

PS16-2

(12)  $\uparrow [\text{OH}^-]$

(9)  $\text{pH} = 3 \rightarrow \text{pOH} = 11$  ,  $[\text{OH}^-] = 1 \times 10^{-11}$

(b)  $1 \times 10^{-4} \text{ M HNO}_3$   
(H<sup>+</sup>) SA  $\Rightarrow [\text{OH}^-] = 1 \times 10^{-10}$

(c)  $\text{pOH} = 12 \Rightarrow [\text{OH}^-] = 1 \times 10^{-12}$

(d) Water  $\text{pH} = 7 \rightarrow \text{pOH} = 7$   $[\text{OH}^-] = 1 \times 10^{-7}$

Feb 27-7:45 AM

CHAPTER 17 - Common ion effect

Cation  $\oplus$   
Anion  $\ominus$  in common

Effect the equilibrium

NaCl

$\text{Na}^+$   $\text{Cl}^-$

Feb 27-8:01 AM

Acetic Acid  $\text{H}_2\text{C}_2\text{H}_3\text{O}_2 \Rightarrow \text{H}_2\text{Ac}^+$  Weak SB  
Weak WA

Start with 0.3M  $\text{H}_2\text{Ac}^+$  WA AND 0.2M  $\text{Na}_2\text{Ac}^-$   
Salt of the WA  
Basic Salt

|                         |                      |              |   |                    |
|-------------------------|----------------------|--------------|---|--------------------|
| $\text{H}_2\text{Ac}^+$ | $\rightleftharpoons$ | $\text{H}^+$ | + | $\text{Ac}^-$      |
| I 0.3                   |                      | <del>x</del> |   | <del>x</del> + 0.2 |
| $\Delta$ - x            |                      | + x          |   | + x                |
| $\Rightarrow$ E 0.3-x   |                      | x            |   | 0.2+x              |

$K_a = \frac{[\text{H}^+][\text{Ac}^-]}{[\text{H}_2\text{Ac}^+]} = \frac{1.8 \times 10^{-5}}{1}$

$\frac{(x)(0.2+x)}{0.3-x} = \frac{1.8 \times 10^{-5}}{1}$

$x = 2.7 \times 10^{-5} = [\text{H}^+] \quad \text{pH} = 4.57$

If add base to the acid REMOVE  $\text{H}^+$  ions from soln  $\therefore$  less acidic  $\text{Na}^+ + \text{Ac}^-$

Feb 27-8:05 AM

Without common ion.

0.3M  $\text{H}_2\text{Ac}^+$       pH = ?

|                         |                      |              |   |               |
|-------------------------|----------------------|--------------|---|---------------|
| $\text{H}_2\text{Ac}^+$ | $\rightleftharpoons$ | $\text{H}^+$ | + | $\text{Ac}^-$ |
| I 0.3                   |                      | <del>x</del> |   | <del>x</del>  |
| $\Delta$ - x            |                      | + x          |   | + x           |
| E 0.3-x                 |                      | x            |   | x             |

$K_a = \frac{[\text{H}^+][\text{Ac}^-]}{[\text{H}_2\text{Ac}^+]} = \frac{1.8 \times 10^{-5}}{1} = \frac{(x)(x)}{0.3-x}$

$x = 2.32 \times 10^{-3}$

$\text{pH} = 2.63$

Feb 27-8:16 AM

Adding a common ion

pH 2.63  $\rightarrow$  4.57

Almost 100x weaker

$$\text{HbAc} \rightleftharpoons \text{H}^+ + \text{aAc}^-$$

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Added common  $\text{aAc}^-$

$$\text{HbAc} \rightleftharpoons \text{H}^+ + \text{aAc}^-$$

Reduce the amount of ionized acid  
 $\rightarrow$   $\text{H}^+$  in solution  
 $\rightarrow$  Acidity

Feb 27-8:19 AM

Find pH of 0.16M  $\text{HNO}_2$   $K_a = 4.5 \times 10^{-4}$

Plan  $\text{HNO}_2 \rightarrow \text{H}^+ + \text{NO}_2^-$

|   |            |      |      |
|---|------------|------|------|
| I | 0.16       | 0    | 0    |
| D | $0.16 - x$ | $+x$ | $+x$ |
| E | $0.16 - x$ | $x$  | $x$  |

