

CHM152 – Chapter 14: Acids and Bases – Homework

Please work all of these problems first then answer the questions in Blackboard.
You have one chance to place your answers in Bb so make it count! – 10 points total

1. What is the conjugate base of HSO_4^- ?
2. Write a balanced equation for the Bronsted-Lowry acid HPO_4^{2-} in water.
3. From the following chemical reactions determine the relative Bronsted-Lowry acid strengths (strongest to weakest).
$$\text{HClO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_3\text{O}^+(\text{aq}) + \text{ClO}_4^-(\text{aq})$$
$$\text{HNO}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{NO}_2^-(\text{aq})$$
 - a. $\text{H}_3\text{O}^+ > \text{HNO}_2 > \text{HClO}_4$
 - b. $\text{H}_3\text{O}^+ > \text{HClO}_4 > \text{HNO}_2$
 - c. $\text{HClO}_4 > \text{HNO}_2 > \text{H}_3\text{O}^+$
 - d. $\text{HClO}_4 > \text{H}_3\text{O}^+ > \text{HNO}_2$
4. Calculate the pH of an aqueous solution that contains $2.50 \times 10^{-4} \text{ M}$ $[\text{H}_3\text{O}^+]$.
5. Calculate the pH of an aqueous solution that contains $3.50 \times 10^{-3} \text{ M}$ $[\text{OH}^-]$.
6. What is the pH of a solution prepared by mixing 100.00 mL of 0.020 M $\text{Ca}(\text{OH})_2$ with 50.00 mL of 0.100 M NaOH? Assume that the volumes are additive.
7. What is the equilibrium constant expression (K_a) for the acid dissociation of formic acid (HCOOH)? (Hint: write a balanced equation for the dissociation of formic acid in water first.)
8. What is the pH of a 0.100 M formic acid solution with a $K_a = 1.8 \times 10^{-4}$?
9. A tablet containing 500.0 mg of aspirin (acetylsalicylic acid or $\text{HC}_9\text{H}_7\text{O}_4$) was dissolved in enough water to make 100.0 mL of solution. Given that $K_a = 3.0 \times 10^{-4}$ for aspirin, what is the pH of the solution?
10. What is the percent dissociation of a benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$) solution with $\text{pH} = 2.59$? The acid dissociation constant for this monoprotic acid is 6.5×10^{-5} .
11. Vinegar is a 5.0% m/m% solution of acetic acid in water. Given that $K_a = 1.8 \times 10^{-5}$ for acetic acid and assuming the density of vinegar to be 1.00 g/mL, what is the pH of this vinegar solution?

12. Calculate the concentration of bicarbonate ion, HCO_3^- , in a 0.010 M H_2CO_3 solution that has the stepwise dissociation constants $K_{a1} = 4.3 \times 10^{-7}$ and $K_{a2} = 5.6 \times 10^{-11}$.
13. Ammonia has a K_b of 1.8×10^{-5} . What is the conjugate acid of ammonia and what is its K_a ?
14. What is the pH of a 0.30 M pyridine solution that has a $K_b = 1.9 \times 10^{-9}$?
- $$\text{C}_5\text{H}_5\text{N}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{C}_5\text{H}_5\text{NH}^+(\text{aq}) + \text{OH}^-(\text{aq})$$
15. Which one of the following salts, when dissolved in water, produces the solution with the highest pH?
- KI
 - KBr
 - KF
 - KCl
16. If an equal number of moles of the HCN and KOH are added to water, is the resulting solution acidic, basic, or neutral?
17. Calculate the pH of a 0.100 M NaCH_3COO solution. K_a for acetic acid, CH_3COOH , is 1.8×10^{-5} .
18. Calculate the pH of a 0.100 M $\text{CH}_3\text{NH}_3\text{Cl}$ solution. K_b for methylamine, CH_3NH_2 , is 3.7×10^{-4} .
19. What is the strongest base among the following?
- ClO^-
 - ClO_2^-
 - ClO_3^-
 - ClO_4^-
20. Which one of the following is **not** considered to be a Lewis base?
- H_2O
 - NH_3
 - NH_4^+
 - Cl^-