

Acid-Base Example Problems

1 (a) What is the conjugate base of each of the following acids: HClO_4 , H_2S , PH_4^+ , HCO_3^- ?

(b) What is the conjugate acid of each of the following bases: CN^- , SO_4^{2-} , H_2O , HCO_3^- ?

2-1. Calculate the concentration of H^+ (aq) and pH in (a) a solution in which $[\text{OH}^-]$ is 0.010 M, (b) a solution in which $[\text{OH}^-]$ is 1.8×10^{-9} M. Note: In this problem and all that follow, we assume, unless stated otherwise, that the temperature is 25°C .

2-2. (a) In a sample of lemon juice $[\text{H}^+]$ is 3.8×10^{-4} M. What is the pH? (b) A commonly available window-cleaning solution has a $[\text{H}^+]$ of 5.3×10^{-9} M. What is the pH? Answers: (a) 3.42, (b) 8.28

3-1. A sample of freshly pressed apple juice has a pH of 3.76. Calculate $[\text{H}^+]$.

3-2. A solution formed by dissolving an antacid tablet has a pH of 9.18. Calculate $[\text{H}^+]$. Answer: $[\text{H}^+] = 6.6 \times 10^{-10}$ M

4-1. What is the pH of a 0.040 M solution of HClO_4 ?

4-2. An aqueous solution of HNO_3 has a pH of 2.34. What is the concentration of the acid?
Answer: 0.0046 M

5-1: What is the pH of (a) a 0.028 M solution of NaOH , (b) a 0.0011 M solution of $\text{Ca}(\text{OH})_2$?

5-2. What is the concentration of a solution of (a) KOH for which the pH is 11.89; (b) $\text{Ca}(\text{OH})_2$ for which the pH is 11.68? Answers: (a) 7.8×10^{-3} M, (b) 2.4×10^{-13} M

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6-1. A student prepared a 0.10 M solution of formic acid (HCHO_2) and measured its pH using a pH meter. The pH at 25°C was found to be 2.38. (a) Calculate K_a for formic acid at this temperature. (b) What percentage of the acid is ionized in this 0.10 M solution?

6-2. A 0.020 M solution of niacin has a pH of 3.26. (a) What percentage of the acid is ionized in this solution? (b) What is the acid-dissociation constant, K_a , for niacin? Answers: (a) 2.7%, (b) 1.5×10^{-5}

7-1. Calculate the pH of a 0.20 M solution of HCN. The K_a for HCN is 4.9×10^{-10}

7-2: The K_a for niacin (Practice Exercise 16.10) is 1.5×10^{-5} . What is the pH of a 0.010 M solution of niacin? Answer: 3.42

8-1: Calculate the percentage of HF molecules ionized in (a) a 0.10 M HF solution, (b) a 0.010 M HF solution.

8-2: In Practice Exercise 7-2, we found that the percent ionization of niacin ($K_a = 1.5 \times 10^{-5}$) in a 0.020 M solution is 2.7%. Calculate the percentage of niacin molecules ionized in a solution that is (a) 0.010 M, (b) 1.0×10^{-3} M. Answers: (a) 3.8%, (b) 12%

9-1: Calculate the concentration of OH^- in a 0.15 M solution of NH_3 .

9-2: Which of the following compounds should produce the highest pH as a 0.05 M solution: pyridine, methylamine, or nitrous acid?