$K_a = \frac{x^2}{0.16 - x} = 4.5 \times 10^{-4}$   
 $x = 8.5 \times 10^{-3}$   
pH = 2.0

$0.16\text{M HNO}_2 + 0.1\text{M KNO}_2$   
Salt of WA

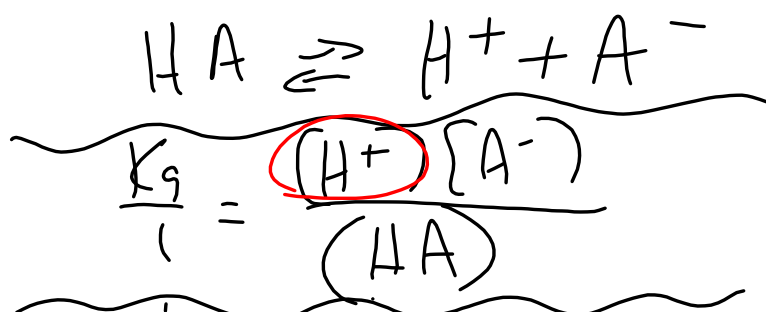
|   |            |      |           |
|---|------------|------|-----------|
| I | 0.16       | 0    | $0 + 0.1$ |
| D | $-x$       | $+x$ | $+x$      |
| E | $0.16 - x$ | $x$  | $0.1 + x$ |

$\frac{x(0.1 + x)}{0.16 - x} = 4.5 \times 10^{-4}$   
 $x = 7.2 \times 10^{-4} = [\text{H}^+]$   
pH = 3.14

Feb 27-8:22 AM

Henderson Hasselbalch eqn.  
pH of buffers. WA + salt of WA

Feb 27-8:50 AM



$$(H^+) = \frac{K_a (HA)}{(A^-)}$$

$$-\log(H^+) = -\log K_a - \log \frac{HA}{A^-}$$

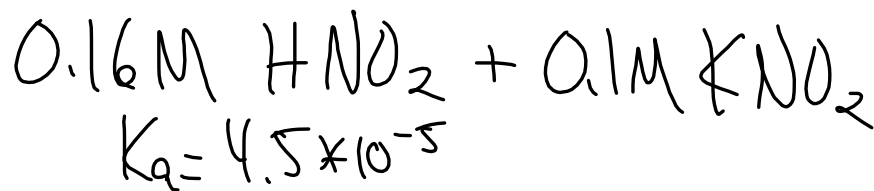
$$pH = pK_a + \log \frac{(A^-)}{(HA)}$$

$\swarrow$  Base  
 $\searrow$  Acid

Feb 27-8:54 AM

$$pH = pK_a + \log \frac{\text{base}}{\text{acid}} \quad \left\{ \frac{A^-}{HA} \right\}$$

$-\log(K_a)$



$$pH = -\log(4.5 \times 10^{-5}) + \log \frac{0.1}{0.16}$$

$pH = 3.14$

Feb 27-9:00 AM

When  $[HA] = [A^-]$

$$pH = pK_a + \log \frac{B}{A}$$

$$pH = pK_a + \log \frac{1}{1}$$

$pH = pK_a$

Feb 27-9:06 AM

Calc the conc of  $\text{NaBz}$  that must be present in  $0.2\text{M}$   $\text{HBz}$  to produce  $\text{pH} = 4$

$\text{HBz} \rightleftharpoons \text{H}^+ + \text{Bz}^-$

|   |         |      |      |
|---|---------|------|------|
| I | $0.2$   | $0$  | $0$  |
| A | $-x$    | $+x$ | $+x$ |
| E | $0.2-x$ | $x$  | $x$  |

$K_a = \frac{x^2}{0.2-x} \approx \frac{x^2}{0.2}$

$x = 1 \times 10^{-4}$

$K_a = 5 \times 10^{-8}$

$\text{pH} = \text{p}K_a + \log \frac{B}{A}$

$4 = -\log(5 \times 10^{-8}) + \log \frac{B}{0.2}$

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$\frac{(1 \times 10^{-4})(1 \times 10^{-4} + x)}{0.2} = 5 \times 10^{-8}$

Feb 27-9:07 AM

17 / 16 a+c, 18

Feb 27-9:15 AM