Name:_____
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CHEMISTRY 12
ACID BASES UNIT
Lesson #6
"STRONG AND WEAK" ACIDS AND BASES

(NO EQUILIBRIUM)

STRONG ACIDS or BASES: are ionized 100% in solution.

$NaOH\ (s) + H_2O\ (l) \longrightarrow Na^+(aq) + OH^-(aq)$

$HCl\ (g) + H_2O\ (l) \longrightarrow H^+(aq) + Cl^-(aq)$

(EQUILIBRIUMS!)

WEAK ACIDS or BASES are ionized less than 100% in

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

$HF\ (aq) + H_2O\ (l) \rightleftharpoons F^-(aq) + H_3O^+(aq)$

IMPT:
1. EQUILIBRIUMS involve ONLY Weak acids/bases, NOT STRONG !!!!!

2. IN PRACTICE weak acids and bases are ionized < 50%.

3. IN CHEMISTRY 12 it is important to get the following terms straight:
STRONG + WEAK- refer to the degree of ionization.

DILUTE + CONCENTRATED- refer to the Molarity of a solution (mol/L)

NOW LETS EXAMINE THE:
"Relative Strenghts of Bronsted-Lowry Acids and Bases" Table.

STRONG ACIDS:
Notice the ONE-WAY ARROWS, that is because STRONG acids do NOT reach equilibrium!!!
Any STRONG ACID in water can be represented by the equation:

$HA + H_2O(l) \Longrightarrow H_3O^+(aq) + A^-(aq)$

STRONG BASES:
Any STRONG BASE in water can be represented by the equation:

$BOH \longrightarrow B^+(aq) + OH^-(aq)$

IMPORTANT: The most common strong bases are metal hydroxides (although they do not directly get mentioned on this table) you should be familiar with the following:

$NaOH, KOH, RbOH, CsOH, LiOH, Sr(OH)_2$

WEAK ACIDS: appear on the LEFT side of the table. OH^- and NH_3 NEVER ACT as ACIDS in aqueous solutions!

WEAK BASES: appear on the RIGHT side of the table, the top six species (ClO_4^- to HSO_4^-) NEVER act as BASES in aqueous solutions!

A SPECIAL NOTE READING THE TABLE: water is absent

ex $H_2S \rightleftharpoons H^+ + HS^-$ base

H_2S acting as as acid:

L-R

$H_2S + H_2O(\ell) \longrightarrow H_3O^+ + HS^-$ (acid, base)

When a substance acts as an ACID with water, **H_3O^+** is ALWAYS PRODUCED!!!

HS^- acting as a base:

R-L

$HS^- + H_2O(\ell) \longrightarrow H_2S + OH^-$ (base, acid)

When a substance acts as a base with water, **OH^-** is ALWAYS PRODUCED!!!

OTHER RELATIONSHIPS FOUND IN THE TABLE:

1. The HIGHER a species is on the left side = the stronger the ACID
2. The LOWER the species is on the right side= the stronger the BASE
3. The STRONGER the ACID, the weaker it's CONJUGATE BASE (VICE VERSA)
4. AMPHIPROTIC species appear on BOTH SIDES of the table!

HCO_3^-, HPO_4^{2-}, HPO_4^{1-}, HSO_3^-, $HC_2O_4^-$, H_2O etc

~~HSO_4^-~~ never does

"THE LEVELLING EFFECT of WATER "

WATER **"levels out"** the strength of all STRONG ACIDS to the same strength, therefore H_3O^+ is the STRONGEST ACID that exists in AQUEOUS SOLUTIONS!!!

ex. ~~$HA + H_2O(\ell)$~~ $\longrightarrow H_3O^+ + A^-$

Water also **"levels out"** the strenght of all STRONG BASES to the same strength, therefore OH^- is the STRONGEST BASE that exists in AQUEOUS SOLUTIONS!!!!

ex. ~~$BOH + H_2O(\ell)$~~ $\longrightarrow B^+ + OH^-$

DEFINITION of THE LEVELLING EFFECT:

All STRONG ACIDS are 100% IONIZED in aqueous solutions and are equivalent to solutions of H_3O^+, while all STRONG BASES are 100% IONIZED in aqueous solutions are are equivalent to solutions of OH^-!

SEATWORK/HOMEWORK:

What sort of an electrical current would a STRONG ACID or BASE solution generate compared to a WEAK ACID or BASE solution?Explain Why

Exercises 21-27 pgs 125-126

PLO's: K1-K7

RELATIVE STRENGTHS OF BRØNSTED-LOWRY ACIDS AND BASES

in aqueous solution at room temperature.

