Chem 112
Quiz No. 2
Jan 14, 2005

This quiz is to be taken during one of the permitted time slots. It is expected that the student spend 20-30 minutes on the quiz, but it MUST be handed in after by the end of the selected time slot. SHOW ALL WORK. NO’MAGIC’ PERMITTED. WATCH SIG FIGS.

1. In each case below you will be given the description of a solution formed when the bulk formula of a substance is placed into water to form a solution. There will be NO major reactions. In each case, you are to:
   a) Identify the solute particles present in solution
   b) Write the appropriate minor reaction and the appropriate K expression from the information given.

I. 10.0 mL of Acetic Acid, HOAc (MW = 60.00) is brought to a final volume of 100.0 mL by the addition of water. The K_a for HOAc is 1.8x10^{-5}
   HOAc present in water as HOAc molecules

\[
\text{HOAc} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{OAc}^- \\
1.8 \times 10^{-5} = \frac{[\text{H}_3\text{O}^+][\text{OAc}^-]}{[\text{HOAc}]} 
\]

II. 12.6 g of ammonium chloride, \(\text{NH}_4\text{Cl} (\text{MW} = 53.5)\) is brought to a final volume of 400 mL by the addition of water. The K_a for \(\text{NH}_4^+\) is \(5.5 \times 10^{-10}\)
   \(\text{NH}_4\text{Cl} \) present in water as \(\text{NH}_4^+\) and \(\text{Cl}^-\) ions (only the \(\text{NH}_4^+\) has \(K_a\) properties)

\[
\text{NH}_4^+ + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{NH}_3 \\
5.5 \times 10^{-10} = \frac{[\text{H}_3\text{O}^+][\text{NH}_3]}{[\text{NH}_4^+]}
\]

III. 5.0 g of Sodium Carbonate, \(\text{Na}_2\text{CO}_3 (\text{MW} = 106.0)\) is brought to a final volume of 500 mL by the addition of water. The K_b for \(\text{CO}_3^{2-}\) is \(1.8 \times 10^{-4}\)
   \(\text{Na}_2\text{CO}_3\) present in water as \(\text{Na}^+\) and \(\text{CO}_3^{2-}\) ions (\(\text{CO}_3^{2-}\) has \(K_b\) properties)

\[
\text{CO}_3^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^- + \text{OH}^- \\
1.8 \times 10^{-4} = \frac{[\text{HCO}_3^-][\text{OH}^-]}{[\text{CO}_3^{2-}]} 
\]

2. Determine the pK_a values for each of the weak acids given above (questions I and II).
   Which is the stronger acid?
   - for \(\text{HOAc}\), pK_a = 4.74 ← stronger acid
   - for \(\text{NH}_4\text{Cl}\), pK_a for \(\text{NH}_4^+\) = 9.26

3. Normal blood has a pH value of 7.4. What is the Hydronium Ion concentration of normal blood?

\[
\text{pH} = -\log [\text{H}_3\text{O}^+] \\
7.4 = -\log [\text{H}_3\text{O}^+] \\
-7.4 = \log [\text{H}_3\text{O}^+] \\
10^{-7.4} = [\text{H}_3\text{O}^+] = 4 \times 10^{-8}
\]

Please Write and Sign the Pledge.