

Exercise 15.2

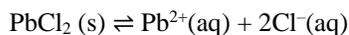
Common Ion Effect & Buffers

Name: _____

Date: _____ Per: _____

Part A – The Common Ion Effect

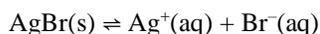
1. Consider the following equilibrium system:



Explain what happens to the solubility of PbCl_2 when the following substances are added to the solution.

- a. $\text{Pb}(\text{NO}_3)_2$ _____
b. NaCl _____
c. H_2O _____
d. AgNO_3 _____

2. Consider the following equilibrium system:



Explain what happens to the solubility of $\text{AgBr}(\text{s})$ when the following substances are added to the solution.

- a. $\text{Pb}(\text{NO}_3)_2$ _____
b. AgNO_3 _____
c. NaCl _____
d. NaBr _____

3. A certain buffer is made by dissolving NaHCO_3 and Na_2CO_3 in some water. Write equations to show how this buffer neutralizes added H^{+} and OH^{-} .
4. Explain why more $\text{Zn}(\text{OH})_2$ dissolves when $3M$ HCl is added to a saturated solution of $\text{Zn}(\text{OH})_2$. Start by writing the correct equilibrium equation.

Part B – Calculating the pH of Buffer Solutions (Use ICE Tables for 5-8.)

5. Calculate the pH of a solution containing $0.085 M$ nitrous acid (HNO_2 , $K_a = 4.5 \times 10^{-4}$) and $0.10 M$ potassium nitrite (KNO_2). (Answer: 3.42)

Exercise 15.2

Common Ion Effect & Buffers

Name: _____

Date: _____ Per: _____

- Calculate the pH of a solution that is 0.295 M in sodium formate (NaHCO_2) and 0.205 M in formic acid (HCO_2H). The K_a of formic acid is 1.77×10^{-4} . (*Answer: 3.910*)
- A buffered solution is made by adding 50.0 g NH_4Cl to 1.00 L of a 0.750 M solution of NH_3 . Calculate the pH of the final solution. Assume no volume change. (K_a of $\text{NH}_4^+ = 5.6 \times 10^{-10}$.)
- Determine the pH of a buffer that is 0.12 M in lactic acid $\text{HC}_3\text{H}_5\text{O}_3$ and 0.10 M in sodium lactate $\text{NaC}_3\text{H}_5\text{O}_3$? For lactic acid, $K_a = 1.4 \times 10^{-4}$. (*Answer: 3.77*)
- Using the Henderson-Hasselbalch formula, calculate the pH of a buffer that contains 0.270 M hydrofluoric acid (HF) and 0.180 M cesium fluoride (CsF). The K_a of hydrofluoric acid is 6.80×10^{-4} . (*Answer: 2.99*)
- Using the Henderson-Hasselbalch formula, calculate the pH of a buffer solution that contains 0.820 grams of sodium acetate and 0.010 moles of acetic acid in 100 ml of water. The K_a of acetic acid is 1.77×10^{-5} . (*Answer: 4.75*)

Exercise 15.2

Common Ion Effect & Buffers

Name: _____

Date: _____ Per: _____

Part C – Preparing Buffer Solutions

- How many moles of NH_4Cl must be added to 2.0 L of 0.10 M NH_3 to form a buffer whose pH is 9.00? K_b of NH_3 is 1.8×10^{-5} . (Assume that the addition of NH_4Cl does not change the volume of the solution.) (*Answer: 0.36 mol NH_4Cl*)
- Calculate the concentration of sodium benzoate that must be present in a 0.20 M solution of benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$) to produce a pH of 4.00. K_a of benzoic acid is 6.3×10^{-5} . (*Answer: 0.13 M*)
- Calculate the mass of sodium acetate that must be added to 500.0 mL of 0.200 M acetic acid to form a pH = 5.00 buffer solution.
- Consider a solution containing 0.100 M fluoride ions and 0.126 M hydrogen fluoride. Calculate the concentration of hydrogen fluoride after addition of 8.00 mL of 0.0100 M HCl to 25.0 mL of this solution. (*Answer: 0.0979*)

Exercise 15.2

Common Ion Effect & Buffers

Name: _____

Date: _____ Per: _____

15. Calculate the percent ionization of nitrous acid in a solution that is 0.249 M in nitrous acid. The acid dissociation constant of nitrous acid is 4.50×10^{-4} . (Answer: 4.25)
16. Calculate the formate ion (COO^-) concentration and pH of a solution that is 0.050 M in formic acid (HCOOH , $K_a = 1.8 \times 10^{-4}$) and 0.10 M in HNO_3 . (Answer: $[\text{HCOO}^-] = 9.0 \times 10^{-5}$, $\text{pH} = 1.00$)
17. Consider the bases in the table provided. Which base would be the best choice for preparing a $\text{pH} = 5.00$ buffer? Explain how to make 1.0 L of this buffer.

Table 14.3 | Values of K_b for Some Common Weak Bases

Name	Formula	Conjugate Acid	K_b
Ammonia	NH_3	NH_4^+	1.8×10^{-5}
Methylamine	CH_3NH_2	CH_3NH_3^+	4.38×10^{-4}
Ethylamine	$\text{C}_2\text{H}_5\text{NH}_2$	$\text{C}_2\text{H}_5\text{NH}_3^+$	5.6×10^{-4}
Aniline	$\text{C}_6\text{H}_5\text{NH}_2$	$\text{C}_6\text{H}_5\text{NH}_3^+$	3.8×10^{-10}
Pyridine	$\text{C}_5\text{H}_5\text{N}$	$\text{C}_5\text{H}_5\text{NH}^+$	1.7×10^{-9}

© George Lehman, All Rights Reserved.