Name:_____**Period:**_____
Ms. Randall
Unit 10: Acids, Bases, Salts Workbook

The **bold, underlined** words are **important vocabulary words** that you should be able to define and use properly in explanations. This is a study guide for what you will be tested on throughout the year. The objectives are divided into categories of "**Knowledge**" (**what you have to *know***) and "**Application**" (**what you have to be able to *do***).

ACIDS, BASES, AND SALTS		
	Knowledge	**Application**
1.	○ The behavior of many acids and bases can be explained by the Arrhenius Theory. ○ **Arrhenius acids** produce **H^+ (hydrogen ions)** as the only positive ions in aqueous solution. The hydrogen ion may also be written as **H_3O^+ and called the hydronium ion.** ○ **Arrhenius bases** produce **OH^- (hydroxide ions)** as the only negative ion is aqueous solution. (Table E)	○ Know the definitions of Arrhenius acids and bases ○ If given the properties, chemical formula, or name, identify a substance as an Arrhenius acid or Arrhenius base. *(Use Tables K, L, and T to help you remember these definitions. Arrhenius acids begin with H, Arrhenius bases are metals + hydroxide ion(s). *Don't be fooled by alcohols, which also end in OH, but contain covalent bonds and do not ionize like bases do in solution. ALCOHOLS ARE NOT BASES!)*
2.	○ Arrhenius acids, Arrhenius bases, and **salts** (ionic compounds) are all electrolytes. An **electrolyte** is a substance which, when dissolved in water, forms a solution capable of conducting an electric current (electricity). Electrolytes can conduct electricity because they **ionize** (break apart into ions) in a solution. ○ The ability of a solution to conduct an electric current depends on the concentration of the ions in it (more ions, more conduction).	○ Given names or chemical formulas, identify acids, bases, and salts as being electrolytes ○ Determine the relative strength (strong or weak) of an electrolyte given information on its ability to ionize in solution. *(Strong acids and strong bases are strong electrolytes – Tables K and L list acids and bases in order from strongest to weakest. If a salt is soluble, it is a strong electrolyte – Table F can be used to determine the solubility of different salts.)*
3.	○ In the process of **neutralization**, an Arrhenius acid and an Arrhenius base react to form a salt and water. Acid + Base → Salt + Water	○ Recognize neutralization reactions when given the reaction equation ○ Write neutralization reactions when given the reactants. *(Remember that this is a double replacement reaction. Just switch the positive ions, look up their charges and cross down the subscripts if needed. Then balance the equation.)*

4.	○ **Titration** is a laboratory process in which a volume of solution with a known concentration is added to another solution of unknown concentration. Titrations are done to determine the concentration of the unknown solution.	○ Calculate the concentration or volume of a solution, using titration data using the equation $M_a \times V_a = M_b \times V_b$ *(This equation is on Table T)*
5.	○ There are **alternate acid-base theories**. One such theory states that the acid is a **proton donor (H^+ donor)** and the base is a **proton acceptor**.	○ Give the alternate definitions of acids and bases ○ Use this definition to explain why ammonia is considered a base
6.	○ The **acidity** or **alkalinity** of an aqueous solution can be measured using the **pH scale**. ○ The pH scale measures the concentration of H^+/H_3O^+ in a solution. $[H^+] = 10^{-pH}$ *A pH of 1 means that the $[H^+] = 10^{-1} = 0.1M$* *A pH of 3 means that the $[H^+] = 10^{-3} = 0.001M$* □ Acids have pH values between 0 and 7 *(the stronger the acid, the lower the pH and the more H^+)* $[H^+] > [OH^-]$ □ Neutral solutions have a pH of 7 $[H^+] = [OH^-]$ □ Bases have pH values between 7 and 14 *(the stronger the base, the higher the pH and the more OH^-)* $[H^+] < [OH^-]$	○ Identify a solution as **acidic**, **basic (alkaline)**, or **neutral** based upon the pH value OR the relative concentrations of H^+/H_3O^+ and OH^- ○ Describe acidic, basic, and neutral solutions in terms of pH value and relative H^+/H_3O^+ and OH^- concentrations ○ Differentiate between strong acids/bases and weak acids/bases given pH values or ion concentrations
7.	○ The pH scale is a logarithmic scale, which means that a change of *one* pH unit changes the concentration of H^+/H_3O^+ by a factor of *ten* □ **tenfold** = 10 times = 10^1 □ **hundredfold** = 100 times = 10^2 □ **thousandfold** = 1000 times = 10^3 *The exponents represent the CHANGE in pH* ○ **If a solution becomes more acidic, the pH ↓, and the $[H^+]/[H_3O^+]$ ↑** ○ **If a solution becomes more basic, the pH ↑, and the $[H^+]/[H_3O^+]$ ↓**	○ Determine the new pH value of a solution given the starting pH and the amount of increase or decrease in $[H^+]/[H_3O^+]$ (such as tenfold, a hundredfold, or a thousandfold) *Ex: A lake with an initial pH of 6 has been affected by acid rain. The acid rain has caused a hundredfold change in the $[H^+]$ concentration of the lake. What is the new pH of the lake?* *Answer: pH = 4* ○ Determine the amount that the $[H^+]/[H_3O^+]$ would increase or decrease given a certain change in pH

