COMMON ACIDS NOTES

lactic acetic phosphoric
citric malic

PROPERTIES OF ACIDS

1.

2.

3.

4.

5.

PROPERTIES OF BASES

1.

2.

3.

4.

5.

NAMING ACIDS NOTES

Binary acids (H + one element)

1. "hydro-"
2. root of name of second element
3. "-ic"

Practice:
- HF
- H_2S

Oxyacids (H + more than 1 element)

1. root of polyatomic ion
2. a. If negative ion ends with "-ate", use "-ic" ending
   b. If negative ion ends with "-ite", use "-ous" ending

- HNO_3
- $HClO_2$

BRONSTED-LOWRY ("B-L") THEORY OF ACIDS & BASES NOTES

~ Involve the transfer of a "proton". A proton is

Acid:

conjugate base (CB):

Base:

conjugate acid (CA):

How do you determine an acid's conjugate base and a base's conjugate acid?

~ Acid is a proton _____. So, conjugate base is the formula for the acid _____

_____.

** EXAMPLE: Acid = HCl; Conjugate Base (CB) =

~ Base is a proton _____. So, conjugate acid is the formula for the base _____

_____.

** EXAMPLE: Base = NO_3^{-1}; Conjugate Acid (CA) =

AMPHOTERISM NOTES

Example: $HNO_3 + H_2O \leftrightarrow NO_3^{-1} + H_3O^{+1}$ Water acts as (acid / base)

$NH_3 + H_2O \leftrightarrow NH_4^{+1} + OH^{-1}$ Water acts as (acid / base)

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BRONSTED - LOWRY ACIDS & BASES WORKSHEET

According to Bronsted-Lowry theory, an acid is a proton (H^{+1}) donor, and a base is a proton acceptor.

Label the Bronsted-Lowry acids (A), bases (B), conjugate acids (CA), and conjugate bases (CB) in the following reactions.

EXAMPLE: $H_2O + Cl^{-1} \leftrightarrow OH^{-1} + HCl$
A B CB CA

1. $C_6H_5NH_2 + H_2O \leftrightarrow C_6H_5NH_3^{+1} + OH^{-1}$

2. $H_2SO_4 + OH^{-1} \leftrightarrow HSO_4^{-1} + H_2O$

3. $HSO_4^{-1} + H_2O \leftrightarrow SO_4^{-2} + H_3O^{+1}$

4. $HBr + OH^{-1} \leftrightarrow H_2O + Br^{-1}$

5. $NH_3 + H_2O \leftrightarrow NH_4^{+1} + OH^{-1}$

CONJUGATE ACID-BASE PAIRS WORKSHEET

A conjugate base is what is left after an acid gives up its proton.
A conjugate acid is what is made once a base gains a proton.

ACID	BASE
	HSO_4^{-1}
H_3PO_4	
	F^{-1}
	NO_3^{-1}
$H_2PO_4^{-1}$	
H_2O	
	SO_4^{-2}
HPO_4^{-2}	
NH_4^{+1}	
	H_2O

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ARRHENIUS THEORY OF ACIDS & BASES NOTES

Acids increase concentration of _____ ions in aqueous solution.
~ Acids have more ____ ions than ____ ions.
~ Formulas for acids begin with ____.
Bases increase concentration of _____ ions in aqueous solution.
~ Bases have more ____ ions than ____ ions.
~ Formulas for bases end with ____.

STRONG VS. WEAK ACIDS & BASES NOTES

Strong acid:

- The 6 strong acids are

Weak acid:

- any acid besides the 6 mentioned above

Strong base:

- Solution of strong base is called
- Strong bases contain any Group 1 or 2 metal (except Be) with OH^{-1}

Weak base:

- any base other than ones mentioned above

MONOPROTIC & POLYPROTIC ACIDS NOTES

~ How many hydrogens does each type contain?

