CHM152 Quiz5 25 Pts Fall 2017 Name: Key

Show all work to receive credit. $pH = pK_a + \log(\text{"base"/"acid"})$

1. (3 Pts) A buffer of pH 4.1 is to be prepared from a weak acid and its salt. The best acid from which to prepare the buffer is

   (A) phthalic acid, $K_1 = 1.3 \times 10^{-3}$ (first ionization)

   (B) hydrogen phthalate, $K_2 = 3.9 \times 10^{-5}$ (second ionization of phthalic acid)

   (C) benzoic acid, $K = 6.3 \times 10^{-5}$ $-\log(6.3 \times 10^{-5}) = 4.2$ closest to 4.1

   (D) hydrocyanic acid, $K = 4 \times 10^{-10}$

2. (4 Pts) What is the pH in a 0.50 M solution of $NH_3(aq)$? $K_b = 1.8 \times 10^{-5}$

	NH_3	+ H_2O ⇌	NH_4^+	+ OH^-
I	0.50		0	0
C	−x		+x	+x
E	0.50−x		x	x

$K_b = 1.8 \times 10^{-5} = \frac{x^2}{0.50 - x}$ ← 5% rule

$x = [OH^-] = 0.003$

$pOH = 2.52$ $pH = 11.48$

3. (5 Pts) What is the pH of a 0.30 M sodium acetate, $NaC_2H_3O_2$ solution? $K_a = 1.8 \times 10^{-5}$

	$C_2H_3O_2^-$	+ H_2O ⇌	$HC_2H_3O_2$	+ OH^-
I,	0.30		0	0
C,	−x		x	x
E,	0.30−x		x	x

$K_b = 10^{-14}/1.8\times10^{-5} = 5.56 \times 10^{-10}$

$5.56 \times 10^{-10} = \frac{x^2}{0.30 - x}$ ← 5% rule

$x = [OH^-] = 1.29 \times 10^{-5}$ $pOH = 4.89$ $pH = 9.11$

4. (4 Pts) What is the $[H^+]$ of a solution which is 0.2 M in $NaC_2H_3O_2$ and 0.1 M in $HC_2H_3O_2$? $K_a = 1.8 \times 10^{-5}$

Buffer solution use H & H equation

$pH = -\log 1.8 \times 10^{-5} + \log \frac{0.2}{0.1} = 5.046$

$[H_3O^+] = 10^{-pH} = 9.0 \times 10^{-6}$

$HC_2H_3O_2 + H_2O \rightleftharpoons H_3O^+ + C_2H_3O_2^-$

$NaC_2H_3O_2 \rightarrow Na^+ + C_2H_3O_2^-$

5. (5 Pts) Enough water is added to 0.35 g of benzoic acid (molar mass = 122 g/mol) to make 1000 mL of solution. What is the pH? $K_a = 6.5 \times 10^{-5}$

	HBz	+ H_2O ⇌	H_3O^+	+ Bz^-
I	2.9×10^{-3}		0	0
C	−x		+x	+x
E	$2.9 \times 10^{-3} - x$		x	x

$6.5 \times 10^{-5} = \frac{x^2}{2.9 \times 10^{-3} - x}$ ← 5% rule

$x = 4.3 \times 10^{-4} = [H_3O^+]$

$pH = 3.36$ Should use Quad. Eq, but told not to.

6. (4 Pts) What is the $[OH^-]$ of a solution which is 0.18 M in ammonium chloride (NH_4Cl) and 0.10 M in ammonia (NH_3)? $K_b = 1.8 \times 10^{-5}$.

Buffer Solution

$pH = -\log\left(\frac{10^{-14}}{1.8\times10^{-5}}\right) + \log \frac{0.10}{0.18}$

$pH = 9.0$ $pOH = 5$ $[OH^-] = 10^{-5}$

$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

$NH_4Cl \rightarrow NH_4^+ + Cl^-$