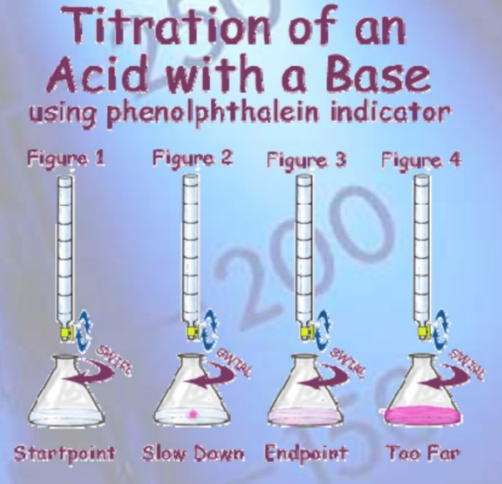
NGSS Regents Chemistry

PRACTICE PACKET

Unit 9: Acids, Bases & Salts



$$HC_2H_3O_2(aq) + H_2O(\ell) \leftrightarrow C_2H_3O_2^-(aq) + H_3O^+(aq)$$

Regents Chemistry **Acid/Base Properties**

1. Which laboratory test result can be used to determine if KCl(s) is an electrolyte?

   A) electrical conductivity of KCl(aq)
   B) pH of KCl(s)
   C) pH of KCl(aq)
   D) electrical conductivity of KCl(s)

2. Which substance is an electrolyte?

   A) CCl_4 B) HCl
   C) H_2O D) C_2H_6

3. Which sample of HCl(aq) contains the greatest number of moles of solute particles?

   A) 1.0 L of 2.0 M HCl(aq)
   B) 2.0 L of 2.0 M HCl(aq)
   C) 3.0 L of 0.50 M HCl(aq)
   D) 4.0 L of 0.50 M HCl(aq)

4. A substance is classified as an electrolyte because

   A) its aqueous solution conducts an electric current
   B) it contains covalent bonds
   C) it has a high melting point
   D) its aqueous solution has a pH value of 7

5. Water containing dissolved electrolyte conducts electricity because the solution contains mobile

   A) ions B) atoms
   C) electrons D) molecules

6. Which sample of HCl most readily conducts electricity?

   A) HCl(s) B) HCl(g)
   C) HCl(aq) D) HCl(ℓ)

7. A hydrogen ion, H^+, in aqueous solution may also be written as

   A) H_2O B) H_2O_2
   C) OH^- D) H_3O^+

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

   A) It has a higher concentration of H_3O^+ than OH^- and causes methyl orange to turn yellow.
   B) It has a higher concentration of H_3O^+ than OH^- and causes litmus to turn blue.
   C) It has a higher concentration of OH^- than H_3O^+ and causes litmus to turn blue.
   D) It has a higher concentration of OH^- than H_3O^+ and causes methyl orange to turn red.

9. Which pH indicates a basic solution?

   A) 12 B) 1 C) 7 D) 5

10. Which of these pH numbers indicates the highest level of acidity?

    A) 12 B) 5 C) 8 D) 10

11. Given the following solutions:

    Solution *A*: pH of 10
    Solution *B*: pH of 7
    Solution *C*: pH of 5
    Which list has the solutions placed in order of increasing H^+ concentration?

    A) *C, A, B* B) *B, A, C*
    C) *C, B, A* D) *A, B, C*

12. As an aqueous solution becomes more acidic, the hydroxide ion concentration

    A) decreases B) increases
    C) remains the same

13. Which of the following pH values indicates the highest concentration of hydronium ions in a solution?

    A) pH = 1 B) pH = 2
    C) pH = 3 D) pH = 4

14. As HCl(g) is added to water, the pH of the water solution

    A) decreases B) increases
    C) remains the same

Acid/Base Properties

15. Which relationship is present in a solution that has a pH of 7?

A) $[H^+] + [OH^-] = 7$ B) $[H^+] > [OH^-]$
C) $[H^+] < [OH^-]$ D) $[H^+] = [OH^-]$

16. Which could be the pH of a solution whose H_3O^+ ion concentration is less than the OH^- ion concentration?

A) 9 B) 2 C) 3 D) 4

17. What is the pH of an aqueous solution of $C_6H_{12}O_6$?

A) 1 B) 7 C) 11 D) 14

18. Which solution reacts with LiOH(aq) to produce a salt and water?

A) CaO(aq) B) KCl(aq)
C) H_2SO_4(aq) D) NaOH(aq)