* MONOPROTIC = ___ H's * DIPROTIC = ___ H's * TRIPROTIC = ___ H's

NEUTRALIZATION REACTIONS

~ ACID + BASE --> _____ + _____

~ salt:

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pH and pOH NOTES

pH: the negative log of the hydrogen (or hydronium) ion concentration (in moles/liter)
pOH: the negative log of the hydroxide ion concentration (in moles/liter)

Self-Ionization of Water: $H_2O + H_2O \leftrightarrow H_3O^{+1} + OH^{-1}$

- Water molecules have the ability to self-ionize.
- This is a naturally-occurring phenomenon.
- In one liter of pure water at 25 °C,
  the concentration of H_3O^{+1} = 0.0000001 moles/liter
  the concentration of OH^{-1} = 0.0000001 moles/liter
  or
  $[H_3O^{+1}] = 1.0 \times 10^{-7}$ moles/L
  $[OH^{-1}] = 1.0 \times 10^{-7}$ moles/L
- Solve for the pH of pure water:
  $pH = - \log [H_3O^{+1}]$ $pOH = - \log [OH^{-1}]$
  $pH = - \log [1.0 \times 10^{-7}]$ $pOH = - \log [1.0 \times 10^{-7}]$
  $pH = 7$ $pOH = 7$

- Equations that will be helpful when solving pH and pOH problems:

$pH = - \log [H^{+1}]$ **$[H^{+1}] = 10^{-pH}$**
$pOH = - \log [OH^{-1}]$ **$[OH^{-1}] = 10^{-pOH}$**
$pH + pOH = 14$
$K_w = [H^{+1}] \cdot [OH^{-1}] = 1 \times 10^{-14}$

NOTE: $[H^{+1}]$ is the same as $[H_3O^{+1}]$

0 7 14
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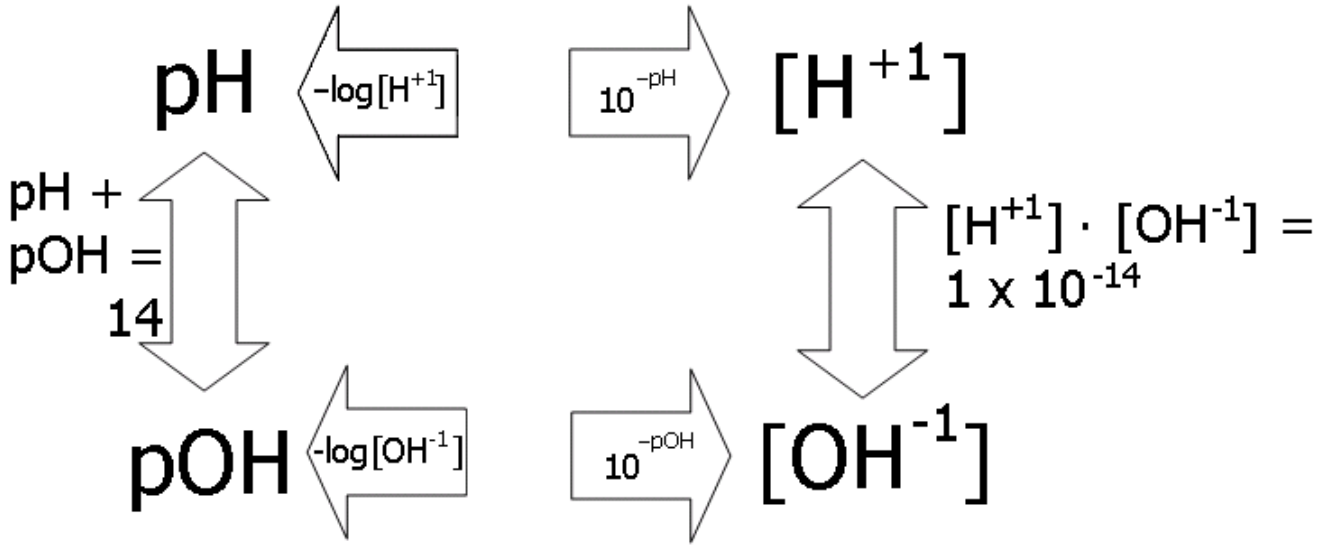
acids neutral bases



pH and pOH WORKSHEET

Part 1 - Calculate the pH and identify as acidic, basic, or neutral.

