Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_\_\_\_

**Acid-Base Neutralization Reactions**

**Information:**

**Acid** – a compound that produces H+ (aq), hydrogen ions (or hydronium ions, H3O+ (aq)) as positive ions in aqueous solution, a solution with H+ > OH-

**Base** – a compound that produces OH- (aq), hydroxide ions as negative ions in aqueous solution,
a solution with OH- > H+

**Neutral solution** – contains hydrogen (or hydronium) ions and hydroxide ions in equal concentrations.

**Spectator ions** – ions present in acidic and basic solutions that do not participate in the neutralization reaction between the H+(aq) (hydrogen ions) and OH-(aq) (hydroxide ions). Spectator ions can be positive or negative, and they are present in quantities needed to produce electrically neutral solutions.

**A/B Model:**



*Note: spectator ions are not shown in this model, but they are present in each solution.*

**Key Questions**

1. Compare the amount (concentration) of H+ and OH- in the each solution above.

|  |  |  |
| --- | --- | --- |
| **Solution A** | **Solution B** | **Solution C** |
|   |  |  |

1. Identify the acidic solution in the model. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Identify the basic solution in the model. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Identify the neutral solution in the model. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Exercises**

1. Based upon the information presented in the key of the Model, ***draw*** reactants and products when an H+ ion is combined with an OH- ion to form a compound.

Write a balanced equation for the reaction above.

1. Would the final solution be acidic or basic if solution A and solution B were mixed? Explain your answer.

**Neutralization (titration) Calculations**

In a neutral solution the moles of H+ = moles of OH-

Molarity (M) = moles solute

 1 liter solution

**Problems**

1. How many moles of H+ ions are present in 1 liter of 2.0 M HCl? Explain your reasoning.
2. How many moles of OH- ions are needed to completely neutralize 1 liter of 2.0 M HCl?
3. How many moles of OH- ions are present in one liter of 0.50 M NaOH? Explain your reasoning.
4. How many moles of H+ ions are needed to completely neutralize one liter of 0.50 M NaOH?
5. How many moles of OH- are needed to completely neutralize 0.50 liter of 2.0 M HCl?

**Using Stoichiometry in Neutralization (titrations)**

Refer to the following example to solve the following problems.

**How many mL of 2.0 M NaOH are required to exactly neutralize 100.0 mL of a 3.0 M solution of HBr?**

1. *Write a balanced equation*: NaOH + HBr 🡪 NaBr + H2O

Notice: for every mole of HBr, there is 1 mole of H+ and for every mole of NaOH, there is 1 mole of OH-

1. *Determine the moles of H+:* 3.0M = x mol x = 0.30 molH+ , therefore 0.300 mol of OH- is needed

 0.100L

c. *Determine the mL of NaOH*: 2.0M = 0.30 mol x = 0.15 L, 0.15 L of NaOH is required to neutralize the HBr
 x L

Refer to the example above to solve #12-13.

1. How many mL of 2.0 M HBr are needed to exactly neutralize 20.0 mL of 4.0 M KOH? Remember, write a balanced equation first.
2. How many mL of 2.0 M KOH are required to exactly neutralize 100.0 mL of a 3.0 M solution of HCl? Remember, write a balanced equation first.

**A short-cut method for solving titration calculations**

**MAVANA = MBVBNB**

**MA** = molarity of acid **MB** = molarity of base

**VA** = volume of acid **VB** = volume of base

**NA** = # of H+ ions in acid **NB** = # of OH- ions in base

Use the short-cut above to solve 14-16.

1. If 50.0 mL of 3.0 M HNO3 completely neutralized 150.0 mL of KOH, what was the molarity (M) of the KOH solution?
2. How many mL of 2.0 M HBr are required to exactly neutralize 30.0 mL of a 4.0 M solution of Mg(OH)2?
3. If 50.0 mL of 3.0 M H3PO4 completely neutralized 150.0 mL of Mg(OH)2, what was the molarity of the Mg(OH)2 solution?