19. Which word equation represents a neutralization reaction?

A) salt + water → acid + base
B) salt + acid → base + water
C) base + acid → salt + water
D) base + salt → water + acid

20. Which equation represents a neutralization reaction?

A) $HNO_3(aq) + KOH(aq) \rightarrow KNO_3(aq) + H_2O(\ell)$
B) $4Fe(s) + 3O_2(g) \rightarrow Fe_2O_3(s)$
C) $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$
D) $AgNO_3(aq) + KCl(aq) \rightarrow KNO_3(aq) + AgCl(s)$

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

A) $H_2SO_4(aq)$ and $Ca(OH)_2(aq)$
B) $H_2S(g)$ and $Ca(ClO_4)_2(s)$
C) $H_2SO_3(aq)$ and $Ca(NO_3)_2(aq)$
D) $SO_2(g)$ and CaO(s)

22. 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?

A) $BaSO_4$ B) $BaSO_3$
C) BaS D) $BaSO_2$

23. Given the reaction:

$Ba(OH)_2(aq) + H_2SO_4(aq) \rightarrow BaSO_4(s) + 2\ H_2O(\ell)$ + energy

As the barium hydroxide solution is added to the solution of sulfuric acid, the electrical conductivity of the acid solution decreases because the

A) concentration of ions increases
B) temperature of the reaction mixture decreases
C) volume of the reaction mixture increases
D) concentration of ions decreases

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

A) CH_3OH B) NaCl
C) CH_3CHO D) KOH

25. Which reaction occurs when hydrogen ions react with hydroxide ions to form water?

A) saponification B) neutralization
C) substitution D) ionization

26. Which equation represents a neutralization reaction?

A) $Na_2CO_3 + CaCl_2 \rightarrow 2\ NaCl + CaCO_3$
B) $H_2SO_4 + Mg(OH)_2 \rightarrow MgSO_4 + 2\ H_2O$
C) $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$
D) $Ni(NO_3)_2 + H_2S \rightarrow NiS + 2\ HNO_3$

27. What is the pH of a solution that results from the complete neutralization of an HCl solution with a KOH solution?

A) 1 B) 7 C) 10 D) 4

28. As an acid solution is added to neutralize a base solution, the OH^- concentration of the base solution

A) decreases B) increases
C) remains the same

Regents Chemistry **Acids & Bases as Electrolytes**

1. Which compound is an electrolyte?

   A) CH_3OH B) $C_6H_{12}O_6$
   C) $Ca(OH)_2$ D) CCl_4

2. Which two compounds are electrolytes?

   A) $C_6H_{12}O_6$ and HCl
   B) $C_6H_{12}O_6$ and CH_3CH_2OH
   C) NaOH and HCl
   D) NaOH and CH_3CH_2OH

3. A substance is classified as an electrolyte because

   A) its aqueous solution conducts an electric current
   B) it contains covalent bonds
   C) it has a high melting point
   D) its aqueous solution has a pH value of 7

4. A student tested a 0.1 M aqueous solution and made the following observations:
   - conducts electricity
   - turns blue litmus to red
   - reacts with Zn(s) to produce gas bubbles

   Which compound could be the solute in this solution?

   A) LiOH B) LiBr
   C) HBr D) CH_3OH

5. Which aqueous solution is the best conductor of an electrical current?

   A) 0.01 M KOH B) 0.01 M CH_3OH
   C) 0.1 M CH_3 OH D) 0.1 M KOH

Acids & Bases as Electrolytes

6. A student was given four unknown solutions. Each solution was checked for conductivity and tested with phenolphthalein. The results are shown in the data table below.

Solution	Conductivity	Color with Phenolphthalein
A	Good	Colorless
B	Poor	Colorless
C	Good	Pink
D	Poor	Pink

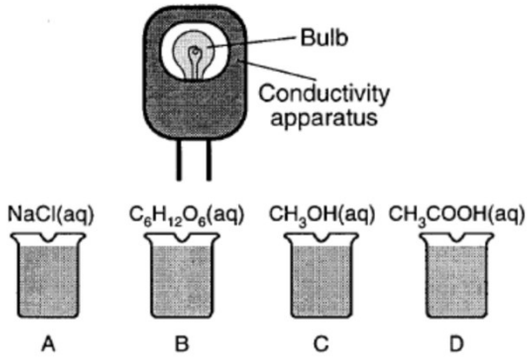
Based on the data table, which unknown solution could be 0.1 M NaOH?

