CHM152 Quiz 6 25 Pts Spring 2018 Name: Key
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1) For $PbCl_2$ ($K_{sp} = 2.4 \times 10^{-4}$), will a precipitate of $PbCl_2$ form when 0.10 L of 3.0×10^{-2} M $Pb(NO_3)_2$ is added to 400 mL of 9.0×10^{-2} M NaCl? You must show work to support you answer.

A) Yes, because $Q > K_{sp}$.
B) No, because $Q = K_{sp}$
C) Yes, because $Q < K_{sp}$.
[✓ D)] No, because $Q < K_{sp}$.

$PbCl_2(s) \rightleftharpoons Pb^{2+} + 2Cl^-$ $Q_{sp} = [Pb^{2+}][Cl^-]^2$

M Pb^{2+}: $\frac{0.10\,\cancel{L}\,\cancel{Pb(NO_3)_2}}{} \cdot \frac{3.0\times10^{-2}\,mol}{\cancel{L}} \cdot \frac{Pb^{2+}}{\cancel{Pb(NO_3)_2}} \cdot \frac{}{0.500\,L} = 6.0\times10^{-3}\,M$

M Cl^-; $\frac{0.400\,\cancel{L}\,\cancel{NaCl}}{} \cdot \frac{9.0\times10^{-2}\,mol}{\cancel{L}} \cdot \frac{Cl^-}{\cancel{NaCl}} \cdot \frac{}{0.500\,L} = 7.2\times10^{-2}\,M$

$Q_{sp} = [6.0\times10^{-3}][7.2\times10^{-2}]^2$

$Q_{sp} = 3.1\times10^{-5}$

$Q_{ss} < K_s$

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? [$K_a(HOCl) = 3.2 \times 10^{-8}$]

$HOCl + H_2O \rightleftharpoons H_3O^+ + OCl^-$

Buffer solution

$pH = pKa + \log \frac{B}{A}$

$pH = -\log 3.2\times10^{-8} + \log \frac{0.05}{0.1}$

$\boxed{pH = 7.19}$

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) $NaNO_2 / HNO_2$ ($K_a = 4.5 \times 10^{-4}$)
B) NaCl / HCl
C) CH_3COONa / CH_3COOH ($K_a = 1.8 \times 10^{-5}$)
D) NaOCl / HOCl ($K_a = 3.2 \times 10^{-8}$)
[✓ E)] NH_3 / NH_4Cl ($K_a = 5.6 \times 10^{-10}$) $-\log(5.6\times10^{-10}) = 9.25$

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

$SnI_2(s) \rightleftharpoons Sn^{2+} + 2I^-$

1.28×10^{-2} 2.56×10^{-2}

$K_{sp} = [1.28\times10^{-2}][2.56\times10^{-2}]^2 = \boxed{8.39\times10^{-6}}$

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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? [$K_a = 1.8 \times 10^{-5}$]

moles HOAc: $0.5000 \cancel{L} \left| \frac{0.20 \text{ mol}}{\cancel{L}} \right. = 0.10$

moles OAc⁻ $0.5000 \cancel{L} \left| \frac{0.30 \text{ mol}}{\cancel{L}} \right. = 0.15$

moles added Base: $0.0200 \cancel{L} \left| \frac{1.00 \text{ mol } OH^-}{\cancel{L}} \right. = 0.0200$

$$pH = -\text{Log}\, 1.8 \times 10^{-5} + \text{Log}\, \frac{0.15 + 0.0200}{0.10 - 0.0200}$$

$$\boxed{pH = 5.07}$$

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?

$$PbI_2(s) \rightleftharpoons Pb^{2+} + 2I^-$$

molar mass $PbI_2 = 461 \text{ g/mol}$

$$[Pb^{2+}]: \frac{0.064 \cancel{g\, PbI_2}}{0.100 L} \left| \frac{\text{mol}}{461 \cancel{g}} \right| \frac{Pb^{2+}}{\cancel{PbI_2}} = 1.39 \times 10^{-3} \frac{\text{mol}}{L}$$

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

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

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