Chemistry 112 Spring 2007 Prof. Metz Exam 3 Practice

Questions 1 and 2 refer to a solution made by dissolving 0.020 mol of benzoic acid ($HC_7H_5O_2$) and 0.010 moles of sodium benzoate ($NaC_7H_5O_2$) in enough water to make 1.00 L of solution. pK_a for $HC_7H_5O_2$ is 4.20.

1. What is the approximate pH of this solution?

(A) 4.20 (C) 4.50 (E) 3.10
(B) 3.90 (D) 2.96

2. What is the approximate pH after the addition of 0.010 mol of solid NaOH to the solution (assume no volume change)?

(A) 5.89 (C) 4.50 (E) 2.96
(B) 12.0 (D) 4.20

Question 3 refers to a buffer made by dissolving 0.50 moles of NH_3 and 0.30 moles of NH_4Cl in enough water to form 1.00 L of solution. For NH_3 $K_b = 1.74 \times 10^{-5}$

3. When a small amount of HCl is added to the original buffer solution, the pH slightly _____, the concentration of NH_3 _____, and the concentration of NH_4^+ _____.

	pH	$[NH_3]$	$[NH_4^+]$
(A)	increases	increases	increases
(B)	decreases	decreases	increases
(C)	increases	increases	decreases
(D)	decreases	increases	decreases
(E)	decreases	decreases	decreases

4. Which of the solutions below will make a good buffer? (choose one answer)

(A) 0.10 M HBr + 0.05 M NaBr

(B) 0.10 M KNO_2 + 0.05 M $NaNO_2$

(C) 0.10 M $NaNO_2$ + 0.05 M HNO_2

(D) 0.10 M CH_3CO_2H + 0.05 M $HClO_4$

(E) All of the above will make good buffers.

5. When one liter of a 0.50 M CH_3CO_2H, 0.50 M $CH_3CO_2^-$ buffer solution is diluted to a volume of two liters, the:

(A) pH is doubled
(B) pH is halved
(C) $[H_3O^+]$ is doubled
(D) $[H_3O^+]$ is halved
(E) $[H_3O^+]$ is nearly constant

6. Calculate the $[ClO^-]/[HClO]$ ratio necessary to give a buffer with a pH = 8.00.
K_a for HClO is 3.5×10^{-8}

(A) 1.00 (B) 1.07 (C) 3.50 (D) 0.286 (E) 0.932

7. Calculate the approximate $[H_3O^+]$ in a 0.020 M H_2S solution.
For H_2S; $K_{a1} = 1.1\times10^{-7}$ and $K_{a2} = 1.0\times10^{-14}$

(A) 4.7×10^{-5} (C) 1.1×10^{-21} (E) 1.1×10^{-7}
(B) 2.2×10^{-9} (D) 3.3×10^{-11}

8. What is the $[Ba^{2+}]$ in a saturated BaF_2 solution?

$K_{sp} = 1.0 \times 10^{-6}$

(A) 1.0×10^{-3} M
(B) 6.3×10^{-3} M
(C) 1.3×10^{-2} M
(D) 2.0×10^{-6} M
(E) 3.0×10^{-6} M

9. The molar solubility of calcium hydroxide in water is 1.3×10^{-4} M. The solubility product constant (K_{sp}) for $Ca(OH)_2$ is _____ M.

(A) 1.3×10^{-4}
(B) 1.7×10^{-8}
(C) 2.2×10^{-12}
(D) 8.8×10^{-12}
(E) 3.4×10^{-8}

10. The molar solubility of calcium carbonate in 0.20 M calcium nitrate is _____ M.

For $CaCO_3$ $K_{sp} = 8.7 \times 10^{-9}$

(A) 8.7×10^{-9}
(B) 9.3×10^{-5}
(C) 4.4×10^{-8}
(D) 6.3×10^{-3}
(E) 3.2×10^{-3}

11. If solid NaCl is added to an aqueous solution which is 0.10 M in $Pb(NO_3)_2$ and 0.10 M in $AgNO_3$ until the $[Cl^-]$ is 0.020 M, what will happen? Assume no volume change.

