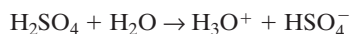


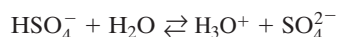
532. The $[\text{H}_3\text{O}^+]$ of a solution of acetoacetic acid, $\text{CH}_3\text{COCH}_2\text{COOH}$, is $4.38 \times 10^{-3} \text{ M}$ at 25°C . The concentration of nonionized acid is 0.0731 M at equilibrium. Calculate K_a for acetoacetic acid at 25°C .

533. The K_a of 2-chloropropanoic acid, $\text{CH}_3\text{CHClCOOH}$, is 1.48×10^{-3} . Calculate the $[\text{H}_3\text{O}^+]$ and the pH of a 0.116 M solution of 2-chloropropionic acid. Let $x = [\text{H}_3\text{O}^+]$. The degree of ionization of the acid is too large to ignore. If your set up is correct, you will have a quadratic equation to solve.

534. Sulfuric acid ionizes in two steps in water solution. For the first ionization shown in the following equation, the K_a is so large that in moderately dilute solution the ionization can be considered 100%.



The second ionization is fairly strong, and $K_a = 1.3 \times 10^{-2}$:



Calculate the total $[\text{H}_3\text{O}^+]$ and pH of a 0.0788 M H_2SO_4 solution. Hint: If the first ionization is 100%, what will $[\text{HSO}_4^-]$ and $[\text{H}_3\text{O}^+]$ be? Remember to account for the already existing concentration of H_3O^+ in the second ionization. Let $x = [\text{SO}_4^{2-}]$.

535. The hydronium ion concentration of a 0.100 M solution of cyanic acid, HOCN , is found to be $5.74 \times 10^{-3} \text{ M}$ at 25°C . Calculate the ionization constant of cyanic acid. What is the pH of this solution?

536. A solution of hydrogen cyanide, HCN , has a 0.025 M concentration. The cyanide ion concentration is found to be $3.16 \times 10^{-6} \text{ M}$.

- What is the hydronium ion concentration of this solution?
- What is the pH of this solution?
- What is the concentration of nonionized HCN in the solution? Be sure to use the correct number of significant figures.
- Calculate the ionization constant of HCN .
- How would you characterize the strength of HCN as an acid?
- Determine the $[\text{H}_3\text{O}^+]$ for a 0.085 M solution of HCN .

537. A 1.20 M solution of dichloroacetic acid, CCl_2HCOOH , at 25°C has a hydronium ion concentration of 0.182 M .

- What is the pH of this solution?
- What is the K_a of dichloroacetic acid at 25°C ?
- What is the concentration of nonionized dichloroacetic acid in this solution?
- What can you say about the strength of dichloroacetic acid?

538. Phenol, $\text{C}_6\text{H}_5\text{OH}$, is a very weak acid. The pH of a 0.215 M solution of phenol at 25°C is found to be 5.61 . Calculate the K_a for phenol.

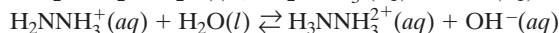
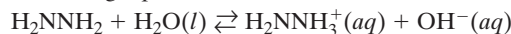
539. A solution of the simplest amino acid, glycine ($\text{NH}_2\text{CH}_2\text{COOH}$), is prepared by dissolving 3.75 g in 250.0 mL of water at 25°C . The pH of this solution is found to be 0.890 .

- Calculate the molarity of the glycine solution.
- Calculate the K_a for glycine.

540. Trimethylamine, $(\text{CH}_3)_3\text{N}$, dissociates in water the same way that NH_3 does—by accepting a proton from a water molecule. The $[\text{OH}^-]$ of a 0.0750 M solution of trimethylamine at 25°C is $2.32 \times 10^{-3} \text{ M}$. Calculate the pH of this solution and the K_b of trimethylamine.

541. Dimethylamine, $(\text{CH}_3)_2\text{NH}$, is a weak base similar to the trimethylamine in item 540. A $5.00 \times 10^{-3} \text{ M}$ solution of dimethylamine has a pH of 11.20 at 25°C . Calculate the K_b of dimethylamine. Compare this K_b with the K_b for trimethylamine that you calculated in item 540. Which substance is the stronger base?

542. Hydrazine dissociates in water solution according to the following equations:



The K_b of this second dissociation is 8.9×10^{-16} , so it contributes almost no hydroxide ions in solution and can be ignored here.

- The pH of a 0.120 M solution of hydrazine at 25°C is 10.50 . Calculate K_b for the first ionization of hydrazine. Assume that the original concentration of H_2NNH_2 does not change.
- Make the same assumption as you did in (a) and calculate the $[\text{OH}^-]$ of a 0.020 M solution.
- Calculate the pH of the solution in (b).

Equilibrium of Salts, K_{sp} : Chap. 18, Sec. 4

543. Silver bromate, AgBrO_3 , is slightly soluble in water. A saturated solution is found to contain 0.276 g AgBrO_3 dissolved in 150.0 mL of water. Calculate K_{sp} for silver bromate.

544. 2.50 L of a saturated solution of calcium fluoride leaves a residue of 0.0427 g of CaF_2 when evaporated to dryness. Calculate the K_{sp} of CaF_2 .

545. The K_{sp} of calcium sulfate, CaSO_4 , is 9.1×10^{-6} . What is the molar concentration of CaSO_4 in a saturated solution?

546. A salt has the formula X_2Y , and its K_{sp} is 4.25×10^{-7} .

- What is the molarity of a saturated solution of the salt?
- What is the molarity of a solution of AZ if its K_{sp} is the same value?

In each of the following problems, include the calculated ion product with your answer.

547. Will a precipitate of $\text{Ca}(\text{OH})_2$ form when $320. \text{ mL}$ of a 0.046 M solution of NaOH mixes with $400. \text{ mL}$ of a 0.085 M CaCl_2 solution? K_{sp} of $\text{Ca}(\text{OH})_2$ is 5.5×10^{-6} .

548. 20.00 mL of a 0.077 M solution of silver nitrate, AgNO_3 , is mixed with 30.00 mL of a 0.043 M solution of sodium acetate, $\text{NaC}_2\text{H}_3\text{O}_2$. Does a precipitate form? The K_{sp} of $\text{AgC}_2\text{H}_3\text{O}_2$ is 2.5×10^{-3} .

549. If you mix $100. \text{ mL}$ of 0.036 M $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$ with $50. \text{ mL}$ of 0.074 M NaCl , will a precipitate of PbCl_2 form? The K_{sp} of PbCl_2 is 1.9×10^{-4} .