A) *A* B) *B* C) *C* D) *D*

7. Which formula represents a compound that is a strong electrolyte?

A) HNO_2 B) HNO_3
C) $C_{12}H_{22}O_{11}$ D) $C_6H_{12}O_6$

8. Beakers *A, B, C,* and *D* shown below each contain a different solution.



The bulb will glow when the conductivity apparatus is placed into which beakers?

A) *A* and *D* B) *C* and *D*
C) *B* and *C* D) *A* and *B*

9. Water containing dissolved electrolyte conducts electricity because the solution contains mobile

A) ions B) atoms
C) electrons D) molecules

10. Which sample of HCl most readily conducts electricity?

A) HCl(s) B) HCl(g)
C) HCl(ℓ) D) HCl(aq)

11. Which of the following 0.1 M solutions is the best conductor of electricity?

A) $C_{12}H_{22}O_{11}$(aq) B) H_2S(aq)
C) HCl(aq) D) $C_6H_{12}O_6$(aq)

12. Which compound, in the liquid phase, conducts electricity best?

A) NH_3 B) NaOH
C) H_2O D) H_2S

13. Which substance is an electrolyte?

A) NaOH(s) B) H_2(g)
C) $C_6H_{12}O_6$(s) D) $C_2H_5OH(\ell)$

Regents Chemistry **Arrhenius Acid-Base Theory**

1. According to one acid-base theory, a water molecule acts as an acid when the molecule
   A) donates an H^+ ion
   B) donates an OH^- ion
   C) accepts an OH^- ion
   D) accepts an H^+ ion

2. Which compounds are classified as Arrhenius acids?
   A) HNO_3 and NaCl
   B) HBr and H_2SO_4
   C) HCl and NaOH
   D) NH_3 and H_2CO_3

3. Which substance yields $H^+(aq)$ as the only positive ion in an aqueous solution?
   A) CH_3COOH B) CH_3CH_2OH
   C) CH_3CHO D) CH_3OCH_3

4. Given the equation representing a reversible reaction:

   $NH_3(g) + H_2O(\ell) \leftrightarrow NH_4^+(aq) + OH^-(aq)$

   According to one acid-base theory, the reactant that donates an H^+ ion in the forward reaction is
   A) $NH_4^+(aq)$ B) $H_2O(\ell)$
   C) $OH^-(aq)$ D) $NH_3(g)$

5. When dissolved in water, an Arrhenius base yields
   A) hydronium ions B) hydroxide ions
   C) oxide ions D) hydrogen ions

6. Which compound is an Arrhenius acid?
   A) NH_3 B) HCl C) K_2O D) CaO

7. When one compound dissolves in water, the only positive ion produced in the solution is H_3O^+ (aq). This compound is classified as
   A) a hydrocarbon B) a salt
   C) an Arrhenius acid D) an Arrhenius base

8. Which substance is always a product when an Arrhenius acid in an aqueous solution reacts with an Arrhenius base in an aqueous solution?
   A) KBr B) H_2O
   C) KOH D) HBr

9. Given the equation:

   $HCl(g) + H_2O(\ell) \rightarrow X(aq) + Cl^-(aq)$

   Which ion is represented by X?
   A) perchlorate B) hypochlorite
   C) hydronium D) hydroxide

10. An aqueous solution of lithium hydroxide contains hydroxide ions as the only negative ion in the solution. Lithium hydroxide is classified as an
    A) alcohol B) aldehyde
    C) Arrhenius base D) Arrhenius acid

11. The Arrhenius theory explains the behavior of
    A) alcohols and amines
    B) metals and nonmetals
    C) acids and bases
    D) isomers and isotopes

12. Which two formulas represent Arrhenius acids?
    A) NaSCN and Na_2S_2O
    B) CH_3COOH and CH_3CH_2OH
    C) $HC_2H_3O_2$ and H_3PO_4
    D) $KHCO_3$ and $KHSO_4$

