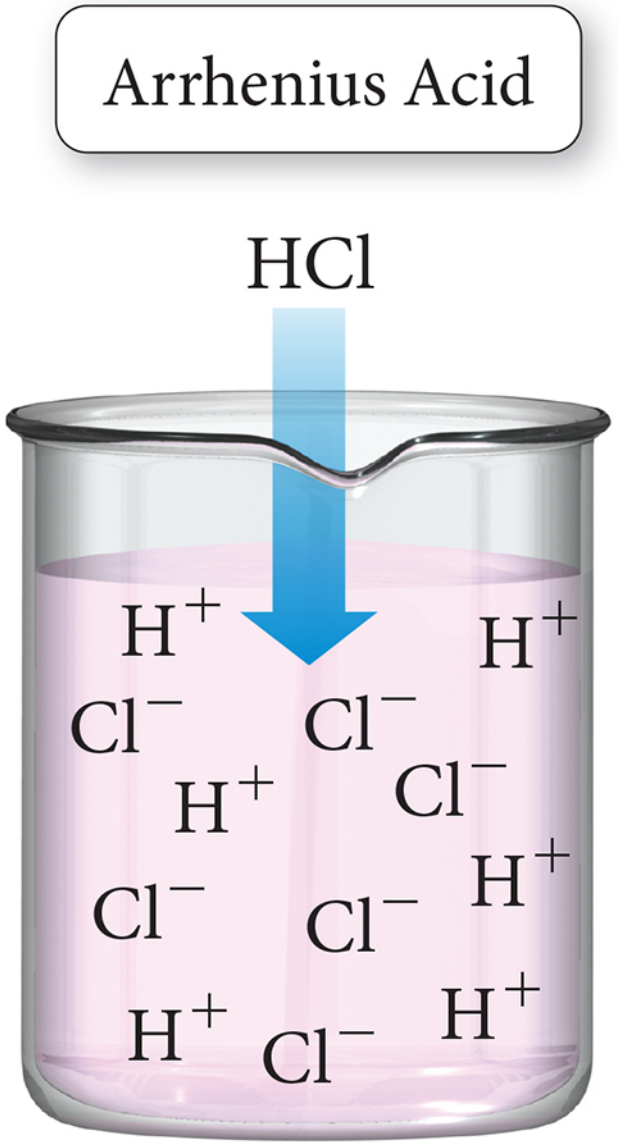
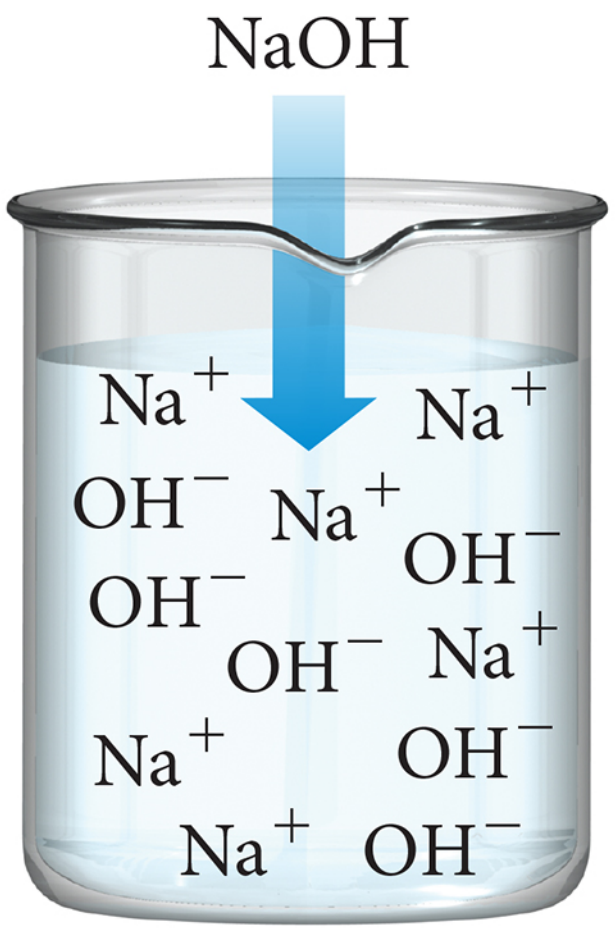