8.	○ The pH of a solution can be shown by using **indicators**. ○ An indicator is a substance that changes color depending on the concentration of hydrogen/hydronium ions in a solution.	○ Interpret changes in acid-base indicator color ○ Explain how different indicators can be used to distinguish between solutions with different pH values ○ Identify appropriate indicators that can be used to show changes in pH values, such as during a titration, given starting and ending pH values

Goal setting: Based upon your learning style results and the information above list at least two techniques you plan to use to study during this unit.

1.
2.

What grade would you like to achieve on this unit based on your efforts? _____%

Lesson 1: <u>Chapter Diary 15</u>

<u>Objective:</u> To summarize concepts related to acids and bases

Directions: After reading the Chapter diary 15 answer the following questions

1. The acidity or alkalinity of a solution can be measured by its pH value.
    a. Does a higher or lower pH indicate an alkaline solution?

2. The relative level of acidity or alkalinity of a solution can be shown by using indicators.
    a. What table on your reference table lists these indicators?

3. Arrhenius acids yield H_3O^+ (hydronium ions) as the only positive ions in an aqueous solution.
    a. Give an example of an Arrhenius acid.

4. Arrhenius bases yield OH^- (hydroxide ions) as the only negative ions in an aqueous solution.
    a. Give an example of an Arrhenius acid.

5. Given properties, identify substances as Arrhenius acids or Arrhenius bases.
    a. What is the difference between an Arrhenius acid or Arrhenius base?

6. Identify solutions as acid, base, or neutral based upon the pH.
    a. What does a pH of 7 indicate? _____ 3? _____ 11? _____

7. Interpret changes in acid-base indicator color.
    a. Methyl orange indicator is placed into a solution and turns red. What is a possible pH of this solution?

List 10 facts from the reading

List any questions you may have from your reading:

Lesson 2: Acids and Bases are Electrolytes Date:_____

Objective: To compare and contrast the three types of electrolytes: acids, bases and salts.

Check your understanding:

1. Which substance is an Arrhenius acid?

(1) LiF(aq) (2) HBr(aq) (3) $Mg(OH)_2$(aq) (4) CH_3CHO(aq)

2. A sample of $Ca(OH)_2$ is considered to be an Arrhenius base because it dissolves in water to yield

(1) Ca^{2+} ions as the only positive ions in solution
(2) H_3O^+ ions as the only positive ions in solution
(3) OH^- ions as the only negative ions in solution
(4) H^- ions as the only negative ions in solution

3. The only positive ion found in an aqueous solution of sulfuric acid is the

(1) hydroxide ion (2) hydronium ion (3) sulfite ion (4) sulfate ion

4. Which compound is an Arrhenius base?

(1) CH_3OH (2) CO_2 (3) LiOH (4) NO_2

5. Which species can conduct an electric current?

(1) NaOH(s) (2) NaCl (s) (3) H2O(l) (4) HCl(aq)

6. According to the Arrhenius theory, when a base dissolves in water it produces

(1) CO_3^{2-} as the only negative ion in solution
(2) OH^{-1} as the only negative ion in solution
(3) NH_4^{+1} as the only positive ion in solution
(4) H^{+1} as the only positive ion in solution

Practice:

1. Use Table K and Table L to help you identify the rules for determining whether a substance is an acid, a base, or a salt based on the formula. Underline all the acids, circle bases, and box in salts. Leave the covalent substances alone.

