AP Chem Unit 10 - NMSI - Buffers

1) PH = ? Before & PH = ? After 10.0 mL of 1.00 M HCl

Before: .50M formic Acid, .70M Sodium formic Acid ⇒ 0.500L soln

$K_a = 1.8 \times 10^{-4}$ formic Acid

$$[H^+] = K_a \frac{[\text{Acid}]}{[\text{Base}]}$$

$$= 1.8 \times 10^{-4} \left(\frac{.50}{.70}\right)$$

$$[H^+] = 1.29 \times 10^{-4}$$

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

pH = 3.89 Before

* Note: can use M here, only need in moles for + or - (Buffer!)

After: Adding Acid: 10.0 mL of 1.0 M HCl

$$[H^+] = K_a \frac{\text{Acid} + \text{invader Acid}}{\text{Base} - \text{invader Acid}}$$

* Note must ± moles

$$= 1.8 \times 10^{-4} \frac{\left(\frac{[.25 + .010]}{.510\,L \text{ Total new volume}}\right)}{\left(\frac{[.35 - .010]}{.510\,L}\right)}$$

formic acid: $\left(\frac{.50 \text{ moles}}{1L}\right)\left(\frac{.500L}{1}\right) = .25$ moles

Na formic: $\left(\frac{.70 \text{ moles}}{1L}\right)\left(\frac{.500L}{1}\right) = .35$ moles

* note can crossout Total new Volume

HCl: $\left(\frac{1.0 \text{ moles}}{1L}\right)\left(\frac{.010\,L}{1}\right) = .010$ moles

$$= 1.8 \times 10^{-4} \frac{(.26 \text{ moles})}{(.34 \text{ moles})}$$

$$[H^+] = 1.38 \times 10^{-4}$$

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

pH = 3.86 After very little Change

AP Chem - Unit 10 - RMSI - Buffers

2) We want a pH = 5 we know $[H^+] = 1 \times 10^{-5}$ $pH = -\log[H]$

$K_a = 1.8 \times 10^{-5}$ for Acetate

$$[H^+] = K_a \frac{[Acid]}{[Base]}$$

$1 \times 10^{-5} = 1.8 \times 10^{-5}$ Ratio

$$\frac{1 \times 10^{-5}}{1.8 \times 10^{-5}} = \text{Ratio}$$

1 : 1.8 RATIO / 1 Acid : 1.8 Base

How to make solution: (HA) (NaA)

Mix 1.0 mole of Acid to 1.8 mole of Base in enough H_2O to dissolve the salt. The Amount of water is Not critical, only the relative amounts of A:B. You should have notice from #1 the "Total volume" part of the expression drops out.

4) pH = 4.3 $[H^+] = K_a \frac{[Acid]}{[Base]}$

$[H^+] = 5.01 \times 10^{-5}$ $\frac{[H^+]}{K_a} = \text{Ratio}_{\frac{A}{B}}$

A) Chloroacetic Acid $\text{Ratio} = \frac{5.01 \times 10^{-5}}{1.35 \times 10^{-3}} = .039$

B) Propanic Acid $\text{Ratio} = \frac{5.0 \times 10^{-5}}{1.3 \times 10^{-5}} = 3.8$

C) Benzoic Acid $\text{Ratio} = \frac{5.0 \times 10^{-5}}{6.4 \times 10^{-5}} = .78$ Closest to 1:0 :. Best Choice

d) Hypochlorous Acid $\text{Ratio} = \frac{5.0 \times 10^{-5}}{3.5 \times 10^{-8}} = 1400$

APChem - Unit 10 - NMSI - Buffers

3) Buffered soln .25 M NH_3 ($K_b = 1.8 \times 10^{-5}$) + .40 M NH_4Cl

A)

$[H^+] = K_a \frac{[Acid]}{[BASE]}$

$K_a K_b = K_w$

$K_a = \frac{K_w}{K_b} = \frac{1 \times 10^{-14}}{1.8 \times 10^{-5}} = 5.6 \times 10^{-10}$

$= 5.6 \times 10^{-10} \frac{(.40)}{(.25)}$

$[H^+] = 8.9 \times 10^{-10}$

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

$\boxed{pH = 9.1}$

B) pH = ? After Acid Added

$[H^+] = K_a \frac{Acid + mole}{BASE - mole}$

$NH_3 \left(\frac{.25\ mole}{1L}\right)(1L) = .25\ mole$

$NH_4Cl \left(\frac{.40\ mole}{1L}\right)(1L) = .40 mole$

Add HCl .10 mole

$= 5.6 \times 10^{-10} \frac{(.40 + .10)}{(.25 - .10)}$

$[H^+] = 2.0 \times 10^{-9}$

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

$\boxed{pH = 8.73}$