: **Mbase Vbase = Macid Vacid**

-ex1) A 0.100*M* LiOH solution was used to titrate an HBr solution of unknown concentration. At the endpoint, 21.0 mL of LiOH solution had neutralized 10.0 mL of HBr. What is the molarity of the HBr solution?

-ex2) A 0.350 *M* LiOH solution was used to titrate an HBr solution of unknown concentration. At the endpoint, 75.0 mL of LiOH solution had neutralized 25.0 mL of HBr. What is the molarity of the HBr solution?

-ex3) 100 mL of 0.75 *M* HCl is used to titrate 150 mL NaOH. What is the concentration of NaOH?

**-Buffer:** a solution that \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ in pH

-Prepared by using a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with one of its \_\_\_\_\_\_\_\_\_ (is conjugate base/conjugate acid)