Extra Buffer Problems

1. A recipe calls for 0.200 L of a buffer to made at 0.0500 M in HA, and 0.0800 M in A–.
   a. If the Ka value of HA is $7.88 \times 10^{-6}$, what is the pH of the buffer?
   b. What is the pH of the buffer after 20.0 mL of 0.200 M NaOH is added?

2. 3.224 g of sodium acetate were combined with 5.80 mL of glacial (pure, no water) acetic acid in a total volume of 100.0 mL. The density of glacial acetic acid is 1.05 g/mL.
   a. What is the molarity of each component of the buffer?
   b. What is the pH of the buffer?

3. What will be the pH of a carbonic acid buffer containing 90% bicarbonate (HCO$_3$–) and 10% carbonic acid (H$_2$CO$_3$)? The pKa of carbonic acid is 6.8.

4. Neo has been given the password that controls the Matrix. He is about to embark on a dangerous journey, and needs to share the password with someone in the case of his demise. The Oracle has told him to only trust a chemist. The password secret is locked in the pH values of solutions A and B: Fortunately for Neo, Agent Smith is not a chemist.
   A. the pH of 50.0 mL of 0.100 M solution of weak acid HX
   B. the pH resulting from the addition of 15.0 mL of 0.250 M KOH to the above solution of HX
   C. info: A 0.0500 M solution of NaX has a pH of 10.02
   what is the password?

5. Calculate the buffer capacity for added acid (in moles of H$^+$) for 500.0 mL of an acetic acid/acetate buffer that is pH 5.50, and has [HAc] of 0.14 M?

6. Calculate the pH at the equivalence point when 30.00 mL of a 0.100 M solution of the acid in problem 1 is titrated with 0.200 M NaOH.

7. What volume of 1.00 M NaOH would be added to 500.0 mL of 0.200 M sodium dihydrogen phosphate solution to make a buffer with a pH of 7.40? H$_3$PO$_4$ $K_{a1} = 7.1 \times 10^{-3}$, $K_{a2} = 6.3 \times 10^{-8}$, $K_{a3} = 4.2 \times 10^{-13}$

Answers on next page
Answers:

1. (A) pH = 5.31       (B) pH = 5.62

2. (A) 0.393 M acetate, 1.02 M acetic acid     (B) pH = 4.33

3. pH = 7.75

4. 4.17, 7.82 (use the info in part C to calculate the $K_b$, then the $K_a$, of the acid, then determine the pH for (a)

5. 0.403 moles of $H_3O^+$

6. pH = 8.96 (calculate the concentration of $A^-$ at the equivalence point, then assume that $A^-$ ionizes in water to make $OH^-$ and HA. Don’t forget to calculate $K_b$ for the anion ionization.

7. 61.2 mL (write the appropriate equation for the acidic ionization of $H_2PO_4^-$, be sure to pick the correct $K_a$ value, make sure that the number of moles of anion is subtracted from the number of moles of acid).