NH_3	NaCl	CH_3OH	H_2SO_4	$Ca(OH)_2$	CH_4
NH_4Br	HCl	Na_2SO_4	HNO_3	CH_3COOH	NaOH
H_3PO_4	LiOH	$CH_2(OH)_2$	NH_4OH	$Ca(NO_3)_2$	$HC_2H_3O_2$

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- All acids have the _____ ion in common.
- All bases have the _____ ion in common.
- All salts have formulas:

  _____

2. Which formula represents a hydronium ion?
(1) H_3O^+ (2) OH^- (3) NH_4^+ (4) HCO_3^-

3. Which compound is an Arrhenius acid?
(1) H_2SO_4 (2) NaOH (3) KCl (4) NH_3

4. Which substance is an Arrhenius acid?
(1) $Ba(OH)_2$ (2) H_3PO_4 (3) CH_3COOCH_3 (4) NaCl

5. Which compound releases hydroxide ions in an aqueous solution?
(1) CH_3COOH (2) HCl (3) CH_3OH (4) KOH

6. The Arrhenius theory explains the behavior of
   (1) acids and bases
   (2) alcohols and amines
   (3) isomers and isotopes
   (4) metals and nonmetals

7. Which two compounds are electrolytes?
   (1) $C_6H_{12}O_6$ and CH_3CH_2OH
   (2) $C_6H_{12}O_6$ and HCl
   (3) NaOH and HCl
   (4) NaOH and CH_3CHOH

8. Given the equation:
   $HCl(g) + H_2O(l) \rightarrow X(aq) + Cl^-(aq)$
   Which ion is represented by X?
   (1) hydroxide (3) hypochlorite
   (2) hydronium (4) perchlorate

9. When one compound dissolves in water, the only positive ion produced in the solution is $H_3O^+(aq)$. This compound is classified as
   (1) a salt (2) a hydrocarbon
   (3) an Arrhenius acid (4) an Arrhenius base

10. An aqueous solution of lithium hydroxide contains hydroxide ions as the only negative ion in solution. Lithium hydroxide is classified as an
   (1) aldehyde (3) Arrhenius acid
   (2) alcohol (4) Arrhenius base

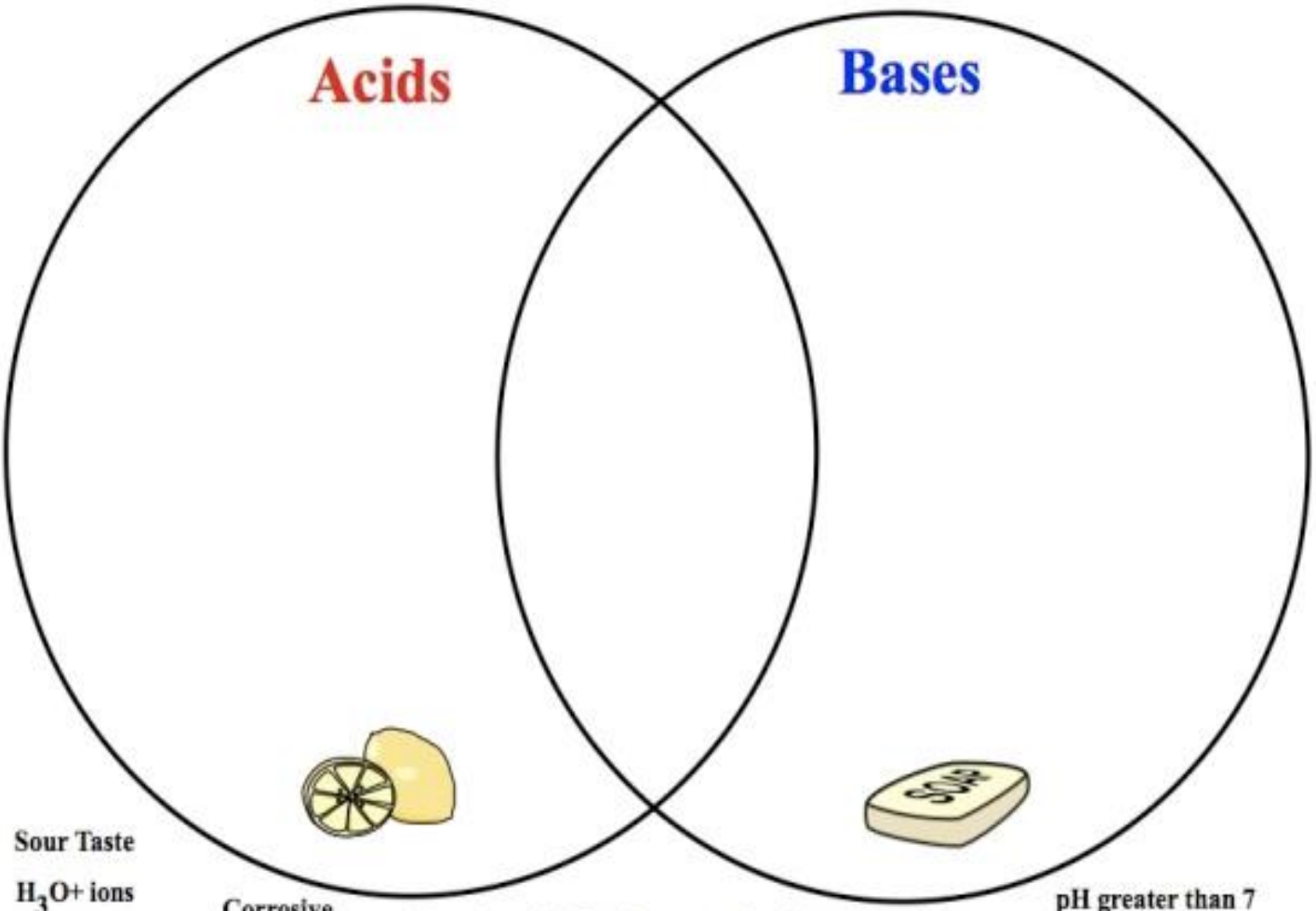
Lesson 3: Characteristics of Acids, Bases and salts **Date:_____**

