

COMMON ACIDS NOTES

lactic
citric

acetic
malic

phosphoric

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

- H₂S

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

- HNO₃

- HClO₂

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?

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

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

~ A base is a proton acceptor/recipient. So, conjugate acid is the formula for the base _____.

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

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AMPHOTERISM NOTES

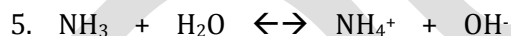
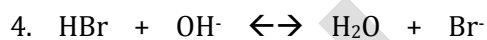
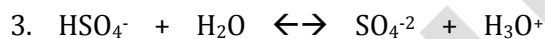
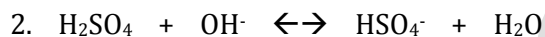
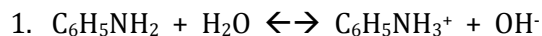
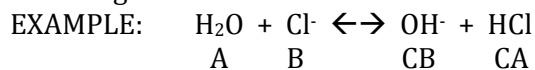
Example:



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BRONSTED - LOWRY ACIDS & BASES WORKSHEET

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



CONJUGATE ACID-BASE PAIRS WORKSHEET

ACID	BASE
	HSO_4^-
H_3PO_4	
	F^-
	NO_3^-
H_2PO_4^-	
H_2O	

ACID	BASE
	SO_4^{2-}
HPO_4^{2-}	
NH_4^+	
	H_2O
	NO_2^-
NH_3	

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⁻

Weak base:

- any base other than ones mentioned above

~ Rule for strength of acids & bases (B-L theory):

**The stronger an acid is, the _____ its conjugate base.

**The stronger a base is, the _____ its conjugate acid.

Which is a weaker base, Cl⁻ or NO₂⁻?

Which is a stronger base, HSO₄⁻ or H₂PO₄⁻?

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:

pH and pOH NOTES

pH: the negative log of the hydrogen ion concentration $[H^+]$

pOH: the negative log of the hydroxide ion concentration $[OH^-]$

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

- 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^+ or simply H^+ = 0.0000001 moles/liter
the concentration of OH^- = 0.0000001 moles/liter

or

$$[H_3O^+] = [H^+] = 1.0 \times 10^{-7} \text{ moles/L}$$

$$[OH^-] = 1.0 \times 10^{-7} \text{ moles/L}$$

- Solve for the pH of pure water:

$$pH = -\log [H_3O^+]$$

$$pOH = -\log [OH^-]$$

$$pH = -\log [1.0 \times 10^{-7}]$$

$$pOH = -\log [1.0 \times 10^{-7}]$$

$$pH = 7$$

$$pOH = 7$$

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

$$pH = -\log [H^+]$$

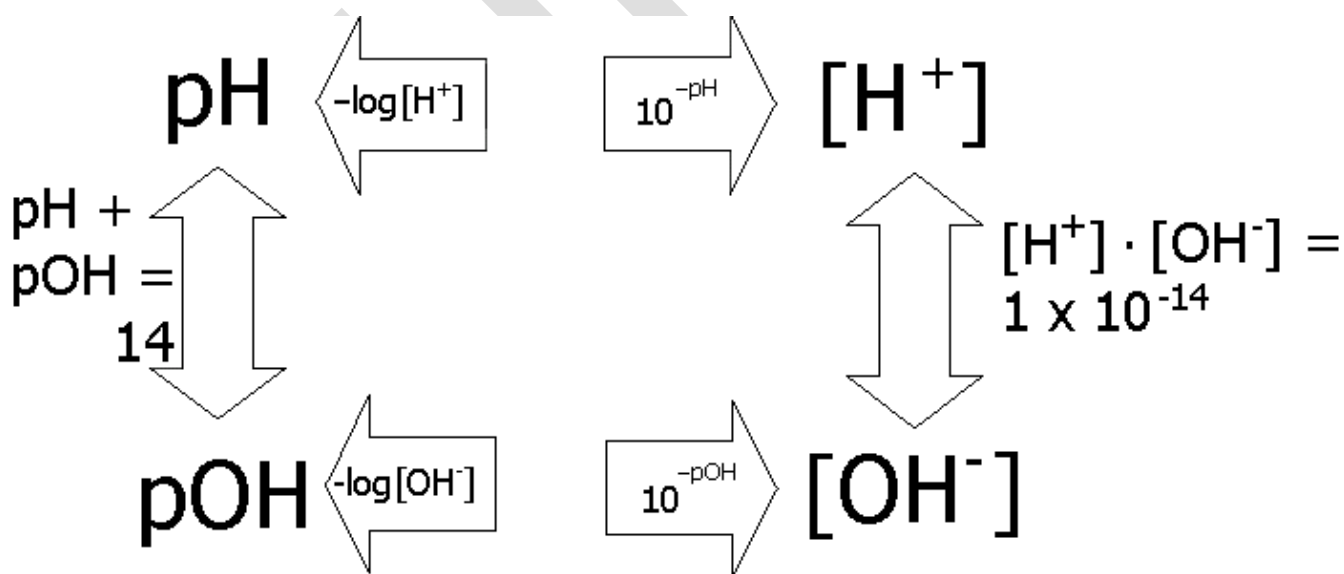
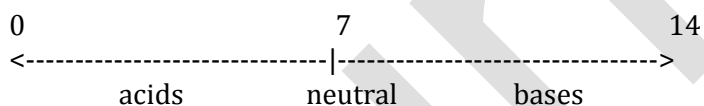
$$[H^+] = 10^{-pH}$$

$$pOH = -\log [OH^-]$$

$$[OH^-] = 10^{-pOH}$$

$$pH + pOH = 14$$

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



pH and pOH WORKSHEET

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

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

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

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

Part 3 - Calculate the missing $[H^+]$ or $[OH^-]$ and identify as acidic, basic, or neutral.