$$HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$$

Arrhenius Base



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

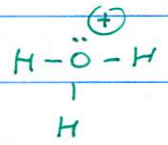
3/22/2019

H^+ = proton ~doesn't really exist in H_2O

hydrogen-ion

↙ HYDRONIUM ion

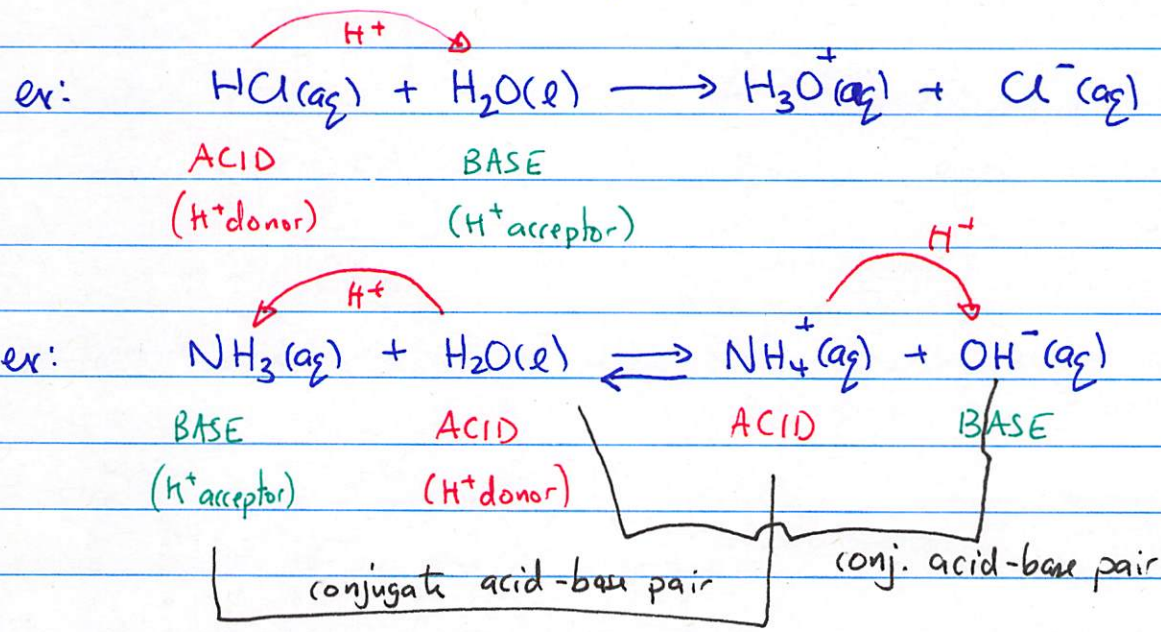
"H^+" = H_3O^+

↖ H^+ attached to H_2O, 

1923 Brønsted-Löwry.

Acid: H^+ (proton) donors.

Bases: H^+ acceptors.