13. The compound NaOH(s) dissolves in water to yield
    A) hydroxide ions as the only negative ions
    B) hydroxide ions as the only positive ions
    C) hydronium ions as the only negative ions
    D) hydronium ions as the only positive ions

14. How are $HNO_3(aq)$ and $CH_3COOH(aq)$ similar?
    A) They are Arrhenius bases and they turn blue litmus red.
    B) They are Arrhenius bases and they turn red litmus blue.
    C) They are Arrhenius acids and they turn blue litmus red.
    D) They are Arrhenius acids and they turn red litmus blue.

15. When an Arrhenius acid dissolves in water, the only positive ion in the solution is
    A) Li^+ B) Na^+ C) K^+ D) H^+

Regents Chemistry **Acid-Base Theories**

1. In the reaction

$$NH_3 + H_2O \leftrightarrow NH_4^+ + OH^-$$

A conjugate acid-base pair is

A) H_2O and OH^- B) H_2O and NH_4^+
C) NH_3 and H_2O D) NH_3 and OH^-

2. Which is the conjugate acid of HSO_4^-?

A) H_3O^+ B) HSO_3^-
C) SO_4^{2-} D) H_2SO_4

3. What are the bases that accept protons in the reaction?

$$H_2S + H_2O \leftrightarrow H_3O^+ + HS^-$$

A) HS^- and H_3O^+ B) H_2S and H_3O^+
C) HS^- and H_2O D) H_2S and H_2O

4. In the reaction:

$$HBr + H_2O \leftrightarrow H_3O^+ + Br^-$$

Which is a conjugate acid-base pair?

A) HBr and H_2O B) H_3O^+ and HBr
C) H_3O^+ and Br^- D) HBr and Br^-

5. Given the reaction:

$$CH_3COOH(aq) + H_2O(\ell) \leftrightarrow CH_3COO^-(aq) + H_3O^+(aq)$$

In this reaction, which substances are accepting protons?

A) $H_2O(\ell)$ and $H_3O^+(aq)$
B) $H_2O(\ell)$ and $CH_3COO^-(aq)$
C) $CH_3COOH(aq)$ and $CH_3COO^-(aq)$
D) $CH_3COOH(aq)$ and $H_2O(\ell)$

6. In the reaction:

$$H_2PO_4 + H_2O \leftrightarrow H_3PO_4 + OH$$

Which pair represents an acid and its conjugate base?

A) H_2O and H_2PO_4
B) H_3PO_4 and OH^-
C) H_2O and H_3PO_4
D) H_3PO_4 and $H_2PO_4^-$

7. Given the reaction at equilibrium:

$$HSO_4^- + NH_3 \leftrightarrow SO_4^{2-} + NH_4^+$$

What are the two species that are acids?

A) NH_3 and SO_4^{2-} B) NH_3 and NH_4^+
C) HSO_4^- and SO_4^{2-} D) HSO_4^- and NH_4^+

8. In the reaction:

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

The water is

A) a proton donor, only
B) a proton acceptor, only
C) both a proton donor and a proton acceptor
D) neither a proton donor nor a proton acceptor

9. The compound HNO_3 can be described as an

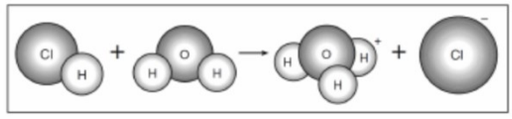
A) Arrhenius base and a nonelectrolyte
B) Arrhenius acid and a nonelectrolyte
C) Arrhenius acid and an electrolyte
D) Arrhenius base and an electrolyte

10. Which compound releases hydroxide ions in an aqueous solution?

A) KOH B) CH_3OH
C) HCl D) CH_3COOH

Acid-Base Theories

11. Given the diagram representing a reaction:



According to one acid-base theory, the water acts as

A) an acid because it accepts an H^+
B) an acid because it donates an H^+
C) a base because it donates an H^+
D) a base because it accepts an H^+

12. Which substance is always a product when an Arrhenius acid in an aqueous solution reacts with an Arrhenius base in an aqueous solution?

