

Key

1) For PbCl_2 ($K_{sp} = 2.4 \times 10^{-4}$), will a precipitate of PbCl_2 form when 0.10 L of $3.0 \times 10^{-2} \text{ M}$ $\text{Pb}(\text{NO}_3)_2$ is added to 400 mL of $9.0 \times 10^{-2} \text{ M}$ NaCl ? You must show work to support your answer.

A) Yes, because $Q > K_{sp}$.

C) Yes, because $Q < K_{sp}$.

B) No, because $Q = K_{sp}$

D) No, because $Q < K_{sp}$.

$\text{PbCl}_2(s) \rightleftharpoons \text{Pb}^{2+} + 2\text{Cl}^- \quad Q_{sp} = [\text{Pb}^{2+}][\text{Cl}^-]^2$

M Pb^{2+} :	0.10 L $\text{Pb}(\text{NO}_3)_2$	$3.0 \times 10^{-2} \text{ mol}$	Pb^{2+}	0.500 L	$= 6.0 \times 10^{-3} \text{ M}$	$Q_{sp} = [6.0 \times 10^{-3}][7.2 \times 10^{-2}]^2$
M Cl^- :	0.400 L NaCl	$9.0 \times 10^{-2} \text{ mol}$	Cl^-	0.500 L	$= 7.2 \times 10^{-2} \text{ M}$	$Q_{sp} = 3.1 \times 10^{-5}$

$Q_{sp} < K_{sp}$

2) A solution is prepared by mixing 500. mL of 0.10 M NaOCl and 500. mL of 0.20 M HOCl . What is the pH of this solution? [$K_a(\text{HOCl}) = 3.2 \times 10^{-8}$]



Buffer solution

$$\text{pH} = \text{p}K_a + \text{Log} \frac{B}{A}$$

$$\text{pH} = -\text{Log} 3.2 \times 10^{-8} + \text{Log} \frac{0.05}{0.1}$$

pH = 7.19

3) Assuming equal concentrations of conjugate base and acid, which one of the following mixtures is suitable for making a buffer solution with an optimum pH of 9.2–9.3?

A) $\text{NaNO}_2 / \text{HNO}_2$ ($K_a = 4.5 \times 10^{-4}$)

B) NaCl / HCl

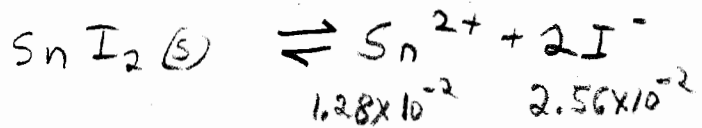
C) $\text{CH}_3\text{COONa} / \text{CH}_3\text{COOH}$ ($K_a = 1.8 \times 10^{-5}$)

D) $\text{NaOCl} / \text{HOCl}$ ($K_a = 3.2 \times 10^{-8}$)

E) $\text{NH}_3 / \text{NH}_4\text{Cl}$ ($K_a = 5.6 \times 10^{-10}$)

$-\text{Log}(5.6 \times 10^{-10}) = 9.25$

4) The molar solubility of tin(II) iodide is $1.28 \times 10^{-2} \text{ mol/L}$. What is K_{sp} for this compound?



$K_{sp} = [1.28 \times 10^{-2}][2.56 \times 10^{-2}]^2 = 8.39 \times 10^{-6}$

Key

- 5) You have 500.0 mL of a buffer solution containing 0.20 M acetic acid (CH_3COOH) and 0.30 M sodium acetate (CH_3COONa). What will the pH of this solution be after the addition of 20.0 mL of 1.00 M NaOH solution? [$K_a = 1.8 \times 10^{-5}$]

$$\text{moles HOAc: } \frac{0.5000 \text{ L} \times 0.20 \text{ mol/L}}{1} = 0.10$$

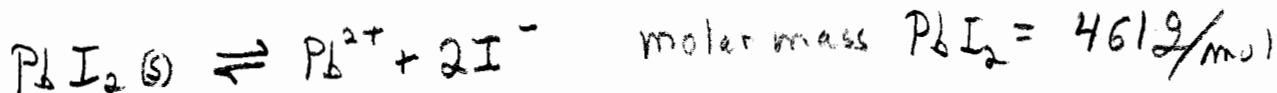
$$\text{moles OAc}^-: \frac{0.5000 \text{ L} \times 0.30 \text{ mol/L}}{1} = 0.15$$

$$\text{moles added Base: } \frac{0.0200 \text{ L} \times 1.00 \text{ mol/L OH}^-}{1} = 0.0200$$

$$\text{pH} = -\log(1.8 \times 10^{-5}) + \log \frac{0.15 + 0.0200}{0.10 - 0.0200}$$

$$\text{pH} = 5.07$$

- 6) The solubility of lead(II) iodide is 0.064 g/100 mL at 20°C. What is the solubility product for lead(II) iodide?



$$[\text{Pb}^{2+}] = \frac{0.064 \text{ g PbI}_2}{0.100 \text{ L}} \times \frac{1 \text{ mol PbI}_2}{461 \text{ g PbI}_2} = 1.39 \times 10^{-3} \frac{\text{mol}}{\text{L}}$$

$$[\text{I}^-] = 2 \times 1.39 \times 10^{-3} = 2.28 \times 10^{-3} \frac{\text{mol}}{\text{L}}$$

$$K_{sp} = [1.39 \times 10^{-3}] [2.28 \times 10^{-3}]^2$$

$$K_{sp} = 1.1 \times 10^{-8}$$