Name: Notes

Date: Block:

- 1. Properties of Acids & Bases
- 2. Definitions of Acids and Bases
- 3. Conjugate Acid-Base Pairs
- 4. Amphiprotic Substances

Properties of Acids and Bases

	Acids	Bases	
tastes	1. Sour	1. bitter	
feels	2. burns	2. Slippen	
PH	3. 7	3. >7 , <14	
reacts with	4. metals	4. oils 8 fats	

Definitions of Acids and Bases

Arrhenius Theory of Acid and Bases

(re: Science 10)

- Arrhenius acids **Class** H+ ions
- Arrhenius bases (Clast OH ions.

Typically... (neutralization reaction)

Acid + Base
$$\rightarrow$$
 Salt + Water

HCl (aq) + NaOH (aq) \rightarrow NaCl (aq) + H2O (I)

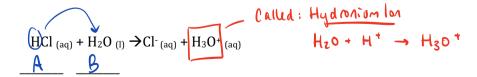
 \rightarrow H-OH

Brønsted-Lowry Acids and Bases (Chem 12)

A broader definition

- Brønsted-Lowry acids <u>dωλατεν</u> Η on. ("ροτοπ")
- Brønsted-Lowry bases <u>Accepts</u> H+ ion.

Example 1:



HCl donats a proton, H+, to the water molecule – HCl is acting as a $\frac{B-L}{ACLPTS}$ a proton, H+, from HCl – water is acting as a $\frac{B-L}{ACLPTS}$.

Example 2:

			7
NH _{3 (aq)}	+ H ₂ O ₍₁₎ =	= N(H ₄ +) _(aq) +	OH- (aq
B	A	A	B

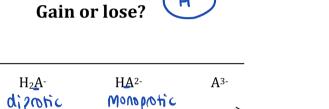
NH₃ Occepts a proton, H+. NH₃ is acting as a B-L base

 H_2O __donates a proton, H^+ . water is acting as a __ B^- L__acid_

In the reverse reaction....

$$NH_{4^+}$$
 donates a proton, H^+ and is acting as a $B-L$ acid.

OH- accepts a proton, H+. and is acting as a B-L base



Gaining /Accepting H+ BASE

Rewrite the following compounds in order of decreasing number of protons:

a) HPO₄²⁻ | H₃PO₄ | H₂PO₄- | PO₄³-

ACID

Losing/Donating H+

tipotic

b) H₂O | H₃O+ | OH-

c) SO₄ ²⁻ | H₂SO₄ | HSO₄-

- d) NH₃ | NH₂- | NH₄+ NHyt, NH3, NH2
- e) $H_2SO_3 \mid SO_3^{2-} \mid HSO_3^{-1}$ H₂SO₃, H_SO₃, SO₃².

Practice! Identify the following as an acid or base

$$\begin{array}{c}
\text{HClO}_4 + \text{H}_2\text{O} \rightarrow \text{ClO}_4^- + \text{H}_3\text{O}^+ \\
& \text{B}
\end{array}$$

$$HBr + H_2O \rightarrow Br + H_3O^+$$

$$HIO_3 + H_2O \leftrightharpoons IO_3^- + H_3O^+$$
 $A \quad B \quad B \quad A$

$$HIO_3 + OH^- \leftrightharpoons IO_3^- + H_2O$$

$$A \qquad B \qquad B \qquad A$$

$$HC_2O_4^- + H_3O^+ = H_2C_2O_4 + H_2O$$

B

A

B

$$HI + H_2O \rightarrow I^- + H_3O^+$$

A
B

$$HCl + H_2O \rightarrow Cl^- + H_3O^+$$
A
B

$$HCOOH + H_2O \leftrightharpoons COOH - + H_3O + B B A$$

$$H_3PO_4 + OH^- \leftrightharpoons H_2PO_4^- + H_3O^+$$

$$A \qquad B \qquad A$$

$$SO_3^{2-} + H_3O^+ \leftrightharpoons HSO_3^- + H_2O$$

<u>Hebden Workbook Pg. 117 #11, 12</u> <u>Brønsted-Lowry Acid-Base Worksheet #1-8</u>



