Q:19 pKa of acetic acid and pKb of ammonium hydroxide are 4.76 and 4.75 resp. calculate pH of NH_4-acetate soln.

→ pKa slight high. hence, basic.

$pH = 7 + \frac{1}{2}(4.76 - 4.75) \rightarrow 7 + \frac{1}{2}(0.01) = \boxed{7.005}$

⇒ Buffer solution:

- solution whose pH does not change significantly on addition of small amount of acid or alkali.
- pH of Buffer solution is not affected by dilution.
- based on common ion effect.

⇒ Types:

Buffer soln
- Simple
- Mixed
  - Acidic
  - Basic

✳ Simple Buffers:

- salt of weak acid and weak base in water.

Eg: CH_3COONH_4 ; NH_4CN.

- $\boxed{pH = \frac{1}{2}(pKw + pKa - pKb)}$ or $\boxed{7 + \frac{1}{2}(pKa - pKb)}$

* Mixed Buffers:

- aqueous solution of mixture of weak acid and salt of same weak acid with any kind of strong base.

1) **Acidic:** (weak acid with its strong base or conjugate)

→ WA + salt (WASB).
or WA + conjugated ion salt.

eg: $CH_3COOH + CH_3COONa$; $HCOOH + HCOOK$; $HCN + NaCN$
$C_6H_5COOH + C_6H_5COONa$; $H_2CO_3 + Na_2CO_3$; $H_2S + NH_4HS$.

→ pH (by Hendersons's eqn):

- $pH = pKa + \log \frac{[SALT]}{[W.ACID]}$ or $pH = pKa + \log \frac{[conj.\ base]}{[w.acid]}$

or $pH = -\log Ka + \log \frac{[salt]}{[w.acid]}$

2.) **Basic:** (weak base with its strong acid or conjugate)

→ aqueous solution of mixture of weak base and salt of same weak base with any kind of strong acid

→ WB + salt (SAWB)
or WB + conjugated ion salt.

eg: $NH_4OH + NH_4Cl$; $NH_4OH + NH_4NO_3$;

→ pOH (by Hendersons eqn):

- $pOH = pK_b + \log \frac{[salt]}{[w.base]}$ or $pOH = -\log K_b + \log \frac{[salt]}{[w.base]}$

Q:20 B^- & HB^+'s concentrations. for B^- is 10^{-10}. pH?

→ $pOH = (-\log K_b) + \log \frac{[salt]}{[w.acid]}$

$= (-\log 10^{-10}) + \log \frac{[B^-]}{[HB]}(1)$: $\log 1 = 0$.

$= \boxed{10}$.

$pH = 14 - 10 \longrightarrow \boxed{4}$.

Q:21 NH_3 conc. 0.30 M and NH_4^+ conc. 0.20 M

$K_b = 1.8 \times 10^{-5}$ pH = ?

→ $pOH = -\log 1.8 \times 10^{-5} + \log \left[\frac{0.2}{0.3}\right]$

$= -\log 18 \times 10^{-5} + \log \left[\frac{2}{3}\right]$

$= 5 - \log 1.8 + \log \left[\frac{2}{3}\right]$

$pOH = 5 + \log \left[\frac{2}{3 \times 1.8_{0.9}}\right]$

$= 5 + \log \left[\frac{1}{2.7}\right] \longrightarrow 5 - \log(2.7)$.

∴ $pOH = 5 - 0.43$

$= \underline{4.57}$.

14.00
4.57
9.43

∴ $pH = 14 - 4.57$

$= \boxed{9.43}$

Buffer capacity / index / range:

- defined as number of moles of strong acid / base required for changing its pH value by 1 unit of a one litre solution.
- number of H^+/OH^- added = change in number of moles of acid / base = change in no. of mole of salt

Buffer range for buffer sol^n of pKa ± 1:

- buffer range for buffer sol^n = $\frac{[salt]}{[w.Acid]}$ = 1 to 10. = $\frac{1}{10}$

→ **CASE: I**

if conc^n ratio of $\frac{[salt]}{[w.acid]}$ = $\frac{1}{10}$ to 10. (diff. of ± of pH)

then; sol^n act as buffer sol^n

∴, $\boxed{pH = pKa + \log \frac{[salt]}{[w.acid]}}$

→ **CASE: II**

if conc^n ratio of $\frac{[salt]}{[w.acid]} > 10$ (salt ↑ w_A ↓)

∴, SBWA

then, $\boxed{pH = \frac{1}{2}(pKw + pKa + \log C)}$

→ **CASE: III.**

if conc^n. ratio < 1/10 (salt ↓ w_A ↑).

then, $\boxed{pH = \frac{1}{2}(pKa - \log C)}$