Objective: To compare and contrast the chemical and physical properties of acids and bases

Check your understanding:

1. If a solution is acidic, what ion is causing this property? _____

2. If a solution is alkaline, what ion is causing this property? ____



Practice

1. Which compound is an Arrhenius acid?
   (1) H_2SO_4 (3) NaOH
   (2) KCl (4) NH_3

2. An Arrhenius base yields which ion as the only negative ion in an aqueous solution?
   (1) hydride ion (3) hydronium ion
   (2) hydrogen ion (4) hydroxide ion

3. Which two formulas represent Arrhenius acids?
   (1) CH_3COOH and CH_3CH_2OH
   (2) $HC_2H_3O_2$ and H_3PO_4
   (3) $KHCO_3$ and $KHSO_4$
   (4) NaSCN and $Na_2S_2O_3$

4. According to the Arrhenius theory, an acid is a substance that
   (1) changes litmus from red to blue
   (2) changes phenolphthalein to pink
   (3) produces hydronium ions as the only positive ions in an aqueous solution
   (4) produces hydroxide ions as the only negative ions in an aqueous solution

5. Which formula represents a hydronium ion?
   (1) H_3O^+ (2) OH^- (3) NH_4^+ (4) HCO_3^-

6. Which substance is an Arrhenius acid?
   (1) $Mg(OH)_2$ (2) H_2SO_4 (3) CH_3COOCH_3 (4) LiCl

7. Which compound releases hydroxide ions in an aqueous solution?
   (1) CH_3COOH (2) HF (3) CH_3OH (4) LiOH

8.. Which substance is an Arrhenius base?
   (1) CH_3OH (2) LiOH (3) CH_3Cl (4) LiCl

9. The only positive ion found in $H_2SO_4(aq)$ is the
   (1) ammonium ion (3) hydronium ion
   (2) hydroxide ion (4) sulfate ion

Practice with Acids and Metals:

1. According to Reference Table J, which of these metals will react most readily with 1.0 M HCl to produce $H_2(g)$?
   (1) Ca (2) K (3) Mg (4) Zn

2. Under standard conditions, which metal will react with 0.1 M HCl to liberate hydrogen gas?
   (1) Ag (2) Au (3) Cu (4) Mg

3. Because tap water is slightly acidic, water pipes made of iron corrode over time, as shown by the balanced ionic equation below:

   $2Fe(s) + 6H^+(aq) \rightarrow 2Fe^{3+}(aq) + 3H_2(g)$

   1. Explain, in terms of chemical reactivity, why copper pipes are less likely to corrode than iron pipes.

5. Many ancient cultural statues and buildings were made out of marble. Marble is a type of rock which contains the metal calcium in it. Explain, using Table *J*, why marble statues are damaged by acid rain.

6. During a laboratory activity, a student reacted a piece of zinc with 0.1 M HCl(aq).
   (a) Complete the equation below by writing the formula of the missing product.

$$Zn(s) + 2HCl(aq) \rightarrow \_\_\_\_\_ (aq) + H_2(g)$$

   (b) Identify *one* metal that does *not* react spontaneously with HCl(aq). _____

Lesson 4: Bronsted-Lowry and Buffers **Date:_____**

Objective: To relate weak acids and bases to buffering systems (Le Chatelier's revisited!)

Check your understanding:

1) According to the Bronsted-Lowry theory, what does H_3O^+ act as in the following reaction?

$CH_3COO^- + H_3O^+ \Leftrightarrow CH_3COOH + H_2O$

2) According to the Bronsted-Lowry theory, what does H_2O act as in the following reaction?

$HCl + H_2O \Leftrightarrow H_3O+ + Cl^-$

3) According to the Bronsted-Lowry theory, what does NH_3 act as in the following reaction?