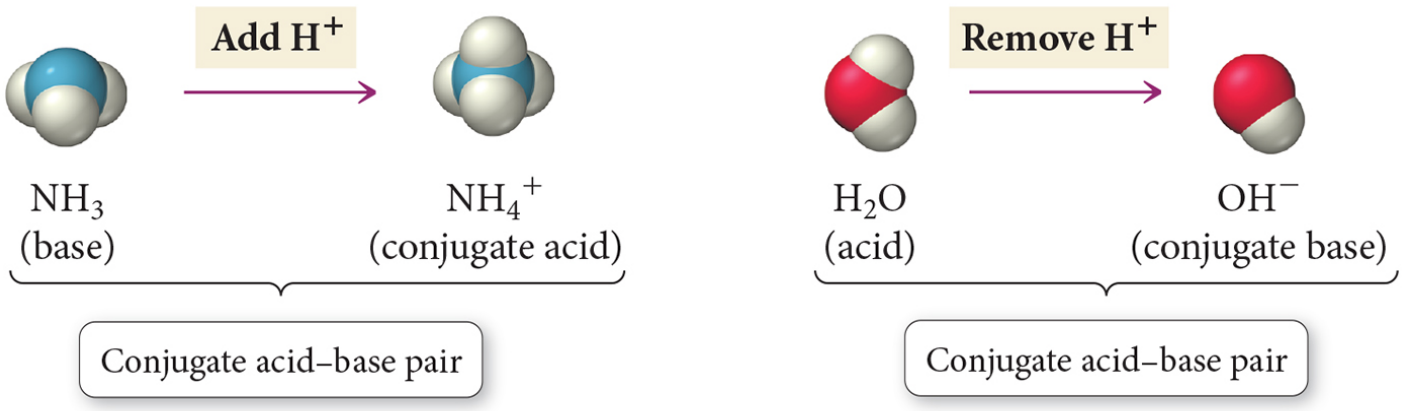


NH_3/NH_4^+ = conj. acid-base pair (↑more H^+ = acid ↓fewer H^+ = base)

base acid

H_2O/OH^- = " ——— "

acid base



Acid Strength, + Acid ionization/dissociation constant, K_a

ch 4: strong electrolyte: 100% ionization/dissociation
weak " : <100% " ——— "

ex: Strong acid, $HA(aq)$
(strong electrolyte)

$$HA(aq) + H_2O(l) \xrightarrow{100\%} H_3O^+(aq) + A^-(aq)$$

(H^+ transferred)

6 strong acids memorize:

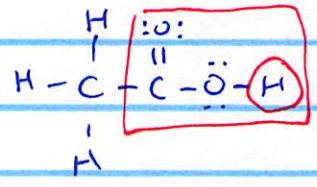
$HCl(aq)$	Hydrochloric acid	1 H^+
$HBr(aq)$	" bromic "	MONOPROTIC
$HI(aq)$	" iodic "	ACIDS
$HNO_3(aq)$	Nitric acid	
$HClO_4(aq)$	Perchloric acid	

