Acid-Base 4 • Chem 220

1. Predict the products and K for the following acid-base reactions:

SO_3^{2-} + HClO ⇔ HSO_3^- + ClO^- K = $\frac{3.5\times10^{-8}}{6.2\times10^{-8}}$ = 0.56

3.5×10^{-8} 6.2×10^{-8}

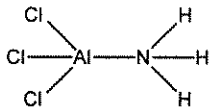
NH_4^+ + HCO_2^- ⇔ NH_3 + HCO_2H K = $\frac{5.6\times10^{-10}}{1.8\times10^{-4}}$ = 3.1×10^{-6}

5.6×10^{-10} 1.8×10^{-4}

2. Identify the following Lewis acid and base in the following reactions. Predict the formula of the products (if not given).

A) $AlCl_3$ + NH_3 ⇔

LA LB



B) SO_2 + H_2O ⇔ H_2SO_3

LA LB

C) CaO + H_2O ⇔ $Ca(OH)_2$

LB LA

3. A 50.0 mL sample of a 0.500 M NaOH is mixed with 125.0 mL of a 0.250 M solution of nitric acid. What will be the pH, $[H_3O^+]$, and $[OH^-]$of the resulting solution?

	NaOH +	HNO_3 →	H_2O +	$NaNO_3$
start	25 mmol	31.25 mmol	–	–
final	0 mmol	6.25 mmol	–	–

Total volume = 175 mL $[H^+] = \frac{6.25\ \text{mmol}}{175\ \text{mL}} = 0.0357\ M$ $\boxed{pH = 1.45}$

4. A 25.0 mL sample of a 0.500 M KOH is mixed with 25.0 mL of a [redacted] 0.200 M solution of sulfuric acid. What will be the pH, $[H_3O^+]$, and $[OH^-]$of the resulting solution?

	2 KOH +	1 H_2SO_4 →	K_2SO_4 +	2 H_2O
start	12.5 mmol	5.0 mmol		
rxn	−10.0 mmol	−5.0 mmol		
final	2.5 mmol	∅		

$[OH^-] = \frac{2.5\ \text{mmol}}{50\ \text{mL}} = 0.050\ M$

pOH = 1.30 ⇒ $\boxed{pH = 12.70}$

5. Selenite, SeO_3^{2-}, is a weak base anion. What is the pH and the concentration of all selenium-containing species for a 0.25 *M* solution of sodium selenite, Na_2SeO_3?

The K_a values for the diprotic selenous acid, Na_2SeO_3, are: $K_{a1} = 2.7 \times 10^{-3}$ | $K_{a2} = 2.5 \times 10^{-7}$

$K_{b2} = 3.7\times10^{-12}$ | $K_{b1} = 4.0\times10^{-8}$

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	$SeO_3^{2-}{}_{(aq)}$ +	$H_2O_{(l)}$ $\rightleftharpoons$	$HSeO_3^-{}_{(aq)}$ +	$OH^-{}_{(aq)}$
i	0.25 M	—	0	0
c	$-x$	—	$+x$	$+x$
e	$0.25-x$ ≈ 0.25	—	x	x

$$K_{b1} = 4.0\times10^{-8} = \frac{x^2}{0.25}$$

$x = 1.0\times10^{-4}$ M $= [OH^-]$ $\quad$ pOH = 4.00 $\Rightarrow$ $\boxed{pH = 10.00}$

$[SeO_3^-] = 0.25 - x = 0.25$ M

$[HSeO_3^-] = x = 1.0\times10^{-4}$ M

$[H_2SeO_3] = K_{b2} = 3.7\times10^{-12}$ M

pH = 10.00