Acid/Base Equilibrium

In Class

1. You each have a solution for question 1a and 1b from the preparation assignment

   (a) Make sure that everyone has finished this problem. If someone was unsuccessful, then help them complete it.

   (b) Plot predicted pH vs ionic strength based on the data you calculated. What conclusion can you draw?

   (c) Plot percent ionization vs ionic strength based on the data you calculated. Does this result make sense?

   (d) What would have changed in your process to calculate your values if you had an acid with

      i. $K_a = 1 \times 10^{-3}$
      ii. $K_a = 1 \times 10^{-12}$

2. Kidney stones are pieces of Calcium Oxalate ($CaC_2O_4(s)$) that grow in the kidneys and are excreted through urine. The K_b of $C_2O_4{}^{2-}$ is 1.639×10^{-10} and the K_{sp} of $CaC_2O_4(s)$ is 3.0×10^{-9}.

   (a) Write down the solubility equilibrium for $CaC_2O_4(s)$

   (b) Write down the hydrolysis equilibrium for $C_2O_4{}^{2-}(aq)$

   (c) If the normal pH of kidney fluid is 8.2, predict whether the formation of kidney stones can be minimized by increasing or decreasing the pH of the fluid present in the kidneys.

   (d) Why does it make sense that people who ingest Calcium supplements have a higher risk of kidney stone formation?

3. Acetylsalicylic acid (aspirin, $C_9H_8O_4$) is a common medication used to tread pain, fever and inflammation. It is a monoprotic acid with a $K_a = 3.0 \times 10^{-4}$

   (a) Calculate the percent ionization of a 0.20 M solution of $C_9H_8O_4$.

   (b) The $[H_3O^+]$ due to the gastric juices in the stomach of a certain individual is 0.1 M. After a few aspirin tablets have been swallowed by this certain individual, the $[C_9H_8O_4(aq)]$=0.20 M in the gastric juices. What is the percent ionization of aspirin under these conditions?

   (c) The non-ionized/protonated version of aspirin irritates the stomach lining as it passes through it. To prevent bleeding from this type of irritation, is it better to have a stomach pH to be 1.00 or 2.00? Why?

4. Buffers that contain the phosphate group (PO_4^{3-}) are present in biological systems such as blood plasma. What is the pH of a buffer with 0.10 M Na_2HPO_4 and 0.08 M KH_2PO_4? Hint: you will need to rederive the modified Henderson-Hasselbalch equation since it assumed that HA was not an ion.

Homework

5. A major industrial spill of Hydrocyanic Acid (HCN) occurred in the ocean. To determine the [HCN] in the water to identify the best method to minimize the environmental impact, you take a 1 L sample of the contaminated sea water ([NaCl]=0.6 M), and add 0.2 moles of potassium cyanide (KCN). The measured pH of the sample was 8.80. If the K_a of HCN is 6.17×10^{-10} what is the [HCN]? ([HCN]=0.392 M)