A) KOH B) KBr
C) H_2O D) HBr

13. According to the Arrhenius theory, an acid is a substance that

A) changes litmus from red to blue
B) changes phenolphthalein from colorless to pink
C) produces hydronium ions as the only positive ions in an aqueous solution
D) produces hydroxide ions as the only negative ions in an aqueous solution

14. An aqueous solution of lithium hydroxide contains hydroxide ions as the only negative ion in the solution. Lithium hydroxide is classified as an

A) Arrhenius acid B) alcohol
C) aldehyde D) Arrhenius base

15. The OH^- ion concentration is greater than the H_3O^+ ion concentration in a water solution of

A) HCl B) $Ba(OH)_2$
C) H_2SO_4 D) CH_3OH

16. Given the equation representing a reaction at equilibrium:

$NH_3(g) + H_2O(\ell) \leftrightarrow NH_4^+(aq) + OH^-(aq)$

The H^+ acceptor for the forward reaction is

A) $H_2O(\ell)$ B) $NH_3(g)$
C) $NH_4^+(aq)$ D) $OH^-(aq)$

17. Potassium hydroxide is classified as an Arrhenius base because KOH contains

A) K^+ ions B) H^+ ions
C) O^{2-} ions D) OH^- ions

18. In which forward reaction is water acting only as a proton acceptor?

A) $NH_3(g) + H_2O(\ell) \leftrightarrow NH_4^+(aq) + OH^-(aq)$
B) $H_2SO_4(aq) + H_2O(\ell) \leftrightarrow HSO_4^-(aq) + H_3O^+(aq)$
C) $H_2O(\ell) + H_2O(l) \leftrightarrow H_3O(\ell) + OH^-(aq)$
D) $CH_3COO^-(aq) + H_2O(\ell) \leftrightarrow CH_3COOH(aq) + OH^-(aq)$

19. Given the equation representing a reversible reaction:

$NH_3(g) + H_2O(\ell) \leftrightarrow NH_4^+(aq) + OH^-(aq)$

According to one acid-base theory, the reactant that donates an H^+ ion in the forward reaction is

A) $OH^-(aq)$ B) $NH_4^+(aq)$
C) $H_2O(\ell)$ D) $NH_3(g)$

20. Which compound is an Arrhenius acid?

A) CaO B) NH_3 C) K_2O D) HCl

21. Which compound is an Arrhenius acid?

A) H_2SO_4 B) KCl
C) NH_3 D) NaOH

22. When dissolved in water, an Arrhenius base yields

A) hydronium ions B) oxide ions
C) hydroxide ions D) hydrogen ions

The Power of pH:

For each question, the two pH values are being compared. How many times more acidic or basic does the pH of the solution become?

1) pH 5 → pH 3 10^2 100 x acidic
2) pH 8 → pH 4 10^4 10,000 x acidic
3) pH 10 → pH 7 1000x acidic
4) pH 14 → pH 7 10000000 x acidic
5) pH 4 → pH 3 10 x acidic
6) pH 7 → pH 3 10000 x acidic
7) pH 5 → pH 1 10000 x acidic
8) pH 9 → pH 3 1000000 x acidic
9) pH 8 → pH 6 1000x acidic
10) pH 3 → pH 6 10^3 1000 x basic
11) pH 1 → pH 3 100 x basic
12) pH 2 → pH 7 100000 x basic

Circle the answer the best completes the following sentences:

13) The pH scale was developed to express ([H+]/[OH-]) as a number between 0 and 14.

14) A pH of 1 is a (strong/weak) (acid/base).

15) A pH of 8 is a (strong/weak) (acid/base).

16) In an acid, the [H+] </> [OH-].

17) In a base, the [H+] </> [OH-].

18) A decrease from 5 to 4 on the pH scale represents a tenfold (increase/decrease) in the concentration of ([H+] / [OH-]).

19) Strong acids and bases will dissociate (completely/slightly).

