**What is PH?**

It is a unit of measure which describes the acidity or alkalinity of a solution. It runs on a scale of 1 to 14. **7** is neutral, below 7 is acidic and above 7 is alkaline.

P is a mathematical symbol for **neg** **logarithm** while H is a symbol for hydrogen.

By definition the PH of a solution is defined as the negative logarithm of hydrogen ion activity in a solution.

pH = -log[H+]

PH is directly related to the ratio of hydrogen ions and hydroxyl ion concentrations. If the concentrations of H ions exceed that of OH then the solution is acidic. If the concentrations are the same then the solution is neutral.

**Dissociation of water**

Different Molecules must come into contact with each other for a reaction to occur.

Almost all reactions need a media to take place in and most of the time it is water that is the medium of choice.

One of the properties of water is its ability to dissociate into H and OH ions. This property is important in acid-base reactions.

H2O ⇌ H+ + OH-

The hydrated state of the H ion is sometimes denoted as H3O+ which implies that it is a Hydrogen ion in water i.e. H.H2O.

The probability of this occurring in pure water is 1/10,000,000 and this has been determined experimentally.

Therefore, the PH of pure water is

pH = -log[H+]

PH = -log (1x 10-7) =7

at this PH water is considered neutral and the concentration of Hydrogen ions is the same as that of Hydroxyl ions.

Meaning at any given time the ionic product of water =H ions x OH ions=10-7 x10-7=10-14 will always be constant.

At a neutral PH the concentrations of OH and H for pure water is assumed to be equal i.e.

H+ x OH-…………………. KwH2O

10-7 x 10-7…………10-14 moles per litre.

Since large numbers are tedious to manipulate, logarithm was introduced for ease of manipulation, in which case they symbol P was adopted which stands for the negative power.

The PH varies between 0-14 with 7 being neutral.

**Revision questions**

**What is the PH of a 0.05M HCL acid**

HCL ⇌ H+ + CL-

0.05 0.05 0.05

The reaction is at a ratio of 1 to 1

Ph =-log (0.05) = 1.3

**What is the PH of a solution of NaOH whose concentration is 0.02moles per litre**

Being a strong base it will dissociate completely in water. The concentration of the base will be equal to the concentration of NaOH

NaOH ⇌ Na+ + OH-

The reaction is at a ratio of 1to 1 so the concentration of OH will be the same as that of Na+ and it will be 0.02

But we know that the PH is given by

PH + POH=14

POH=-log OH

Therefore, the POH=-log 0.02=1.7

But PH +POH=14

PH+1.7=14

PH=14-1.7

=12.3

## **The Henderson-Hasselbalch Equation**

Let’s assume we have a weak acidic salt with positive ionic part **H** and the negative ionic part **A**

So, our weak acid has the formula **HA**

If HA dissolved in water dissociates into

**HA**⇌ **H+ + A- ………………………………equation 1**

**The ionic product of the salt is always given by**

**Ka = (H+) (****A-) /** **HA…………………………. equation 2**

**If we make H as the subject of formula**

**H = Ka (HA)/ (A)………………………………..equation 3**

**If we introduce logarithms it can be written as**

**Log H= log Ka + log HA-log A ……………………equation 4**

**But remember that PH is the neg log of Hydrogen ion therefore multiplying by neg**

**(Log H= log Ka + log HA-log A)** X **neg-**

**-Log H=** **-log Ka - log HA+log A………………………equation 5**

**PH = -log Ka - log HA+log A**

**PH = pka +log (A/HA)………………………………. formula for PH of weak acids**

**PH =pka +log (proton acceptor/proton donor)**

**Pka=-log ka**

**Buffer solutions**

A buffer is a solution that has the ability to resist drastic changes in PH and thereby maintain a constant PH when there is exposure to small changes in ph. In the body this could occur in cases like administration of certain drugs or poisoning.

A buffer is made up of a solution of a **weak** acid or base mixed with the salt of its conjugate acid or base respectively.

To calculate the ph of buffers the HH equation should be used.

**Revision question**

what is the PH of a buffer solution consisting of 0.035M NH3 and 0.05MNH4+ salt given the Ka of NH4 salt as 5.6 x 10-10

discuss regulation of body PH when a patient takes an excess dose of aspirin which is an acidic drug.

**PH= PKa+ log (proton acceptor/proton donor)**

**But Pka= -log Ka=-log (**5.6 x 10-10)= 9.25

**PH=9.25 + log (0.035/0.05)**

**PH=9.25+ (-0.15)**

**= 9.25-0.15**

**=9.1**

**the buffer is alkaline**