Conjugate Acid-Base Pairs

Example 3 – Identify the Brønsted-Lowry acid and base in the following reaction:

$$\begin{array}{c} \text{HF}_{(aq)} + \text{CN}_{(aq)} & \rightleftharpoons \text{HCN}_{(aq)} + \text{F}_{(aq)} \\ \textbf{A} & \textbf{B} & \textbf{A} & \textbf{B} \end{array}$$

Two substances that differ by one H+ ion are called a conjugate acid-base pair.

Let's practice!

Complete the following table:

ibic.	
Conjugate Acid (donates a proton)	Conjugate Base (accepts a proton)
$H_2C_2O_4$	HCzOy
H203_	SO ₃ ² -
HCO₃-	C032-
H_2O_2	Ho _z -
H3803	H ₂ BO ₃ -
нсоон	COOH -
C6H607	C ₆ H ₅ O ₇ ²⁻
H ₃ 0+	H ₂ O
H ₂ O	OH-

Hebden Workbook pg. 119 #13

13. Identify each species in the following equations as being an acid or base.

a) $HF + SO_3^{2-} \rightleftharpoons F^- + HSO_3^-$ d) $H_2PO_4^- + S^2^- \rightleftharpoons HS_3^-$ Identify each species in the following equations as being an acid or base.

a) $HF + SO_3^{2^-} \rightleftharpoons F^- + HSO_3^-$ b) $H_2O + HCO_3^- \rightleftharpoons H_3O^+ + CO_3^{2^-}$ e) $N_2H_5^+ + SO_4^{2^-} \rightleftharpoons N_2H_4 + HSO_4^-$

has one more

a)
$$HF + SO_3^2 \rightleftharpoons F^- + HSO_3^-$$

d)
$$H_2PO_4 + S^2 \implies HS^- + HPO_4^2$$

has one fewer

e)
$$N_2H_5^+ + SO_4^2 \implies N_2H_4 + HSO_4$$

c)
$$NO_2^- + H_2O \Longrightarrow OH^- + HNO_2$$

Consider the two reactions below:

$$\begin{array}{c|c} NH_{3 \ (aq)} + H_{2}O_{\ (l)} & \leftrightharpoons NH_{4^{+} \ (aq)} + OH_{\ (aq)} \\ B & A & B \\ \hline \\ HF_{\ (aq)} + H_{2}O_{\ (l)} & \leftrightharpoons H_{3}O_{\ (aq)} + F_{\ (aq)} \\ B & A & B \\ \end{array}$$

Generally, if a substance has:

1. A regative charge and

2. An easily removable H

Then it is amphiprotic

and easily removable

ex. H₂C₆H₅O₇

In the first reaction, water acts as a BL-acid. In the second reaction, water acts as a BL-base.

An amphiprotic substance has the ability to act as an acid or a base, depending on what it is reacting with.

1. Which of the following would be expected to exhibit amphiprotic behavior. Circle those that apply.













2. Of the species that were circled in the above question, write two equations: (1) behaving as an acid with water (2) behaving as a base with water

$$\begin{cases}
HSe^{-} + H2O \rightleftharpoons Se^{2^{-}} + H3O^{+} \\
HJe^{-} + H2O \rightleftharpoons H2Se + OH^{-}
\end{cases}$$

$$\begin{cases}
HPOy^{2^{-}} + H2O \rightleftharpoons POy^{3^{-}} + H3O^{+} \\
HPOy^{2^{-}} + H2O \rightleftharpoons H2POy^{-} + OH^{-}
\end{cases}$$

$$\begin{cases}
HSO_{3}^{-} + H2O \rightleftharpoons SO_{3}^{2^{-}} + H3O^{+} \\
HSO_{3}^{-} + H2O \rightleftharpoons H2SO_{3} + OH^{-}
\end{cases}$$