Chapter 14 Review Worksheet Name: Key

1. Identify the conjugate acid-base pairs in the following reaction: Label A, B, CA, CB.

A B CA CB
$HSO_4^- + F^- \leftrightarrow HF + SO_4^{2-}$

2. Rank the following acids in terms of their strength (strongest to weakest).

	Acid	K_a	K_b
2	HClO	2.9×10^{-8}	--
1	HF	6.6×10^{-4}	--
3	NH_4^+	-- 5.6×10^{-10}	1.8×10^{-5}
4	$(CH_3)_2NH_2^+$	-- 1.7×10^{-11}	5.9×10^{-4}

$\frac{K_w}{K_b} = K_a$

$HF > HClO > NH_4^+ > (CH_3)_2NH_2^+$

3. Identify the stronger acid in each pair and explain your choice.
   a. HCl or HBr — Br is larger so weaker bond = ↑ acidity; Cl is more EN, so ↑ polarity = stronger bond
   b. HNO_3 or HNO_2 — more terminal Os pull e⁻ away from H-O bond, ↑ acid

4. A detergent solution has a pH of 11.13 at 25°C. What is the $[OH^-]$ in the solution?

pH = 11.13 at 25°C. $[OH^-] = ?$

14 - pH = pOH
pOH = 2.87
$10^{-2.87} = [OH^-] = 1.3 \times 10^{-3} M$

5. Pyridine, C_5H_5N, ($K_b = 1.5 \times 10^{-9}$) is an organic base, used in the synthesis of vitamins, drugs, and fungicides. Calculate the pH of an aqueous solution, having 1.25 grams of pyridine in 125 mL solution.

$\frac{1.25\ g\ P}{0.125\ L} \left| \frac{mol}{79.11\ g} \right. = 0.126\ M\ P$

$C_5H_5N + H_2O \rightleftharpoons C_5H_5NH^+ + OH^-$

	C_5H_5N		$C_5H_5NH^+$	OH^-
I	0.126		0	~0
C	$-x$		$+x$	$+x$
E	$0.126 - x$		x	x

$K_b = \frac{x^2}{0.126 - x} = 1.5 \times 10^{-9}$

$x = 1.4 \times 10^{-5} M$

assump. is good.

$[OH^-] = x = 1.4 \times 10^{-5} M$

$pOH = -\log(1.4 \times 10^{-5}) = 4.86$

$pH = 14 - 4.86 = 9.14 = pH$

6. Write the ionization equations for H_3PO_3S, thiophosphoric acid. Which ionization would have the largest K_a? Why?

$H_3PO_3S + H_2O \rightleftharpoons H_2PO_3S^- + H_3O^+$

$H_2PO_3S^- + H_2O \rightleftharpoons HPO_3S^{2-} + H_3O^+$

$HPO_3S^{2-} + H_2O \rightleftharpoons PO_3S^{3-} + H_3O^+$

1st ionization would have biggest Ka. Others are anions, so H+ sticks more.

7. Predict whether each solution is acidic, basic, or neutral. Write equations for any hydrolysis reactions that occur.

a. $NaClO_4$ Neutral (SB, SA)

b. NH_4Br (WB, SA) Acidic $NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$

c. KC_2H_3O (SB, WA) Basic $C_2H_3O_2^- + H_2O \rightleftharpoons HC_2H_3O_2 + OH^-$

8. Acrylic acid (CH_2CHCO_2H) is a precursor for many important plastics. K_a for acrylic acid is 5.6×10^{-5}.

a. Calculate the pH of a 0.10 M solution of acrylic acid.

$Hacr \rightarrow CH_2CHCO_2H$

$acr^- \rightarrow CH_2CHCO_2^-$

	Hacr ⇌	H+ +	acr⁻
I	0.10 M	~0	0
C	−x	+x	+x
E	(0.10 − x)	x	x

$K_a = 5.6\times10^{-5} = \frac{x^2}{0.10 - x}$

$x = 2.4\times10^{-3}$

assump. is good.

$x = 2.4\times10^{-3}\ M = [H^+]$

$pH = -\log(2.4\times10^{-3})$

$pH = 2.62$

b. Calculate the percent dissociation of a 0.10 M solution of acrylic acid.

$\frac{[H^+]}{[Hacr]_0} \times 100 = \frac{2.4\times10^{-3}}{0.10} \times 100 = 2.4\%$

c. Calculate the pH of a 0.050 M solution of sodium acrylate: ($NaC_3H_3O_2$).

acr^- is a weak base and the major source of OH^-.

	$acr^- + H_2O$ ⇌	Hacr +	OH^-
I	0.050	0	~0
C	−x	+x	+x
E	(0.050 − x)	x	x

$K_b = \frac{K_w}{K_a} = \frac{1.0\times10^{-14}}{5.6\times10^{-5}} = 1.8\times10^{-10}$

$K_b = \frac{x^2}{(0.050 - x)} = 1.8\times10^{-10}$

$x = 3.0\times10^{-6}$

Assump. is good.

$x = [OH^-] = 3.0\times10^{-6}\ M$

$pOH = 5.52$

$pH = 8.48$