Regents Chemistry **The pH Scale**

1. When the hydronium ion concentration of a solution is increased by a factor of 10, the pH value of the solution
   A) decreases 1 pH unit
   B) decreases 10 pH units
   C) increases 1 pH unit
   D) increases 10 pH units

2. When the pH value of a solution is changed from 2 to 1, the concentration of hydronium ions
   A) decreases by a factor of 2
   B) increases by a factor of 2
   C) decreases by a factor of 10
   D) increases by a factor of 10

3. A solution with a pH of 2.0 has a hydronium ion concentration ten times greater than a solution with a pH of
   A) 1.0 B) 3.0 C) 0.20 D) 20

4. The pH of an aqueous solution changes from 4 to 3 when the hydrogen ion concentration in the solution is
   A) decreased by a factor of 10
   B) increased by a factor of 10
   C) decreased by a factor of $\frac{3}{4}$
   D) increased by a factor of $\frac{4}{3}$

5. What is the pH of a solution that has a hydronium ion concentration 100 times greater than a solution with a pH of 4?
   A) 5 B) 2 C) 3 D) 6

6. As the pH of a solution is changed from 3 to 6, the concentration of hydronium ions
   A) increases by a factor of 1000
   B) decreases by a factor of 1000
   C) decreases by a factor of 3
   D) increases by a factor of 3

7. 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*?
   A) 1000 B) 3 C) 2 D) 100

8. Which pH change represents a hundredfold increase in the concentration of H_3O^+?
   A) pH 5 to pH 7 B) pH 4 to pH 3
   C) pH 3 to pH 1 D) pH 13 to pH 14

9. Which statement correctly describes a solution with a pH of 9?
   A) It has a higher concentration of OH^- than H_3O^+ and causes methyl orange to turn red.
   B) It has a higher concentration of H_3O^+ than OH^- and causes methyl orange to turn yellow.
   C) It has a higher concentration of OH^- than H_3O^+ and causes litmus to turn blue.
   D) It has a higher concentration of H_3O^+ than OH^- and causes litmus to turn blue.

10. Which of these pH numbers indicates the highest level of acidity?
    A) 5 B) 10 C) 8 D) 12

11. Given the following solutions:

    Solution *A*: pH of 10
    Solution *B*: pH of 7
    Solution *C*: pH of 5
    Which list has the solutions placed in order of increasing H^+ concentration?
    A) *C, B, A* B) *C, A, B*
    C) *A, B, C* D) *B, A, C*

12. Which of these 1 M solutions will have the highest pH?
    A) NaCl B) CH_3OH
    C) HCl D) NaOH

13. As an aqueous solution becomes more acidic, the hydroxide ion concentration
    A) decreases B) increases
    C) remains the same

14. Which of the following pH values indicates the highest concentration of hydronium ions in a solution?
    A) pH = 1 B) pH = 2
    C) pH = 3 D) pH = 4

pH & Indicators:

Given the pH of the following common substances determine what color the indicator will turn when placed in each substance.

Substance	pH	Methyl Orange	Bromthymol Blue	Phenolphthalein	Litmus	Bromcresol green	Thymol blue
Stomach Acid	2	red	yellow	colorless	Red	yellow	yellow
Cola Drink	3	red	yellow	colorless	red	yellow	yellow
Blood	7.5	yellow	green	colorless	purple	blue	yellow
Pure Water	7.0	yellow	green	colorless	purple	blue	yellow
Oven Cleaner	14	yellow	blue	pink	blue	blue	blue
Tomatoes	4	Orange	yellow	colorless	red	Green	yelow
Milk	6.5	yellow	green	colorless	purple	Blue	yellow
Detergent	10	yellow	blue	Pink	blue	blue	blue
Coffee	5	yellow	Yellow	colorless	purple	Green	yellow
Household Cleaners	11	yellow	blue	Pink	blue	blue	blue

For the following choose an appropriate indicator to note a transformation.

20) endpoint pH = 9 thymolblue, phth, litmus

21) endpoint pH = 5 bromocresol green, litmus, methyl org

22) endpoint pH = 3 methyl orange, bromocresol green

Neutralization Reactions:

Remember that: Acid + Base → Salt + Water

Using the above general reaction, complete the following reactions with correct formulas. Then balance the entire double replacement reaction. Also name the salt that is produced in the space provided below the product side of the reaction.