Name of Acid	Acid		Base	K_a
Perchloric	$HClO_4$	→	$H^+ + ClO_4^-$	very large
Hydriodic	HI	→	$H^+ + I^-$	very large
Hydrobromic	HBr	→	$H^+ + Br^-$	very large
Hydrochloric	HCl	→	$H^+ + Cl^-$	very large
Nitric	HNO_3	→	$H^+ + NO_3^-$	very large
Sulphuric	H_2SO_4	→	$H^+ + HSO_4^-$	very large
Hydronium Ion	H_3O^+	⇄	$H^+ + H_2O$	1.0
Iodic	HIO_3	⇄	$H^+ + IO_3^-$	1.7×10^{-1}
Oxalic	$H_2C_2O_4$	⇄	$H^+ + HC_2O_4^-$	5.9×10^{-2}
Sulphurous $(SO_2 + H_2O)$	H_2SO_3	⇄	$H^+ + HSO_3^-$	1.5×10^{-2}
Hydrogen sulphate ion	HSO_4^-	⇄	$H^+ + SO_4^{2-}$	1.2×10^{-2}
Phosphoric	H_3PO_4	⇄	$H^+ + H_2PO_4^-$	7.5×10^{-3}
Hexaaquoiron ion, iron(III) ion	$Fe(H_2O)_6^{3+}$	⇄	$H^+ + Fe(H_2O)_5(OH)^{2+}$	6.0×10^{-3}
Citric	$H_3C_6H_5O_7$	⇄	$H^+ + H_2C_6H_5O_7^-$	7.1×10^{-4}
Nitrous	HNO_2	⇄	$H^+ + NO_2^-$	4.6×10^{-4}
Hydrofluoric	HF	⇄	$H^+ + F^-$	3.5×10^{-4}
Methanoic, formic	$HCOOH$	⇄	$H^+ + HCOO^-$	1.8×10^{-4}
Hexaaquochromium ion, chromium(III) ion	$Cr(H_2O)_6^{3+}$	⇄	$H^+ + Cr(H_2O)_5(OH)^{2+}$	1.5×10^{-4}
Benzoic	C_6H_5COOH	⇄	$H^+ + C_6H_5COO^-$	6.5×10^{-5}
Hydrogen oxalate ion	$HC_2O_4^-$	⇄	$H^+ + C_2O_4^{2-}$	6.4×10^{-5}
Ethanoic, acetic	CH_3COOH	⇄	$H^+ + CH_3COO^-$	1.8×10^{-5}
Dihydrogen citrate ion	$H_2C_6H_5O_7^-$	⇄	$H^+ + HC_6H_5O_7^{2-}$	1.7×10^{-5}
Hexaaquoaluminum ion, aluminum ion	$Al(H_2O)_6^{3+}$	⇄	$H^+ + Al(H_2O)_5(OH)^{2+}$	1.4×10^{-5}
Carbonic $(CO_2 + H_2O)$	H_2CO_3	⇄	$H^+ + HCO_3^-$	4.3×10^{-7}
Monohydrogen citrate ion	$HC_6H_5O_7^{2-}$	⇄	$H^+ + C_6H_5O_7^{3-}$	4.1×10^{-7}
Hydrogen sulphite ion	HSO_3^-	⇄	$H^+ + SO_3^{2-}$	1.0×10^{-7}
Hydrogen sulphide	H_2S	⇄	$H^+ + HS^-$	9.1×10^{-8}
Dihydrogen phosphate ion	$H_2PO_4^-$	⇄	$H^+ + HPO_4^{2-}$	6.2×10^{-8}
Boric	H_3BO_3	⇄	$H^+ + H_2BO_3^-$	7.3×10^{-10}
Ammonium ion	NH_4^+	⇄	$H^+ + NH_3$	5.6×10^{-10}
Hydrocyanic	HCN	⇄	$H^+ + CN^-$	4.9×10^{-10}
Phenol	C_6H_5OH	⇄	$H^+ + C_6H_5O^-$	1.3×10^{-10}
Hydrogen carbonate ion	HCO_3^-	⇄	$H^+ + CO_3^{2-}$	5.6×10^{-11}
Hydrogen peroxide	H_2O_2	⇄	$H^+ + HO_2^-$	2.4×10^{-12}
Monohydrogen phosphate ion	HPO_4^{2-}	⇄	$H^+ + PO_4^{3-}$	2.2×10^{-13}
Water	H_2O	⇄	$H^+ + OH^-$	1.0×10^{-14}
Hydroxide ion	OH^-	←	$H^+ + O^{2-}$	very small
Ammonia	NH_3	←	$H^+ + NH_2^-$	very small

STRONG ACIDS

STRONG

STRENGTH OF ACID

WEAK

WEAK

STRENGTH OF BASE

STRONG

BASES