- 11.) $[H^+] = 4.2 \times 10^{-6} M$ $[OH^-] =$ _____ M A B N
- 12.) $[H^+] =$ _____ M $[OH^-] = 4.3 \times 10^{-5} M$ A B N

Part 4 - Complete the following chart.

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

$$n_A \cdot M_A \cdot V_A = n_B \cdot M_B \cdot V_B$$

$$2 \cdot M \cdot 190 \text{ mL} = 1 \cdot 2.5 \text{ M} \cdot 150 \text{ mL}$$

380 M = 375
M = 0.99 M

What is the volume of a sample of 0.25 M HCl that requires 26.15 mL of 0.58 M NaOH to neutralize it?

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 H₂SO₄ was exactly neutralized by 13.5 mL of 1.0 M KOH. What is the molarity of the H₂SO₄?
3. How much 1.5 M NaOH is necessary to exactly neutralize 20.0 mL of 2.5 M H₃PO₄?
4. How much of 0.50 M HNO₃ 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 HClO₃ solution?

UNIT 14 REVIEW WORKSHEET

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

- | | |
|---|---|
| <input type="checkbox"/> 1. taste bitter | <input type="checkbox"/> 6. 1 st element in formula is usually H |
| <input type="checkbox"/> 2. lose a proton (B-L Theory) | <input type="checkbox"/> 7. conduct electricity |
| <input type="checkbox"/> 3. feel slippery | <input type="checkbox"/> 8. taste sour |
| <input type="checkbox"/> 4. change color of indicators | <input type="checkbox"/> 9. gain a proton (B-L Theory) |
| <input type="checkbox"/> 5. 2 nd part of formula is usually OH | <input type="checkbox"/> 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 | 14. hydrobromic acid |
| 12. HNO ₂ | 15. carbonic acid |
| 13. H ₃ PO ₄ | 16. sulfurous acid |

Part 3 – Answer the following questions.

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

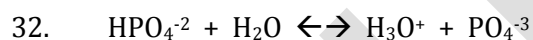
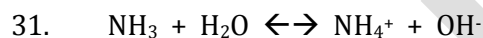
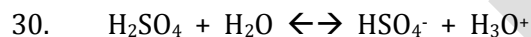
Bases increase ___ ion concentration

18. List the six (6) strong acids.

19. How do you know if a base is strong or weak (in Arrhenius theory)?

20. Define conjugate acid.
21. Define conjugate base.
22. The stronger an acid is, the _____ its conjugate base.
23. Which is a stronger base, ClO_4^{-1} or S^{-2} ?
24. Which is a weaker base, I^{-1} or SO_4^{-2} ?
25. What does it mean if a compound is said to be amphoteric?
26. Can SO_4^{-2} be amphoteric? Why or why not?
27. What is the conjugate base of...
(A) NH_3 (B) H_2SO_4 (C) H_2PO_4^-
28. What is the conjugate acid of...
(A) H_2PO_4^- (B) HSO_4^- (C) HCO_3^-
29. 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).



Part 5 - Solve the following problems.

33. What is the pH of a solution whose $[\text{OH}^-]$ is $3.08 \times 10^{-3} \text{ M}$?
34. What is the $[\text{OH}^-]$ of a solution whose $[\text{H}^+]$ is $5.92 \times 10^{-2} \text{ M}$?
35. 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 ?
36. What volume of 1.50 M $\text{Ca}(\text{OH})_2$ 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 ⁻]	[H ⁺]	A, B, or N
4.63				
	11.75			
		2.96 x 10 ⁻⁸ M		
			5.27 x 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:

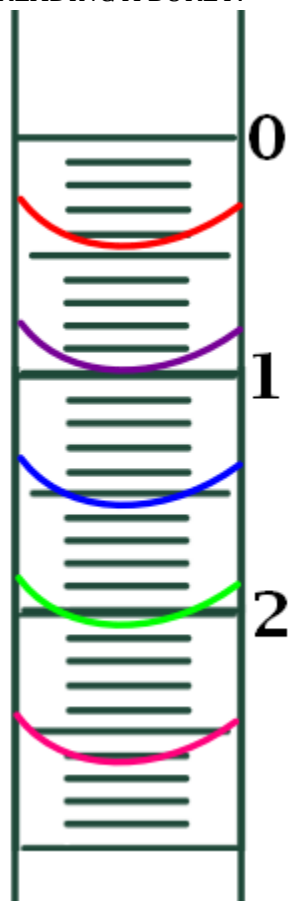
EQUIPMENT

- 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?