General Chemistry II
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Examination #5

Name_____

(4) 1. In a buffer system that consists of HX^{-2}/H_2X^{-1}, the addition of a small amount of KOH will cause a **decrease** in the concentration of (HX^{-2}, H_2X^{-1}) and a corresponding **increase** in the concentration of (HX^{-2}, H_2X^{-1}).

(4) 2. Which one of the following mixtures, when dissolved in water at 25°C, can serve as a buffer system?

a) 0.2 mole KCl + 0.3 mole HCl
b) 0.3 mole KOH + 0.1 mole HF
c) 0.3 mole KOH + 0.2 mole HF
d) 0.3 mole KOH + 0.3 mole HF
e) 0.3 mole KOH + 0.4 mole HF

(4) 3. In the titration of a weak base with strong acid, the **highest** pH value on the titration curve is:

a) the initial pH
b) the pH at the 1/2 neutralization point
c) the pH at the equivalence point
d) the pH beyond the equivalence point

(4) 4. At 25°C, when an aqueous solution of a weak acid, such as $HC_2H_3O_2$, has been half neutralized by strong base:

a) pH = twice the initial pH value
b) pH = one half the initial pH value
c) pH = pK_a
d) pH = pK_a - 14.00
e) pH = 14.00 - pK_a

(4) 5. At 25°C, as KCN is added to a saturated aqueous solution of $Fe(OH)_3$, the **pH** of the solution will (increase, decrease, remain the same).
K_{sp} for $Fe(OH)_3 = 4x10^{-38}$ $K_{formation}$ for $Fe(CN)_6^{-3} = 1x10^{42}$

(4) 6. The $K_{formation}$ value for $X(NH_3)_6^{+2}$ is $1x10^{18}$, whereas that for $Z(NH_3)_6^{+2}$ is $1x10^{30}$. Given 1M aqueous solutions of each complex ion at the same temperature, the solution of _____ will have the **lower pH** of the two.

(4) 7. At a given temperature, as a saturated aqueous $CaCO_3$ solution is acidified, gaseous CO_2 is produced. As acid is added to the medium, the K_{sp} value for $CaCO_3$ (increases, decreases, remains the same).
Assume sufficient $CaCO_3(s)$ is present at all times to maintain equilibrium with its ions.

(4) 8. Which one of the following weak acids would be most suitable for preparing a buffer mixture with a **pH = 4.20** at 25°C?

a) $HCOOH$, $K_a = 1.8\times10^{-4}$ b) HF, $K_a = 6.6\times10^{-4}$

c) HNO_2, $K_a = 7.2\times10^{-4}$ d) CH_3COOH, $K_a = 1.8\times10^{-5}$

e) C_6H_5COOH, $K_a = 6.3\times10^{-5}$

(4) 9. If for a hypothetical slightly soluble salt, $A_2B(s)$, K_{sp} at 25°C is 3.20×10^{-11}, then the molar solubility of A_2B in pure water is:

a) 1.0×10^{-4}M b) 2.0×10^{-4}M c) 3.2×10^{-4}M d) 4.0×10^{-4}M

(4) 10. At what pH will $Cu(OH)_2$ start to precipitate from an aqueous solution with a $[Cu^{+2}] = 0.20$M? K_{sp} for $Cu(OH)_2(s) = 5.6\times10^{-20}$

a) 4.72 b) 5.76 c) 6.62 d) 7.38 e) 8.55

(4) 11. Consider the equilibrium reaction, at 25°C, shown below:

$1AgI(s) + 2CN^{-1}(aq) \rightleftharpoons 1Ag(CN)_2^{-1}(aq) + 1I^{-1}(aq)$ K_c

What is K_c for the equilibrium reaction shown above?
Given: K_{sp} for $AgI(s) = 8.5\times10^{-17}$ K_f for $Ag(CN)_2^{-1}(aq) = 5.6\times10^{18}$

a) 1.5×10^{-35} b) 7.1×10^{-18} c) 476 d) 4.8×10^{22} e) 6.6×10^{36}

(14) 12. Match the following terms in Column A with the appropriate descriptor in Column B:

Column A		Column B
a) Weak acid	____	Complete neutralization
b) Buffer systems	____	Ion product > K_{sp}
c) Instability constant	____	K_a, K_b, or $K_{hydrolysis}$
d) End point	____	Acid-base indicator
e) Equivalence point	____	Ion product < K_{sp}
f) Precipitation will occur	____	$1/K_{formation}$
g) Unsaturated solution	____	Indicator color change

(8) 13. What is the molar solubility, at 25°C, of $Cd(OH)_2$ in an aqueous NaOH solution whose pH is 11.00? K_{sp} for $Cd(OH)_2 = 5.0x10^{-15}$ Show all work in the space below.

(8) 14. Determine the instability constant, $K_{instability}$, for a 0.010M solution of $X(NH_3)_2^{+1}$ given that the equilibrium concentration of NH_3 is $2.0x10^{-6}$M. Show all work in the space below.

(9) 15. What is the pH of a solution resulting from the addition of 80 ml of 0.10M $HC_2H_3O_2$ to 20 ml of 0.10M KOH? Assume volumes are additive. K_a for $HC_2H_3O_2 = 1.8x10^{-5}$. Show all work in the space below.

(8) 16. Consider the following equilibrium:

$$Ag_2C_2O_4(s) \rightleftharpoons 2Ag^{+1} + C_2O_4^{-2}$$

If one liter of pure water can dissolve a maximum of 0.0337 grams of $Ag_2C_2O_4$ (Molar mass = 303.74 g/mol) at 25°C, determine K_{sp} for $Ag_2C_2O_4$. Show all work in the space below.

(9) 17. Consider the following equilibria:

$$NiS(s) \rightleftharpoons Ni^{+2} + S^{-2} \qquad K_{sp} = 1.09\times10^{-21}$$

$$PbS(s) \rightleftharpoons Pb^{+2} + S^{-2} \qquad K_{sp} = 8.89\times10^{-29}$$

$$HgS(s) \rightleftharpoons Hg^{+2} + S^{-2} \qquad K_{sp} = 6.49\times10^{-53}$$

A saturated H_2S solution is 0.020M in Ni^{+2}, 0.015M in Pb^{+2}, and 0.001M in Hg^{+2}. The acidity of the medium is adjusted so that the concentration of S^{-2} is 5.2×10^{-21}M. Which metal ion(s), if any, will precipitate? Show all work in the space below.