General Chemistry
Theoretical

First stage Student
Department of Physics

أستاذة المادة

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Analytical chemistry

Third// Hydrogen ion) acidity degree) or acidity function(pH)
Hydroxyl ion (basicity degree) or basicity function (pOH)

The molar concentration of hydrogen ions in solutions is often less than one (fraction), as when the concentration of a solution is **10^{-3} (0.001)** (Mol/L).To express the concentration of hydrogen ions and acidity Solutions are given relatively large numbers and small fractions are eliminated. It has been agreed to use the acidity number pH or the hydrogen ion or what we call the basic number pOH or the hydroxyl ion , which is called.

And the (pH) defined as :

It is the negative logarithm of the molar concentration of hydrogen ions (gm.ion/L) or the positive logarithm of the reciprocal of the concentration of ions to the base of hydrogen 10.

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

$$pH = +\log \frac{1}{[H^+]}$$

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

In the same way, the hydroxyl ion concentration can be expressed by a similar number, which is the basicity number, where it is equal to the positive logarithm of the reciprocal of the hydroxyl ion concentration.

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

$$pOH = +\log \frac{1}{[OH^-]}$$

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

The concentration of hydrogen ions and hydroxyl ions is determined by knowing the concentration of one of them from the water equilibrium equation.

$$Kw = [H^+] \times [OH^-] = 10^{-14}$$

$$[H^+] = \frac{10^{-14}}{[OH^-]}$$

$$[OH^-] = \frac{10^{-14}}{[H^+]}$$

$$-\log [H^+] - \log [OH^-] = -\log 10^{-14}$$

$$pH + pOH = pKw = 14$$

Example : Calculate the **pH, pOH**, for a solution containing a molar concentration of hydrogen ions equal to **$5x10^{-3}$**.

$$[H^+] = 5x10^{-3}$$
$$[H^+]\ [OH^-] = 10^{-14}$$
$$(5x10^{-3})\ [OH^-] = 10^{-14}$$
$$[OH^-] = \frac{10^{-14}}{5x10^{-3}} = 2x10^{-12}\ mol/L$$

$$pH = -\log[H^+]$$
$$= -\log 5 \times 10^{-3}$$
$$pH = -(0.69) - (-3)$$
$$= -0.69 + 3 = 2.3$$

log 5=0.69

$$pOH = -\log [OH^-]$$
$$= -\log 2x10^{-12}$$
$$= -(0.30) - (-12)$$
$$= -0.30 + 12 = 11.7$$

log 2 =0.30

Example : Calculate the **pOH** and the hydrogen ion concentration and hydroxide ion concentration of a solution **pH** with a value of **(4.4)** ?.

Calculating the pH of buffer solutions

1. $$pH = pKa + \log \frac{[\ Salt\ ]}{[\ Acid\ ]}$$

2. $$pOH = pKb + \log \frac{[\ Salt]}{[\ Base\ ]}$$

3. $$pH = pKw - pKb - \log \frac{[Salt]}{[\ Base]}$$

Example : A solution consisting of **(0.1)** molar ammonium hydroxide and **(0.01)** molar of ammonium chloride, calculate pH ?
if you know that(pKb) for base equal (4.47) ?

$$pOH = pKb + \log \frac{[Salt]}{[Base]}$$

$$pOH = 4.74 + \log \frac{0.01}{0.1}$$

$$pOH = 4.47 + \log 0.1$$

log 0.1 = -1

$$pOH = 4.47 + (-1) = 3.47$$

$$pH + pOH = 14$$

$$pH = 14 - 3.47 = 10.27$$

Example: Calculate the **pH** of a buffer solution consisting of **(0.1M)** acetic acid and sodium acetate **(0.01M)** , knowing that **pka = 1.8 x 10^{-5}** ?

$$pH = pKa + \log \frac{[\ Salt]}{[Acid]}$$

$$pH = -\log 1.8 \times 10^{-5} + \log \frac{0.01}{0.1}$$

log1.8=0.25

$$pH = -(0.25) - (-5) + \log 0.1$$
$$PH = -0.25 + 5 + (-1) = 3.37$$