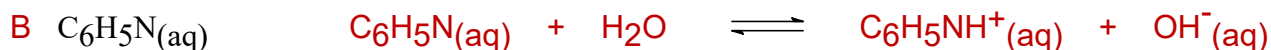


# Chem 10123, Quiz 4

February 19, 2020

# Answer Key

1. (9 points) Indicate whether each of the following aqueous solutions is acidic (A), basic (B), or neutral (N). Also, for each solution, write a **complete, balanced net-ionic equation** for the major **equilibrium** reaction that is occurring in solution.



2. A certain solution (call it Solution A) is prepared by adding 25.0 g of sodium benzoate "NaA" to 250.0 mL of 1.00 M benzoic acid "HA" ( $K_a = 6.50 \times 10^{-5}$ ) and then diluting to a total volume of 1.00 L. (molar masses: NaA = 144.1, HA = 122.1)

- (a) (6 points) **SHOW ALL WORK.** Determine the pH of solution A. Include the important **equilibrium** reaction. (For benzoic acid, use HA for simplicity.)

$$(25.0 \text{ g NaA}) (1 \text{ mole} / 144.1 \text{ g}) = 0.173 \text{ mole NaA} = 0.173 \text{ mole } \text{A}^-$$

$$(250 \text{ mL}) (1.00 \text{ mole HA} / 1000 \text{ mL}) = 0.250 \text{ mole HA} \quad \text{Buffer Solution!}$$



$$[\text{H}^+] = K_a [\text{HA}] / [\text{A}^-] = K_a (\text{mole HA}) / (\text{mole } \text{A}^-)$$

$$[\text{H}^+] = (6.50 \times 10^{-5}) (0.250 \text{ mole}) / (0.173 \text{ mole}) = 9.393 \times 10^{-5} \text{ M}$$

$$\text{pH} = -\log(9.393 \times 10^{-5}) = 4.03$$

- (b) (6 points) **SHOW ALL WORK.** Suppose that 20.0 mL of 5.00 M KOH is added to solution A. Write a **balanced, net-ionic equation** for any reaction that occurs upon mixing and determine the pH of the final solution.

$$(20.0 \text{ mL}) (5.00 \text{ mole } \text{OH}^- / 1000 \text{ mL}) = 0.100 \text{ mole } \text{OH}^- \text{ added}$$



$$0.250 \quad 0.100 \text{ moles} \quad \quad \quad 0.173 \text{ moles}$$

$$-0.100 \quad -0.100 \quad \quad \quad +0.100$$

---


$$0.150 \quad \quad 0 \quad \quad \quad 0.273 \quad (\text{still a buffer solution!})$$

$$[\text{H}^+] = K_a [\text{HA}] / [\text{A}^-] = K_a (\text{mole HA}) / (\text{mole } \text{A}^-)$$

$$[\text{H}^+] = (6.50 \times 10^{-5}) (0.150 \text{ mole}) / (0.273 \text{ mole}) = 3.571 \times 10^{-5}$$

$$\text{pH} = -\log(3.571 \times 10^{-5}) = 4.45 \quad (\text{pH only slightly higher after 40 \% of HA consumed!})$$