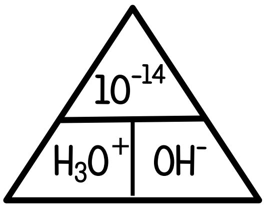
$pH = -\log [H_3O^+]$

$[H_3O^+] = 10^{-pH}$

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

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

$K_W = [H_3O^+][OH^-] = 10^{-14}$



Enter 1.35×10^{-4} into calculator as

1 . 3 5 EXP (-) 4 OR

1 . 3 5 x 10 ^ (-) 4

Weak acids

$Ka = [H_3O^+]^2 / [HA]$

or

$[H_3O^+] = \sqrt{Ka \times [HA]}$

Weak bases

$Kb = [OH^-]^2 / [B]$

or

$[OH^-] = \sqrt{Kb \times [B]}$

Level 2 stuff revisited

Equations for calculating pH of weak acids and bases

Weakly acidic salts eg NH_4^+ which contains NH_4^+ ion

$Ka = [H_3O^+]^2 / [salt]$

or

$[H_3O^+] = \sqrt{Ka \times [salt]}$

Weakly basic salts eg CH_3COONa which contains CH_3COO^- ion

$K_b = [OH^-]^2 / [salt]$

or

$[OH^-] = \sqrt{Kb \times [salt]}$

$pH + pOH = 14$

$pKa + pKb = pKw = 14$

$Ka \times Kb = Kw = 10^{-14}$

$Kw = [H_3O^+][OH^-] = 10^{-14}$

$pKw = pH + pOH = 14$

$pKa = -\log Ka$

$pKb = -\log Kb$

$pKw = -\log Kw$

$Ka = 10^{-pKa}$

$Kb = 10^{-pKb}$

$Kw = 10^{-pKw}$

Equations for calculating pH of salts that are weakly acidic / basic

Converting things when you need something you weren't given

$$pH = pKa + \log\frac{[base]}{[acid]}$$

Note: when [base] = [acid], then pH = pKa

z Remember this! e

The base is the one WITHOUT the proton and the acid is the one WITH the proton!

p o a

Buffer made from CH_3COOH and CH_3COONa

CH_3COONa dissolves completely in water into $CH_3COO^-(aq)$ and $Na^+(aq)$

$CH_3COONa + aq \rightarrow CH_3COO^- + Na^+$

$$pH = pKa + \log\frac{[CH_3COO^-]}{[CH_3COOH]}$$

pKa (CH_3COOH) will be used in calc.

Alter $[CH_3COO^-] : [CH_3COOH]$ ratio to adjust the pH

Buffer equation

Acidic buffer example

Buffer made from NH_3 and NH_4Cl

NH_4Cl dissolves completely in water into $NH_4^+(aq)$ and $Cl^-(aq)$

$NH_4Cl + aq \rightarrow NH_4^+ + Cl^-$

$$pH = pKa + \log\frac{[NH_3]}{[NH_4^+]}$$

pKa (NH_4^+) will be used in calc.

Alter $[NH_3] : [NH_4^+]$ ratio to adjust the pH

Strong acid: $HA + H_2O \rightarrow H_3O^+ + A^-$

Weak acid: $HA + H_2O \rightleftharpoons H_3O^+ + A^-$

Strong base: $NaOH + aq \rightarrow Na^+ + OH^-$

Weak base: $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

Neutral salt: $NaCl + aq \rightarrow Na^+(aq) + Cl^-(aq)$

Acidic salt: $NH_4Cl + aq \rightarrow NH_4^+ + Cl^-$

then $NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$

Basic salt:

$CH_3COONa + aq \rightarrow CH_3COO^- + Na^+$

then $CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$

(write + aq instead of + H_2O if dissolving)

Basic buffer example

Equations for acids, bases and salts in water