1.) $[H^{+1}] = 1.0 \times 10^{-6}$ M pH = ____ A B N
2.) $[H^{+1}] = 2.61 \times 10^{-2}$ M pH = ____ A B N
3.) $[H^{+1}] = 4.0 \times 10^{-9}$ M pH = ____ A B N
4.) $[H^{+1}] = 5.9 \times 10^{-12}$ M pH = ____ A B N
5.) $[H^{+1}] = 1.0 \times 10^{-7}$ M pH = ____ A B N

Part 2 - Calculate the $[H^{+1}]$ and identify as acidic, basic, or neutral.

6.) pH = 4.00 $[H^{+1}]$ = _____ M A B N
7.) pH = 5.89 $[H^{+1}]$ = _____ M A B N
8.) pH = 7.00 $[H^{+1}]$ = _____ M A B N
9.) pH = 12.25 $[H^{+1}]$ = _____ M A B N
10.) pH = 9.11 $[H^{+1}]$ = _____ M A B N

Part 3 - Complete the following chart.

Solution	pH	pOH	$[H^{+1}]$	$[OH^{-1}]$
A	3.68			
B				8.60×10^{-5} M
C			1.80×10^{-9} M	
D		5.48		
E	10.84			
F			3.82×10^{-11} M	
G		2.85		

ACID - BASE TITRATION NOTES

TITRATION: process used in Chemistry lab to determine the concentration of an acid or a base; use a base or an acid with a known concentration to neutralize the acid or base with the unknown concentration

EQUATION TO USE FOR SOLVING TITRATION PROBLEMS: $n_A \cdot M_A \cdot V_A = n_B \cdot M_B \cdot V_B$

n_A = number of H's at the beginning of the formula for the acid
M_A = molarity of the acid
V_A = volume of the acid
n_B = number of OH's in the formula for the base
M_B = molarity of the base
V_B = volume of the base

EXAMPLE PROBLEM:
What is the molarity of a H_2SO_4 solution if 190 mL of the acid is needed to exactly neutralize 150 mL of a 2.5 M NaOH solution?

$2 \cdot M \cdot 190\ mL = 1 \cdot 2.5\ M \cdot 150\ mL$
$380\ M = 375$
$M = 0.99\ M$

Now you try one…
What is the volume of a sample of 0.25 M HCl that requires 26.15 mL of 0.58 M NaOH?

ACID-BASE TITRATION WORKSHEET

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?

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?

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

4.) How much of 0.50 M HNO_3 is necessary to titrate 25.0 mL of 0.050 M $Ca(OH)_2$ solution to the endpoint?

5.) What is the molarity of NaOH solution if 15.0 mL is exactly neutralized by 7.5 mL of a 0.020 M $HClO_3$ solution?

UNIT 14 REVIEW WORKSHEET

Part 1 – Tell whether each of the following properties describes an acid (A), a base (B), or both (AB).

_____ 1. taste bitter
_____ 2. lose a proton (B-L Theory)
_____ 3. feel slippery
_____ 4. change color of indicators
_____ 5. 2nd part of formula is usually OH
_____ 6. 1st element in formula is usually H
_____ 7. conduct electricity
_____ 8. taste sour
_____ 9. gain a proton (B-L Theory)
_____ 10. react with metals to form H_2 gas

Part 2 – Acid Nomenclature – Write the name or the formula for the following acids.

11. HI
12. HNO_2
13. H_3PO_4
14. hydrobromic acid
15. carbonic acid
16. sulfurous acid

Part 3 – Answer the following questions.

17. According to the Arrhenius theory, acids increase _____ ion concentration in aqueous solution.

    Bases increase _____ ion concentration

18. List the six (6) strong acids.

19. How do you know if a base is strong or weak?

20. Define conjugate acid.

21. Define conjugate base.

22. What does it mean if a compound is said to be amphoteric?

23. Can SO_4^{-2} be amphoteric? Why or why not?

24. What is the conjugate base of…
    (A) NH_3 (B) H_2SO_4 (C) $H_2PO_4^{-1}$

25. What is the conjugate acid of…
    (A) $H_2PO_4^{-1}$ (B) HSO_4^{-1} (C) HCO_3^{-1}

26. When an acid and a base react with each other, what are the two (2) products?

Part 4 – Draw lines between the conjugate acid-base pairs and label the acid (A), base (B), conjugate acid (CA), and conjugate base (CB).