$H_2SO_4(aq)$ Sulfuric acid — DIPROTIC ACID, 2 H^+/molecule

ex: acetic acid — acidic H's

$HC_2H_3O_2(aq)$ or CH_3CO_2H

monoprotic



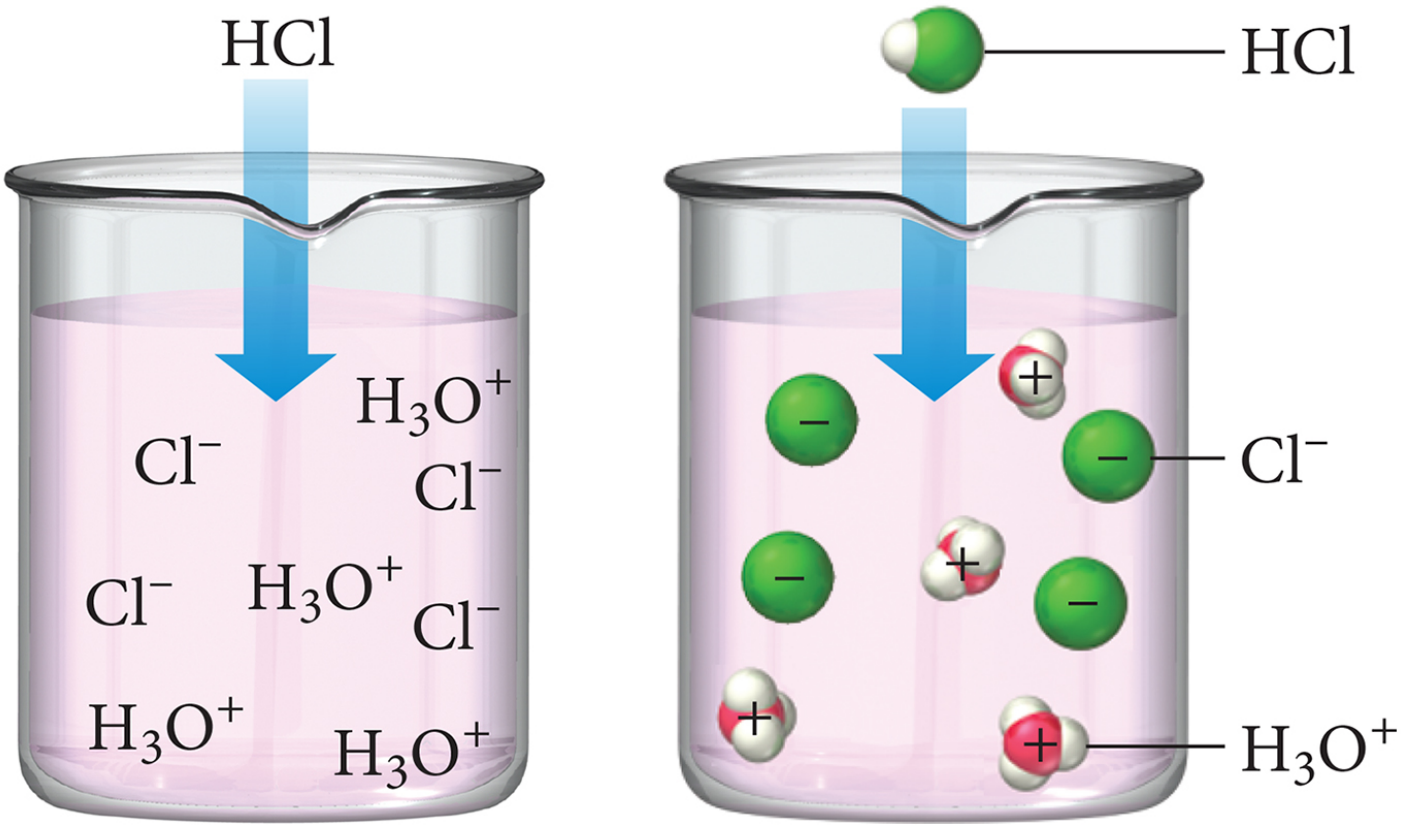
carboxylic acid group

TABLE 16.3 Strong Acids

Hydrochloric acid (HCl)	Nitric acid (HNO_3)
Hydrobromic acid (HBr)	Perchloric acid ($HClO_4$)
Hydriodic acid (HI)	Sulfuric acid (H_2SO_4) (*diprotic*)

A Strong Acid

When HCl dissolves in water, it ionizes completely.



Weak acids

~~weak~~ weak electrolytes

<100% ionization.

ex: $HF_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + F^-_{(aq)}$

(H+ : $HF \rightarrow H_2O$; H+ : $H_3O^+ \rightarrow F^-$)

Hydrofluoric acid — conj. base

conj. acid-base pair

HF: weak acid $\rightleftharpoons$ F^- (conj. base)

- doesn't break down easily — must be strong!