AgCl $K_{sp} = 1.6 \times 10^{-10}$; $PbCl_2$ $K_{sp} = 1.6 \times 10^{-5}$

(A) A precipitate of $PbCl_2$ but not of AgCl will form.
(B) A precipitate of AgCl but not of $PbCl_2$ will form.
(C) Precipitates of both AgCl and $PbCl_2$ will form.
(D) No precipitate will form.
(E) A precipitate of $NaNO_3$ will form.

12. CrO_4^{2-} is added slowly to a solution that is 1.0×10^{-2} M in Ag^+. Assuming no volume change, what is the minimum $[CrO_4^{2-}]$ necessary to initiate precipitation of Ag_2CrO_4? The K_{sp} of $Ag_2CrO_4 = 2.4 \times 10^{-12}$.

(A) 2.4×10^{-10} (C) 1.5×10^{-6} (E) 8.4×10^{-5}
(B) 2.4×10^{-8} (D) 1.3×10^{-4}

Questions 13-16 are worth 2 points each
For the following salts, state whether they will be
(A) more soluble in 0.1 M HCl than in pure water
(B) about the same solubility in 0.1 M HCl and pure water
(C) less soluble in 0.1 M HCl than in pure water

13. AgBr
14. AgCl
15. $Fe(OH)_2$
16. $CaCO_3$

17. What is the concentration of N_2 (in moles/L) in fresh water in equilibrium with air at 25 °C and 1 atm ? The atmosphere is 78% (mole percent) nitrogen. The Henry's Law constant for N_2 in H_2O is $k_H = 8.42 \times 10^{-7}$ M/(mm Hg)
(A) 6.4×10^{-4} (B) 5.0×10^{-4} (C) 6.6×10^{-5} (D) 8.4×10^{-7} (E) 6.6×10^{-7}

Use the following information to answer questions 18-20.
12.20 g of sugar (MW= 180.0), a non-electrolyte, is dissolved in 480.0 g water (MW= 18.00) to give a solution with a volume of 488.0 mL. The temperature of the solution is 25.0°C. The vapor pressure of water at 25.0°C is 23.80 mm Hg.

18. The molality of the sugar solution is:
(A) 0.141 (B) 0.139 (C) 0.0678 (D) 0.158 (E) 0.224

19. The vapor pressure of the sugar solution at 25.0°C in mm Hg is:
(A) 23.80 (B) 0.997 (C) 23.74 (D) 28.86 (E) 760

20. The freezing point of this solution in ^{o}C is:
(A) -.262° (B) -.260° (C) -.186° (D) -.335° (E) –40.2°

21. Arrange the following aqueous solutions from lowest to highest boiling point: 0.65 m sugar (nonelectrolyte), 0.40 m $MgCl_2$, 0.30 m $CaSO_4$, 0.20 m $NaNO_3$:

(A) $NaNO_3$ < $CaSO_4$ < $MgCl_2$ < sugar
(B) sugar < $NaNO_3$ < $CaSO_4$ < $MgCl_2$
(C) $NaNO_3$ < $CaSO_4$ < sugar < $MgCl_2$
(D) $MgCl_2$ < sugar < $CaSO_4$ < $NaNO_3$
(E) $NaNO_3$ < $MgCl_2$ < $CaSO_4$ < sugar

22. Cell walls act as semipermeable membranes in living systems. Assume that these membranes are permeable to solvent only. If the ion concentration inside the cell is 0.0043 M and the ion concentration outside of the cell is 0.0025 M you would predict:

(A) Ions would flow from inside the cell to outside.
(B) Water would flow from inside the cell to outside
(C) Ions would flow from outside the cell to inside
(D) Water would flow from outside the cell to inside
(E) Neither water nor ions would flow