27. $H_2SO_4 + H_2O \leftrightarrow HSO_4^{-1} + H_3O^{+1}$

28. $NH_3 + H_2O \leftrightarrow NH_4^{+1} + OH^{-1}$

29. $HPO_4^{-2} + H_2O \leftrightarrow H_3O^{+1} + PO_4^{-3}$

Part 5 - Solve the following problems.

30. What is the pH of a solution whose $[OH^{-1}]$ is 3.08×10^{-3} M?

31. What is the $[OH^{-1}]$ of a solution whose $[H^{+1}]$ is 5.92×10^{-2} M?

32. What is the concentration (molarity) of NaOH if 15.3 mL are needed to completely neutralize 20.4 mL of 2.50 M H_2SO_4?

33. What volume of 1.50 M $Ca(OH)_2$ is needed to reach the endpoint of a titration using 17.2 mL of 3.00 M H_3PO_4?

Part 6 – Fill in the following chart.

pOH	pH	$[OH^{-1}]$	$[H^{+1}]$	A, B, or N
4.63				
	11.75			
		2.96×10^{-8} M		
			5.27×10^{-9} M	

ACID – BASE TITRATION LAB

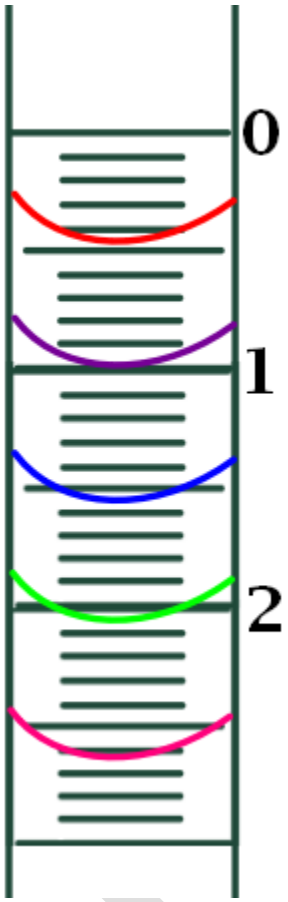
PURPOSE: - to determine the molarity of an aqueous solution of hydrochloric acid (HCl)
- to learn and practice the technique for titration

MATERIALS:

EQUIPMENT
- 2 burets (labeled "A" and "B")
- double buret clamp
- ring stand
- Erlenmeyer flask

CHEMICALS
- _____ M NaOH
- phenolphthalein
- ? M HCl

READING A BURET:



PROCEDURE:

1.) Obtain approximately 10 mL of HCl from the buret labeled "A" for acid in the Erlenmeyer flask. (It is not necessary to have EXACTLY 10.00 mL. However, the volume of the HCl should be measured to the nearest hundredth.)
2.) Add 3 or 4 drops of phenolphthalein. (Only a few drops are needed. Adding more than 3 or 4 drops will not make the reaction any bigger or better.)
3.) Add NaOH from the buret labeled "B" for base SLOWLY until the solution changes color. (When the solution changes color, the acid is neutralized. Ideally, the solution in the flask should be a very faint shade of the color.)

DATA TABLE:

		TRIAL 1	TRIAL 2	TRIAL 3
1	Reading of HCl (at start)	mL	mL	mL
2	Reading of HCl (at end)	mL	mL	mL
3	Volume of HCl used	mL	mL	mL
4	Reading of NaOH (at start)	mL	mL	mL
5	Reading of NaOH (at end)	mL	mL	mL
6	Volume of NaOH used	mL	mL	mL

QUESTIONS AND CALCULATIONS:

1.) Write a balanced equation for the neutralization reaction that occurs between hydrochloric acid (HCl) and sodium hydroxide (NaOH).

2.) What is the mole ratio between HCl and NaOH in the balanced equation?

3.) What volume of HCl was used in TRIAL 1? Show how you determined this volume.

4.) What volume of NaOH was used in TRIAL 1? Show how you determined this volume.

5.) The NaOH had a concentration of _____ M. Using your data, what is the concentration (molarity) of the hydrochloric acid? (CLEARLY and LEGIBLY show your calculations in detail!)

6.) If your group was able to do more than one trial, what was the average molarity?