~~F~~ $HF_{(aq)}$ hydrofluoric acid } monoprotic

$HC_2H_3O_{2(aq)}$ acetic " }

$H_3PO_{4(aq)}$ phosphoric " } triprotic

K_a

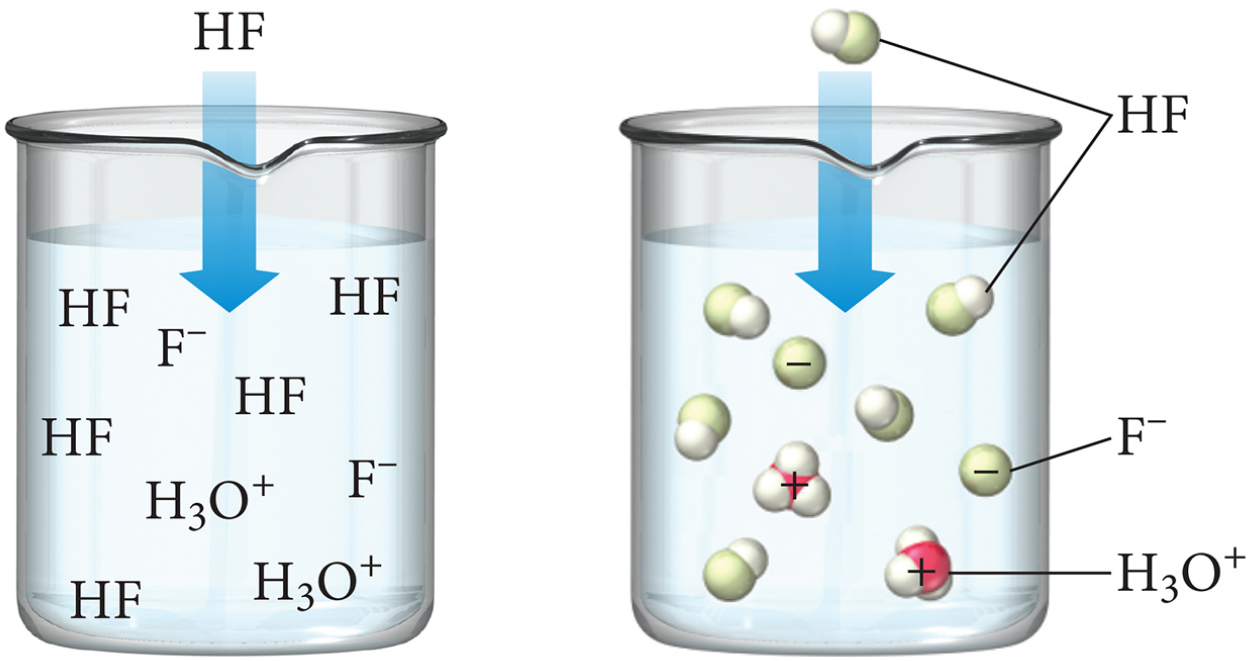
$HA_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + A^-_{(aq)}$ (H+ : $HA \rightarrow H_2O$)

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

$H_2O_{(l)}$ ~ eff conc = 1

A Weak Acid

When HF dissolves in water, only a fraction of the molecules ionize.