1) ____ $HNO_{3(aq)}$ + ____ $KOH_{(aq)}$ → $H_2O + KNO_3$
Potassium nitrate

2) 2 $HCl_{(aq)}$ + ____ $Ca(OH)_{2(aq)}$ → $2H_2O + CaCl_2$
Calcium chloride

3) ____ $H_2SO_{4(aq)}$ + 2 $NaOH_{(aq)}$ → $2H_2O + Na_2SO_4$
Sodium sulfate

4) ____ $H_3PO_{4(aq)}$ + 3 $NaOH_{(aq)}$ → $3H_2O + Na_3PO_4$
Sodium phosphate

5) ____ $NH_4OH_{(aq)}$ + ____ $HI_{(aq)}$ → $H_2O + NH_4I$
Ammonium iodide

6) ____ $HClO_{(aq)}$ + ____ $NaOH_{(aq)}$ → $H_2O + NaClO$
Sodium hypochlorite

7) ____ $Mg(OH)_2$ + ____ CH_3COOH → $2H_2O + Mg(CH_3COO)_2$
Magnesium acetate

8) 3 HNO_3 + ____ $Al(OH)_3$ → $3H_2O + Al(NO_3)_3$
Aluminum nitrate

9) ____ H_3PO_4 + 3 $LiOH$ → $3H_2O + Li_3PO_4$
Lithium phosphate

10) ____ H_2SO_4 + ____ $Mg(OH)_2$ → $2H_2O + MgSO_4$
Magnesium sulfate

11) ____ NH_4OH + ____ HCl → $H_2O + NH_4Cl$
Ammonium chloride

ACID-BASE TITRATIONS:

To determine the concentration of an acid (or base), we can react it with a base (or acid) of known concentration until it is completely neutralized. This point of exact neutralization, know as the endpoint or equivalence point, is noted by the change in color of the indicator.

We use the following **Titration** formula from our Table T (Reference Tables):

$$M_A V_A = M_B V_B$$

Solve the following problems. SHOW ALL WORK!

1. A 25.0 mL sample of HCl was titrated to the endpoint with 15.0 mL of 2.0 M NaOH. What is the molarity of the HCl?

1.2 M HCl

2. A 10.0 mL sample of H_2SO_4 was exactly neutralized by 13.5 mL of 1.0 M KOH. What is the molarity of the H_2SO_4?

2 M_A?

$V_A = 10$ $M_B = 1.0$

$M_A = 2x$

$V_B = 13.5$

$(2x)(10) = (13.5)(1.0)$

$x =$ 0.675 M H_2SO_4

3. How much 1.5 M NaOH is necessary to exactly neutralize 20.0 mL of 2.5 M H_3PO_4?

100 mL NaOH

4. How much of 0.5 M HNO_3 is necessary to titrate 25.0 mL of 0.05 M $Ca(OH)_2$ solution to the endpoint?

5 mL of HNO_3

5. What is the molarity of a NaOH solution if 15.0 mL is exactly neutralized by 7.5 mL of a 0.02 M $HC_2H_3O_2$ solution?

0.01 M NaOH

Reactions with Acids and Bases:

1) Using Table J in your Reference Tables, list two metals that will react with H_2 (or an acid) Any metals above H_2 on the table

2) Using Table J in your Reference Tables, list two metals that will NOT react with H_2 (or an acid) Any metals below H_2 on the table

3) What type of reaction (of the four we have learned) is involved when an acid reacts with a metal? Single replacement

4) Write the general formula (using ABC etc.) for this type of reaction

$$X + HA \rightarrow H_2 + XA$$

5) Predict the products of the following reaction:

$$Mg + 2HNO_3 \rightarrow H_{2(g)} + Mg(NO_3)_2$$

5) Will copper react with an acid? No Explain your answer in terms of activity.

Copper is less active than H_2, copper doesn't give up e^- as easily as H_2

6) Predict the products of the following neutralization reaction:

$$RbOH + HBr \rightarrow RbBr + H_2O$$

7) Set up a reaction below that would occur between HNO_3 and LiOH. Predict the products using your general reaction for neutralization reactions.

$$HNO_3 + LiOH \rightarrow H_2O + LiNO_3$$

8) Predict the products of the following reaction. Remember to create your formulas using the criss cross rule! BALANCE the reaction also.

$$H_2SO_4 + Ca(OH)_2 \rightarrow 2H_2O + CaSO_4$$

Name salt that was produced Calcium sulfate

9) According to your reference tables, which metal would react spontaneously with hydrochloric acid?

a. Gold b. Silver c. Copper d. Zinc