$NH_2^- + H_2O \Leftrightarrow NH_3 + OH^-$

4) According to the Bronsted-Lowry theory, what does H_3O^+ act as in the following reaction?

$H_3O^+ + OH^- \Leftrightarrow H_2O + H_2O$

Practice: Please **circle** the correct answer.

1. One acid-base theory defines a base as an
   (1) H^+ donor (3) H donor
   (2) H^+ acceptor (4) H acceptor

2. One alternate acid-base theory states that an acid is a(n)
   (1) H^+ donor (3) OH^- donor
   (2) H^+ acceptor (4) OH^- acceptor

3. Given the balanced equation representing a reaction:

   $NH_3(g) + H_2O(l) \rightarrow NH_4^+(aq) + OH^-(aq)$

According to one acid-base theory, the $NH_3(g)$ molecules act as
   (1) an acid because they accept H^+ ions
   (2) an acid because they donate H^+ ions
   (3) a base because they accept H^+ ions
   (4) a base because they donate H^+ ions

4. Which statement describes an alternate theory of acids and bases?
   (1) Acids and bases are both H^+ acceptors.
   (2) Acids and bases are both H^+ donors.
   (3) Acids are H^+ acceptors, and bases are H^+ donors.
   (4) Acids are H^+ donors, and bases are H^+ acceptors.

Directions: For questions 5-7 please **circle the acids** and **underline the bases** in the following reactions.

5. $CH_3COO^- + H_3O^+ \leftrightarrow CH_3COOH + H_2O$

6. $H_3O^+ + OH^- \leftrightarrow H_2O + H_2O$

7. $NH_4^+ + HSO_4^- \leftrightarrow NH_3 + H_2SO_4$

8. $HCN + H_2O \leftrightarrow H_3O^+ + CN^-$

Lesson 5: pH and Indicators **Date: _____**

Objective: To categorize substances as acidic or basic based on concentration of H^+ ions in solution (pH)

Check your understanding:

1. When the pH of a solution changes from a pH of 5 to a pH of 3, the hydronium ion concentration is

(a) 0.01 of the original content (c) 10 times the original content
(b) 0.1 of the original content (d) 100 times the original content

2. Which pH change represents a hundredfold increase in the concentration of H_3O^{+1}?
(a) pH 5 to pH 7 b) pH 13 to pH 14 (c) pH 3 to pH 1 (d) pH 4 to pH 3

3. Which statement correctly describes a solution with a pH of 9?

(a) It has a higher concentration of H_3O^+ than OH^- and causes litmus to turn blue.
(b) It has a higher concentration of OH^- than H_3O^+ and causes litmus to turn blue.
(c) It has a higher concentration of H_3O^+ than OH^- and causes methyl orange to turn yellow.
(d) It has a higher concentration of OH^- than H_3O^+ and causes methyl orange to turn red.

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Practice:

1. **Fill in the chart below.**

pH Change	$[H_3O^+]$ increase or decrease?	$[OH^-]$ increase or decrease?	Does the solution become more acidic or basic?	By a factor of…
6 to 8				
8 to 5				
3 to 7				
11 to 9				
14 to 13				
4 to 8				

2. Which of these pH numbers indicates the highest level of acidity?
   (1) 5 (3) 10
   (2) 8 (4) 12

3. Which change in pH represents a hundredfold increase in the concentration of hydronium ions in a solution?
   (1) pH 1 to pH 2 (3) pH 2 to pH 1
   (2) pH 1 to pH 3 (4) pH 3 to pH 1

4. The pH of an aqueous solution changes from 4 to 3 when the hydrogen ion concentration in the solution is
   (1) decreased by a factor of 100
   (2) decreased by a factor of 10
   (3) increased by a factor of 100
   (4) increased by a factor of 10

5. Solution A has a pH of 3 and solution Z has a pH of 6. How many times greater is the hydronium ion concentration in solution A than the hydronium ion concentration in solution Z?

   (1) 100 (3) 3
   (2) 2 (4) 1000

6. Which indicator, when added to a solution, changes color from yellow to blue as the pH of the solution is changed from 5.5 to 8.0?