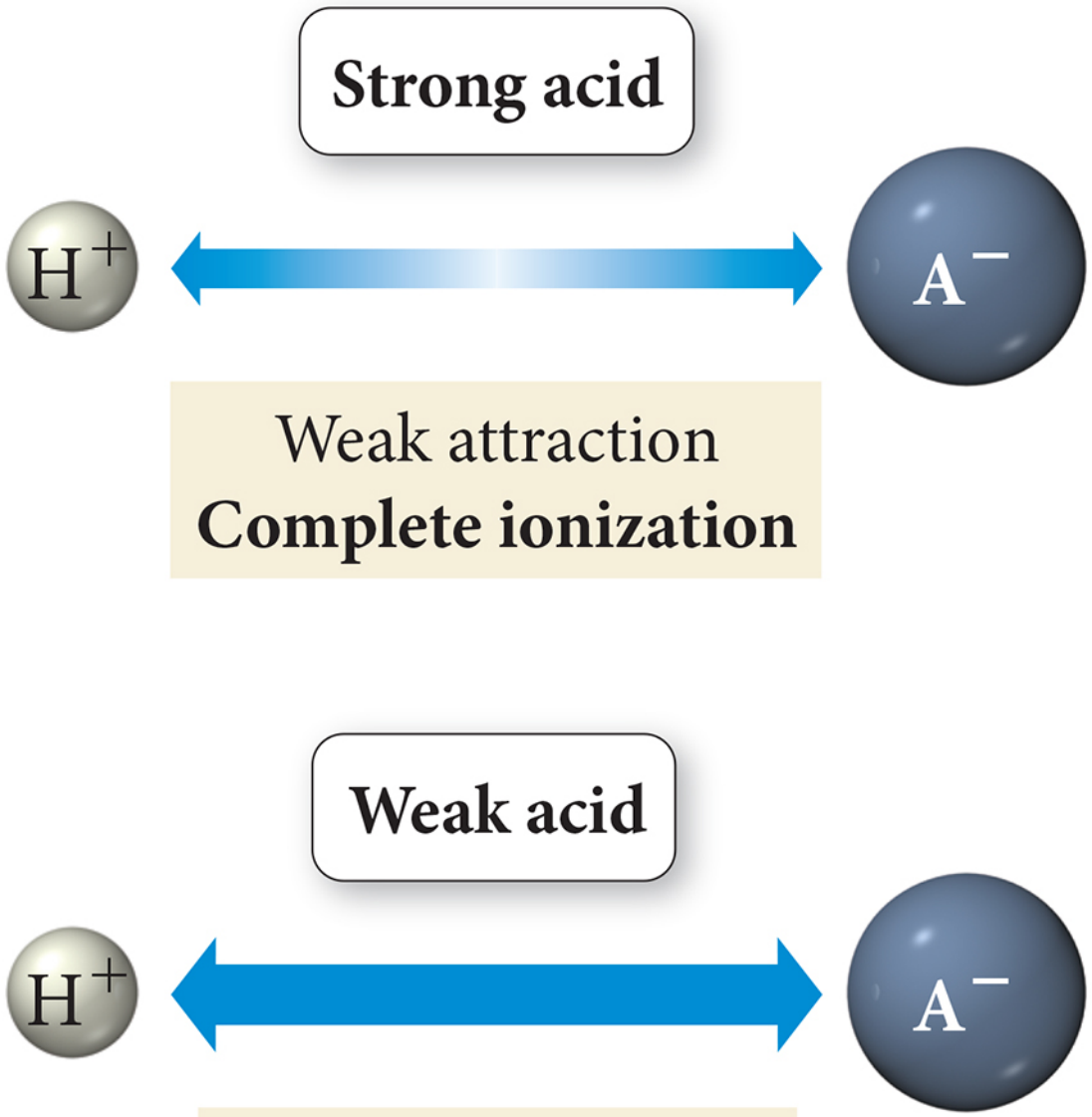
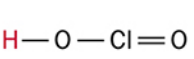
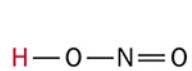
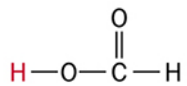
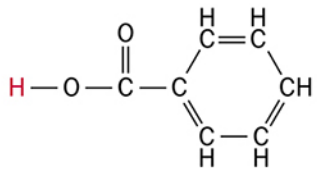
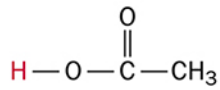
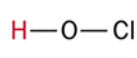
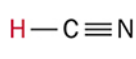
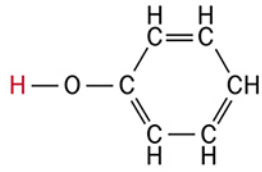


TABLE 16.5 Acid Ionization Constants (K_a) for Some Monoprotic Weak Acids at 25 °C

Acid	Formula	Structural Formula	Ionization Reaction	K_a	pK_a
Chlorous acid	$HClO_2$		$HClO_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + ClO_2^-(aq)$	1.1×10^{-2}	1.96
Nitrous acid	HNO_2		$HNO_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + NO_2^-(aq)$	4.6×10^{-4}	3.34
Hydrofluoric acid	HF		$HF(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + F^-(aq)$	6.8×10^{-4}	3.17
Formic acid	$HCHO_2$		$HCHO_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + CHO_2^-(aq)$	1.8×10^{-4}	3.74
Benzoic acid	$HC_7H_5O_2$		$HC_7H_5O_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + C_7H_5O_2^-(aq)$	6.5×10^{-5}	4.19
Acetic acid	$HC_2H_3O_2$		$HC_2H_3O_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + C_2H_3O_2^-(aq)$	1.8×10^{-5}	4.74
Hypochlorous acid	HClO		$HClO(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + ClO^-(aq)$	2.9×10^{-8}	7.54
Hydrocyanic acid	HCN		$HCN(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + CN^-(aq)$	4.9×10^{-10}	9.31
Phenol	HC_6H_5O		$HC_6H_5O(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + C_6H_5O^-(aq)$	1.3×10^{-10}	9.89