CH302 Spring 2009—Practice Quiz 3, The Professor's Version

1) Estimate the pH of 0.10 M $Na_2HPO_4(aq)$ given $pK_{a1} = 2.12$, $pK_{a2} = 7.21$, and $pK_{a3} = 12.68$ for phosphoric acid.

- **A.** 12.68
- **B.** 9.94
- **C.** 7.40
- **D.** 4.67
- **E.** 2.12

Answer: B

2) A solution of equal concentrations of formic acid and sodium formate was found to have pH = 3.75. What is the value of K_a of formic acid?

- **A.** 1.78×10^{-4}
- **B.** 1.78×10^{-5}
- **C.** 1.78×10^{-6}
- **D.** 1.78×10^{-3}

Answer: A

3) A buffer solution contains 0.25 M $NaNO_2(aq)$ and 0.80 M $HNO_2(aq)$ ($pK_a = 3.37$). What is the pH after 0.10 mol HBr are added to 1.00 L of this buffer?

- **A.** 11.41
- **B.** 4.15
- **C.** 2.59
- **D.** 9.85
- **E.** 3.37

Answer: C

4) Consider the titration of 15.0 mL of 0.200 M $H_3PO_4(aq)$ with 0.200 M NaOH(aq). What is(are) the major species in solution after the addition of 30.0 mL of base?

- **A.** $HPO_4^{2-}(aq)$
- **B.** $H_2PO_4^{-}(aq)$
- **C.** $H_2PO_4^{-}(aq)$ and $HPO_4^{2-}(aq)$

- **D.** $H_3PO_4(aq)$ and $H_2PO_4^-(aq)$
- **E.** $PO_4^{3-}(aq)$

Answer: A

5) 100 mL of each of the following solutions is mixed; which one of the mixed solutions is a buffer?

- **A.** 1.0 M $NH_3(aq)$ + 0.6 M KOH(aq)
- **B.** 1.0 M $NH_4Cl(aq)$ + 1.0 M KOH(aq)
- **C.** 1.0 M $NH_3(aq)$ + 0.4 M HCl(aq)
- **D.** 1.0 M $NH_4Cl(aq)$ + 0.4 M HCl(aq)
- **E.** 1.0 M $NH_3(aq)$ + 1.0 M HCl(aq)

Answer: C

6) You are asked to determine the concentration of equilibrium species when a tetraprotic acid, H4Y, is thrown in water. How many simultaneous equations will you need to create to solve for both the acid and the water equilibria? What is the sum of the coefficients for the charge balance equation for the solution? How many different species are formed in the mass balance equation for the acid?

- **A.** 6,5,4
- **B.** 4,7,3
- **C.** 6,8,4
- **D.** 5,7,4
- **E.** 6,5,3

Answer: C

7) A solution is formed by adding 100 ml of 0.1 M NaOH to 100 ml of 0.1 M acetic acid. The pKa of the acid is 4.74. Which of the following thoughts would enter the brain of an experienced acid base problem solver

- **A.** Acetic acid is a weak acid so the problem to be worked will use the weak acid equation and the answer will be a pH in the 3 to 5 range.
- **B.** The presence of an acid and a base means this is a buffer solution with pH equal to 4.74
- **C.** There are equal moles of a strong base and a weak acid so the neutralized solution will have a pH in the 9 to 11 range.
- **D.** There are equal moles of a base and acid creating a neutral solution will have a pH of 7.
- **E.** NaOH is a strong base so the problem to be worked will use the strong base equation and the answer will be a pH in the 12 to 14 range.

Answer: C

8) Which of these statements is not a reason given to simplify complex equilibria to form the simple acid base

equations we use to solve 90% of our acid base calculations?

- **A.** All of these statements are arguments that have been made.
- **B.** The concentrations of acids and bases added to water are large enough that the Kw is insignificant in the calculation.
- **C.** The dissociation constants of polyprotic acids are sufficiently far apart that we can often use a monoprotic weak acid approximation.
- **D.** A weak acid or base is assumed to dissociate a negligible amount compared to the initial concentration of the weak acid or base.
- **E.** A strong acid or base is assumed to have dissociated completely.

Answer: A