   (1) bromcresol green
   (2) bromthymol blue
   (3) litmus
   (4) methyl orange

7. Which indicator would best distinguish between a solution with a pH of 3.5 and a solution with a PH of 5.5?

   (1) bromthymol blue (3) litmus
   (2) bromcresol green (4) thymol blue

8. In which solution will bromcresol green appear blue?
   (1) 1 M NaCl (3) 1 M NH_3
   (2) 1 M H_2CO_3 (4) 1 M CH_3COOH

9. In which solution will thymol blue indicator appear blue?
   (1) 0.1 M CH_3COOH (3) 0.1 M KOH
   (2) 0.1 M HCl (4) 0.1 M H_2SO_4

10. what is the color of the indicator methyl orange in a solution that has a pH of 2?
   (1) blue (3) yellow
   (2) orange (4) red

11. In a solution with a pH of 3, what color is bromcresol green?
   (1) yellow (3) green
   (2) blue (4) red

12. A student used blue litmus paper and phenolphthalein paper as indicators to test the pH of distilled water and five aqueous household solutions. Then the student used a pH meter to measure the pH of the distilled water and each solution. The results of the student's work are recorded in the table below.

Testing Results

Liquid Tested	Color of Blue Litmus Paper	Color of Phenolphthalein Paper	Measured pH Value Using a pH Meter
2% milk	blue	colorless	6.4
distilled water	blue	colorless	7.0
household ammonia	blue	pink	11.5
lemon juice	red	colorless	2.3
tomato juice	red	colorless	4.3
vinegar	red	colorless	3.3

a) Identify the liquid tested that has the lowest hydronium ion concentration.

b) Explain, in terms of the pH range for color change on Reference Table M, why litmus is not appropriate to differentiate the acidity levels of tomato juice and vinegar.

c) Based on the measured pH values, identify the liquid tested that is 10 times more acidic than vinegar.

Use this info for Questions #13 & 14:
Calcium hydroxide is commonly known as agricultural lime and is used to adjust the soil pH. Before the lime was added to a field, the soil pH was 5. After the lime was added, the soil underwent a 100-fold decrease in hydronium ion concentration.

13. What is the new pH of the soil in the field?

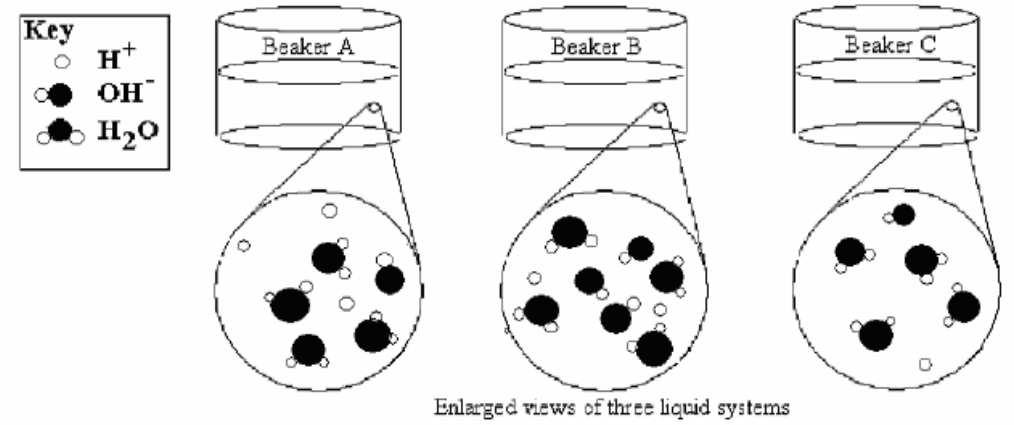
14. According to Reference Table *F*, calcium hydroxide is soluble in water. Identify another hydroxide compound that contains a Group 2 element and is also soluble in water.

Lesson 6: Neutralization and titrations **Date:_____**

Objective: To define neutralization as the reaction between an acid and base creating a salt and water.
To apply neutralization reactions to titrations

Check your understanding:

Model



Enlarged views of three liquid systems

Answer the Key Questions using the model above:

1. How does the concentration of H^+ compare to the concentration of OH^- in solution A?

2. How does the concentration of H^+ compare to the concentration of OH^- in solution B?

3. How does the concentration of H^+ compare to the concentration of OH^- in solution C?

4. Identify the acidic solution in the model.

5. Identify the basic solution in the model.

6. A neutral solution exists when $[H^+]=[(OH)^{-1}]$ .Identify the neutral solution in the model.

Directions: Write the products and balance the equation for each of the following reactions.
Example: 2 HBr + **1** Mg(OH)2 → **1** $MgBr_2$ + **2** H2O

7. ___ HNO_3 + ___ KOH →

8. __H_2SO_4 + ___ KOH →

9. If a chemist had 5 mL of 5 M HNO_3:

a. How much 5 M KOH would they need to neutralize it? _____

b. Would this value be the same for calcium hydroxide? Explain if more or less KOH would be needed. *(Hint: HNO_3 is a monoprotic acid, calcium hydroxide is a dihydroxy base... write out the formula first!)*

