Chemistry 204: Quiz #5

1. For Chemistry 205 you are asked to make separate aqueous solutions of $NaHCO_3$, $NaHSO_3$, and $NaHC_2O_4$, and $NaHSO_4$. Unfortunately, your lab partner misread the instructions and instead of 3.14*M* solutions, your lab partner made 0.314*M* solutions. Which of the 0.314*M* solutions will have the **greatest difference in pH** as the 3.14*M* solution of that salt?

   a) $NaHCO_3$
   b) $NaHSO_3$
   c) $NaHC_2O_4$
   d) $NaHSO_4$
   e) Each of the salts with have essentially the same pH at 3.14*M* as 0.314*M*.

2. You titrate 1.000 L of a 1.00 $\times 10^{-3}$ *M* NaCN(*aq*) solution with 1.00 $\times 10^{-4}$ *M* HCl(*aq*) to the endpoint. Determine the pH of the solution at the endpoint.

   a) 6.53 b) 6.59 c) 6.62 d) 6.72 e) 6.94

3. Consider two separate solutions containing buffer systems. Beaker A has the H_2CO_3/HCO_3^- system, and beaker B has the $H_2PO_4^-/HPO_4^{2-}$ system. The pH of both solutions is 7.00. Which of the following is true concerning the relative amounts of acid and conjugate base in each beaker?

	Beaker A	Beaker B
a)	$[H_2CO_3] > [HCO_3^-]$	$[H_2PO_4^-] > [HPO_4^{2-}]$
b)	$[H_2CO_3] > [HCO_3^-]$	$[HPO_4^{2-}] > [H_2PO_4^-]$
c)	$[HCO_3^-] > [H_2CO_3]$	$[HPO_4^{2-}] > [H_2PO_4^-]$
d)	$[H_2CO_3] = [HCO_3^-]$	$[H_2PO_4^-] = [HPO_4^{2-}]$
e)	$[HCO_3^-] > [H_2CO_3]$	$[H_2PO_4^-] > [HPO_4^{2-}]$

4. Recall the demonstration in which we added baking soda to separate 30.0 mL solutions of 3.00*M* HCl, 3.00*M* $HC_2H_3O_2$, and a mixture of 3.00*M* $HC_2H_3O_2$/3.00*M* $NaC_2H_3O_2$. Suppose instead of adding baking soda, we added 15.0 mL of 3.00M NaOH to each of the solutions. For which of the cases would the **change in pH** (to three significant figures) be the **lowest**?

   a) Adding 15.0 mL of 3.00M NaOH to 30.0 mL of 3.00*M* HCl.
   b) Adding 15.0 mL of 3.00M NaOH to 30.0 mL of 3.00*M* $HC_2H_3O_2$.
   c) Adding 15.0 mL of 3.00M NaOH to 30.0 mL of 3.00*M* $HC_2H_3O_2$/3.00*M* $NaC_2H_3O_2$.
   d) The change in pH would be equally low for a and b above.
   e) The change in pH would be equally low for a and c above.

5. Determine the pH of a solution made by dissolving 1.256 mg of NaOH in 100.0 L of aqueous solution.

   a) 6.38 b) 6.50 c) 7.50 d) 7.54 e) 7.62

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6. You have a 1.000-mol sample of the solid weak acid HA, for which $K_a = 1.00 \times 10^{-3}$. How much water must you add to this acid such that at equilibrium the percent dissociation of the acid is 50.0%?

   a) 250.0 mL   b) 500.0 mL   c) 1.000 L   d) 250.0 L   e) 500.0 L

7. Great! Your friends throw you a surprise party, and knowing your love of chemistry, one of the party games is an acid-base titration. And because they know you are in Accelerated Chemistry at the prestigious University of Illinois at Urbana-Champaign, they have you titrate a solution composed of three acids!

   You have 100.0 mL of a solution labeled "0.100*M* HCl, 0.100*M* HF, and 0.100 *M* HCN". You will titrate this solution with 1.00*M* NaOH. Determine the pH of the solutions at various points along the titration. **Show all work**.

   Full credit is reserved for a coherent, systematic method that we can follow.

   a. Calculate the initial pH before any NaOH is added to the acid mixture.
   b. Calculate the pH after 8.00 mL of 1.00*M* NaOH is added to the acid mixture.
   c. Calculate the pH after 14.00 mL of 1.00*M* NaOH is added to the acid mixture.
   d. Calculate the pH after 20.00 mL of 1.00*M* NaOH is added to the acid mixture.

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KEY:
MC: 1. d, 2. b, 3. e, 4. e, 5. d, 6. e

7. a.1.00, b.1.67, c. 2.98, d. 6.18