

CHAPTER 16

Common ion effect \Rightarrow the presence of an ion that would be the product of a reversible reaction suppresses the forward reaction



HNO_2 in NaNO_2 is LESS acidic than in H_2O

$$K_a = \frac{[\text{H}^+][\text{NO}_2^-]}{[\text{HNO}_2]} \quad [\text{NO}_2^-] \uparrow, [\text{H}^+] \downarrow$$

constant \uparrow \rightarrow predetermined

in general $\text{HA} \rightleftharpoons \text{H}^+ + \text{A}^-$

$$[\text{H}^+] = K_a \frac{[\text{HA}]}{[\text{A}^-]} \quad -\log \text{ both sides}$$

$$\text{pH} = \text{p}K_a + \log \frac{[\text{A}^-]}{[\text{HA}]} \quad \text{Henderson-Hasselbach}$$

BUFFER \rightarrow weak acid AND its conjugate base (from a separate source) both in appreciable amounts

* because, HA , A^- are both weak, we can use initial amounts/concentrations

EXAMPLE $K_a \text{ HNO}_2 = 4.5 \times 10^{-4}$
What is the pH of a 0.20 M soln of HNO_2 ?

$$K_a = 4.5 \times 10^{-4} = \frac{x^2}{0.20} \Rightarrow x = [\text{H}^+] = 0.0095 \text{ M}$$

$$\text{pH} = 2.02$$

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constant \uparrow (pointing to K_a)
predetermined (pointing to $[\text{HNO}_2]$)

in general $\text{HA} \rightleftharpoons \text{H}^+ + \text{A}^-$

$$[\text{H}^+] = K_a \frac{[\text{HA}]}{[\text{A}^-]} \quad -\log \text{ both sides}$$

$$\boxed{\text{pH} = \text{p}K_a + \log \frac{[\text{A}^-]}{[\text{HA}]}} \quad \text{Henderson-Hasselbach}$$

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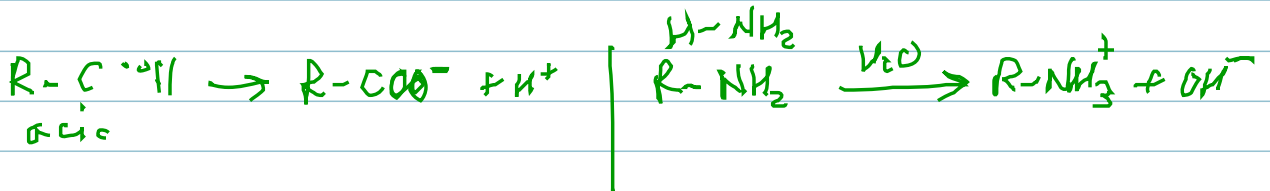
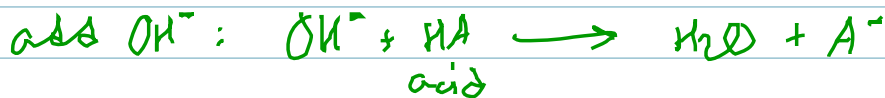
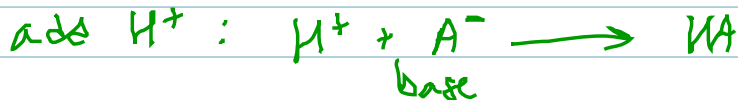
b) What is the pH of a solution where $[\text{HNO}_2] = 0.20\text{M}$ and $[\text{NO}_2^-] = 0.10\text{M}$?

$$\text{pH} = \text{pK}_a + \log \frac{[\text{NO}_2^-]}{[\text{HNO}_2]} = 3.35 + \log \frac{(0.10)}{(0.20)}$$

$$\text{pH} = 3.35 - 0.30 = 3.05$$

* BUFFERS are solns that RESIST a change in pH caused by adding additional H^+ or OH^-

buffer: HA, A^-



HOW TO MAKE A BUFFER

- ① add similar amounts of HA, A^- from separate sources
- ② add enough OH^- to react w/ $\sim \frac{1}{2}$ HA present
 " " H^+ " " w/ $\sim \frac{1}{2}$ A^- present
- ③ HCO_3^- amphoteric ion

BUFFER CAPACITY \rightarrow the buffer's ability to neutralize added H^+ or OH^-

\rightarrow depends on $[HA]$, $[A^-]$

1.0 M $[HA]$, $[A^-]$ * larger "capacity"
0.1 M $[HA]$, $[A^-]$

HF, NaF \checkmark

~~HBr, NaBr~~

CH_3COOH

$CH_3COO^-Na^+$

$NaC_2H_3O_2$

$C_6H_5NH_2$ aniline

$C_6H_5NH_3^+$

H_3PO_4 KH_2PO_4

Na_3PO_4

KH_2PO_4 K_2HPO_4