Practice:

1. What are the products of a reaction between KOH(aq) and HCl(aq)?
   (1) H_2 and KClO
   (2) H_2O and KCl
   (3) KH and HClO
   (4) KOH and HCl

2. Which word equation represents a neutralization reaction?
   (1) base + acid →salt + water
   (2) base + salt →water + acid
   (3) salt + acid →base + water
   (4) salt + water →acid + base

3. Which compound could serve as a reactant in a neutralization reaction?

   (1) NaCl (3) CH_3OH
   (2) KOH (4) CH_3CHO

4. Which substance is always a product when an Arrhenius acid in an aqueous solution reacts with an Arrhenius base in an aqueous solution?
   (1) HBr (3) KBr
   (2) H_2O (4) KOH

5. Which reactants form the salt $CaSO_4(s)$ in a neutralization reaction?

   (1) $H_2S(g)$ and $Ca(ClO_4)_2(s)$
   (2) $H_2SO_3(aq)$ and $Ca(NO_3)_2(aq)$
   (3) $H_2SO_4(aq)$ and $Ca(OH)_2(aq)$
   (4) $SO_2(g)$ and CaO(s)

6. Sulfuric acid, $H_2SO_4(aq)$, can be used to neutralize barium hydroxide, $Ba(OH)_2(aq)$. What is the formula for the salt produced by this neutralization?
   (1) BaS (3) $BaSO_3$
   (2) $BaSO_2$ (4) $BaSO_4$

7. Which chemical equation represents the reaction of an Arrhenius acid and an Arrhenius base?
   (1) $HC_2H_3O_2(aq) + NaOH(aq) \rightarrow NaC_2H_3O_2(aq) + H_2O(l)$
   (2) $C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(l)$
   (3) $Zn(s) + 2\ HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$
   (4) $BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2\ NaCl(aq)$

8. Which volume of 0.10 M $NaOH_{(aq)}$ exactly neutralizes 15.0 milliliters of 0.20 M $HNO_{3(aq)}$?
   (1) 1.5 mL (3) 3.0 mL
   (2) 7.5 mL (4) 30. mL

9. In which laboratory process could a student use 0.10 M NaOH(aq) to determine the concentration of an aqueous solution of HBr?
   (1) chromatography
   (2) decomposition of the solute
   (3) evaporation of the solvent
   (4) titration

10. The data collected from a laboratory titration are used to calculate the
   (1) rate of a chemical reaction
   (2) heat of a chemical reaction
   (3) concentration of a solution
   (4) boiling point of a solution

11. What volume of 0.120 M HNO_3(aq) is needed to completely neutralize 150.0 milliliters of 0.100 M NaOH(aq)?

   (1) 62.5 mL (3) 180. mL
   (2) 125 mL (4) 360. mL

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12. In a laboratory activity, 0.500 mole of NaOH(s) is completely dissolved in distilled water to form 400. milliliters of NaOH(aq). This solution is then used to titrate a solution of HNO_3(aq).

   (a) Identify the negative ion produced when the NaOH(s) is dissolved in distilled water. _____

   (b) What color is bromcresol green after it is added to a sample of NaOH(aq)?

   (c) Calculate the molarity of the NaOH(aq).

   (d) Complete the equation representing this titration reaction by writing the formulas of the products.

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13. In a titration, 15.65 milliliters of a KOH(aq) solution exactly neutralized 10.00 milliliters of a 1.22 M HCl(aq) solution.

   (a) Write the balanced equation for the titration reaction.

   (b) Show a correct numerical setup for calculating the molarity of the KOH(aq) solution.

14. In performing a titration, a student adds three drops of phenolphthalein to a flask containing 25.00 milliliters of HCl(aq). Using a buret, the student slowly adds 0.150 M NaOH(aq) to the flask until one drop causes the indicator to turn light pink. The student determines that a total volume of 20.20 milliliters of NaOH(aq) was used in this titration.

(a) The concentration of the NaOH(aq) used in the titration is expressed to what number of significant figures?

(b) Calculate the molarity of the HCl(aq) used in this titration. Your response must include both a correct numerical setup and the calculated result.

15. Indigestion may be caused by excess stomach acid (hydrochloric acid). Some products used to treat indigestion contain magnesium hydroxide. The magnesium hydroxide neutralizes some of the stomach acid. The amount of acid that can be neutralized by three different brands of antacids is shown in the data table below.

Antacid Brand	**Mass of Antacid Tablet** (g)	**Volume of HCl(aq) Neutralized** (mL)
X	2.00	25.20
Y	1.20	18.65
Z	1.75	22.50

(a) Based on Reference Table *F*, describe the solubility of magnesium hydroxide in water.

