Homework - Bases Worksheet

$NO_{2(aq)}^- + H_2O_{(l)} \rightleftharpoons HNO_{2(aq)} + OH_{(aq)}^-$

$0.427\ mol/L$

$K_b = \frac{[HNO_{2(aq)}][OH_{(aq)}^-]}{[NO_{2(aq)}^-]}$, $[HNO_{2(aq)}] = [OH_{(aq)}^-]$

$K_b = \frac{[OH_{(aq)}^-]^2}{[NO_{2(aq)}^-]}$

$[OH_{(aq)}^-] = \sqrt{(1.39 \times 10^{-11})(0.427)}$

$[OH_{(aq)}^-] = 2.44 \times 10^{-6}\ M$

$pOH = -\log[2.44 \times 10^{-6}]$

$pOH = 5.613$

$K_aK_b = K_w$

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

$K_b = \frac{1.0 \times 10^{-14}}{7.2 \times 10^{-4}}$

$K_b = 1.39 \times 10^{-11}$

$pH + pOH = 14.000$

$pH = 14.000 - 5.613$

$pH = 8.387$

Pure Substance

Entities in Water

....Think High vs. Low Solubility

$NaCl_{(s)}$ high

$Na^+_{(aq)}, Cl^-_{(aq)}, H_2O_{(l)}$

$CaCO_{3(s)}$ Low

$CaCO_{3(s)}, H_2O_{(l)}$

$$Na_2CO_{3(aq)} + CaCl_{2(aq)} \longrightarrow NaCl_{(aq)} + CaCO_{3(s)}$$

$$\longrightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)} + CaCO_{3(s)}$$

Pure Substance

100% STRONG

$HCl_{(g)}$

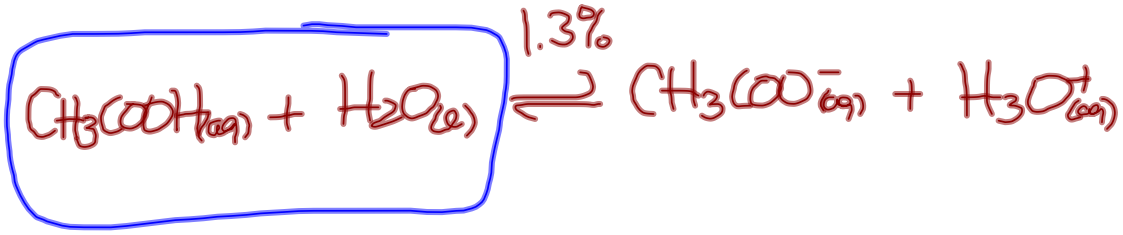
Strong vs. Weak Acid
(back cover)

$CH_3COOH_{(l)}$

Entities in Water

$H_3O^+_{(aq)}$, $Cl^-_{(aq)}$, $H_2O_{(l)}$

$CH_3COOH_{(aq)}$, $H_2O_{(l)}$


1.3%
$CH_3COOH_{(aq)} + H_2O_{(l)} \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$

Predicting Acid-Base Reactions

1. List all entities (ions, atoms, or molecules) initially present.

2. Identify all possible acids and bases, using Bronsted-Lowry definition.

3. Identify the strongest acid and strongest base, using table of acids and bases.

4. Transfer one proton from the acid to the base and predict the conjugate acid and conjugate base as products.

5. Predict the position of the equilibrium.

Sample Problem

Ammonium nitrate fertilizer is produced by the quantitative reaction of aqueous ammonia with nitric acid. Write a balanced acid-base equilibrium equation.

strong acid

$HNO_{3(aq)}$ and $NH_{3(aq)}$

All entities in solution:

SA SB

$H_3O^+_{(aq)}$, $NO_3^-{}_{(aq)}$, $NH_{3(aq)}$, $H_2O_{(\ell)}$

A B B A/B

$$H_3O^+_{(aq)} + NH_{3(aq)} \rightleftharpoons H_2O_{(\ell)} + NH_4^+{}_{(aq)}$$

>99%

Sample Problem

$K^+ SO_4^{2-}$

Write a balanced acid-base equilibrium equation for the reaction of hydrofluoric acid and potassium sulfate.

$HF_{(aq)}$ and $K_2SO_{4(aq)}$

SA SB

$HF_{(aq)}$, $K^+_{(aq)}$, $SO_{4(aq)}^{2-}$, $H_2O_{(l)}$

A — B A/B

$$HF_{(aq)} + SO_{4(aq)}^{2-} \underset{<50\%}{\rightleftharpoons} F^-_{(aq)} + HSO_{4(aq)}^-$$

Homework

Predicting Acid-Base Equilibria

Worksheet