(b) Show a correct numerical setup for calculating the milliliters of HCl(aq) neutralized per gram of antacid tablet for *each* brand of antacid.

(c) Which antacid brand neutralizes the most acid per gram of antacid tablet?

Unit Study Guide

Law, Theories, BIG ideas	**Equations, Calculations, Reference Tables**
Laws:	Equation: (When to use & units)
Theories:	Calculations (When to use)
BIG ideas:	Reference Table (Hints & tricks)

Helpful tips, sayings, shortcuts

Things I always forget…

Unit Review: Acids, Bases, Salts

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

_____1. I can still do everything from Unit 1.	
_____2. I can still do everything from Unit 2.	
_____3. I can still do everything from Unit 3.	
_____4. I can still do everything from Unit 4.	
_____5. I can still do everything from Unit 5.	
_____6. I can still do everything from Unit 6.	
_____7. I can still do everything from Unit 7.	
_____8. I can still do everything from Unit 8.	
_____9. I can still do everything from Unit 9.	

_____10. I can use two different systems to define acids and bases.		**Arrhenius**	**"Alternate Method" (AKA Bronsted-Lowry)**
	acid		
	base		
_____11. I can define pH, [ ], hydronium ion, hydroxide ion, and electrolyte.	**Definitions:** pH [ ] hydronium ion hydroxide ion electrolyte		

_____9. I can state another name for the hydronium ion.	The hydronium ion is also known as the _____ _____.
_____10. Given the hydronium ion concentration, I can determine the pH.	If the $[H_3O^+]$ is 1 x 10^{-8}, the pH of the solution will be_____. If the $[H_3O^+]$ is 1 x 10^{-1}, the pH of the solution will be_____. If the $[H_3O^+]$ is 1 x 10^{-14}, the pH of the solution will be_____. If the $[H_3O^+]$ is 1 x 10^{-7}, the pH of the solution will be_____.
_____11. Based on pH, I can determine if a solution is acidic, basic, or neutral.	If the pH of a solution is 4.5, the solution is _____. If the pH of a solution is 7.0, the solution is _____. If the pH of a solution is 11, the solution is _____. If the pH of a solution is 5.7, the solution is _____.
_____12. I can state the relationship between H^+ concentration and pH.	As the H^+ concentration decreases , the pH _____. As the H^+ concentration increases, the pH _____.
_____13. I can determine the change in pH when the H^+ concentration of a solution is changed.	If the H^+ concentration is increased by a factor of 10, the pH will decrease by _____. If the H^+ concentration is increased by a factor of 100, the pH will decrease by _____. If the H^+ concentration is decreased by a factor of 1000, the pH will increase by _____.
_____14. I can give examples of the chemical names of common acids and bases.	List the chemical names of three common acids and three common bases. **Acids** | **Bases** | | | | | |

<table>
<tr><td>_____15. I can give examples of chemical formulas of common acids and bases.</td><td>List the chemical formulas of three common acids and three common bases.<table><tr><th>Acids</th><th>Bases</th></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr></table></td></tr>
<tr><td>_____16. I can define neutralization.</td><td><u>Definition:</u>
neutralization</td></tr>
<tr><td>_____17. I can identify a neutralization reaction from a list of reactions.</td><td>Which of the following equations is a neutralization reaction?
A) $6Na + B_2O_3$ -----> $3Na_2O + 2B$
B) $Mg(OH)_2 + 2HBr$ -----> $MgBr_2 + 2HOH$
C) $2H_2 + O_2$ -----> $2H_2O$
D) $2KClO_3$ -----> $2KCl + 3O_2$</td></tr>
<tr><td>_____18. I can state the name of the laboratory equipment that is used to carry out a titration.</td><td>Which piece of laboratory equipment is used to carry out a titration?</td></tr>
<tr><td>_____19. I can state the purpose of titration.</td><td>Why do scientists do titrations?</td></tr>
<tr><td>_____20. I can solve for any variable in the titration equation from Reference Table T.</td><td>If it requires 56.95 mL of 0.0043 M HNO_3 to neutralize 34.56 mL of LiOH, what is the concentration of the LiOH?</td></tr>
<tr><td>_____21. I can state the three types of substances that are electrolytes.</td><td>_____, _____, and _____ are three classes of compounds that are electrolytes.</td></tr>
<tr><td>_____22. Given the pH, I can determine the color of acid-base indicators.</td><td>Which indicator is red in a solution that has a pH of 3.6?
A) bromcresol green
B) bromthymol blue
C)litmus
D) thymol blue</td></tr>
</table>