

Key (white)

$$pH = pK_a + \log\left(\frac{\text{conj. base}}{\text{acid}}\right)$$

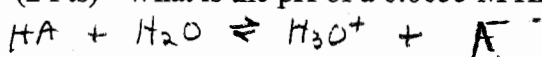
Show all work to receive credit.

1. (2 Pts) Which of the following yields a basic solution when dissolved in water?

- I.  $\text{NH}_3$
- II.  $\text{Na}_2\text{O}$
- III.  $\text{LiOH}$
- IV.  $\text{P}_4\text{O}_{10}$

- A) I, II, and III
- B) I and IV
- C) I and II
- D) II and III
- E) I, II, III, and IV

2. (2 Pts) What is the pH of a 0.0055 M HA (weak acid) solution that is 8.2% ionized?



$$[\text{H}_3\text{O}^+] = 0.082 \times 0.0055$$

$$[\text{H}_3\text{O}^+] = 4.51 \times 10^{-4}$$

$$pH = -\log [\text{H}_3\text{O}^+] = 3.35$$

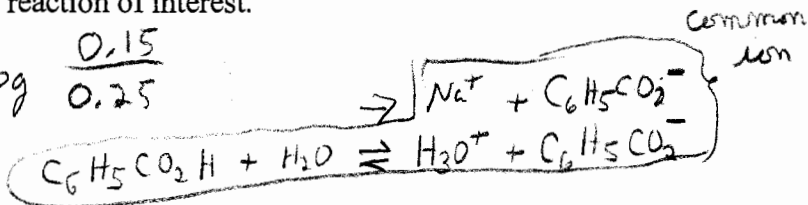
3. (2 Pts) Which one of the following combinations cannot function as a buffer solution?

- A)  $\text{HNO}_3$  and  $\text{NaNO}_3$
- B)  $\text{HNO}_2$  and  $\text{NaNO}_2$
- C)  $\text{HF}$  and  $\text{NaF}$
- D)  $\text{NH}_3$  and  $(\text{NH}_4)_2\text{SO}_4$
- E)  $\text{HCN}$  and  $\text{KCN}$

4. (4 Pts) Calculate the pH of a buffer solution that contains 0.25 M benzoic acid ( $\text{C}_6\text{H}_5\text{CO}_2\text{H}$ ) and 0.15M sodium benzoate ( $\text{C}_6\text{H}_5\text{COONa}$ ). [ $K_a = 6.5 \times 10^{-5}$  for benzoic acid]. You must first write a chemical equation showing the equilibrium reaction of interest.

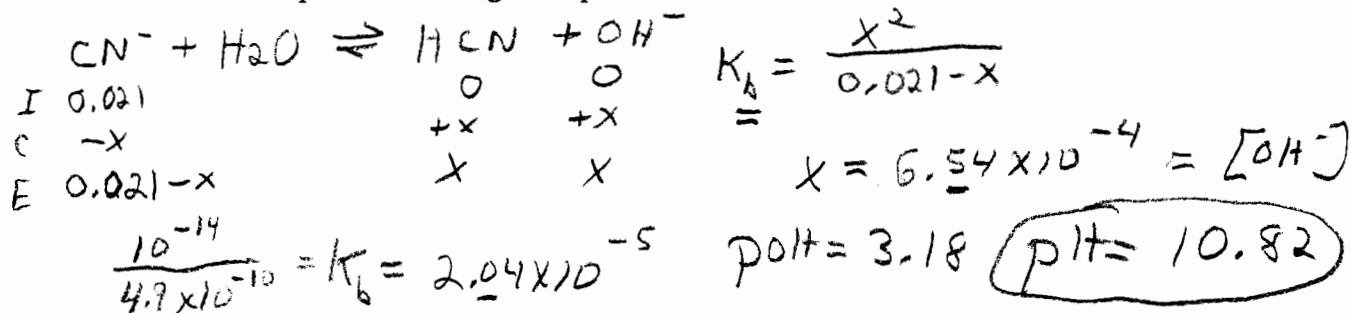
$$pH = -\log 6.5 \times 10^{-5} + \log \frac{0.15}{0.25}$$

$$pH = 3.97$$

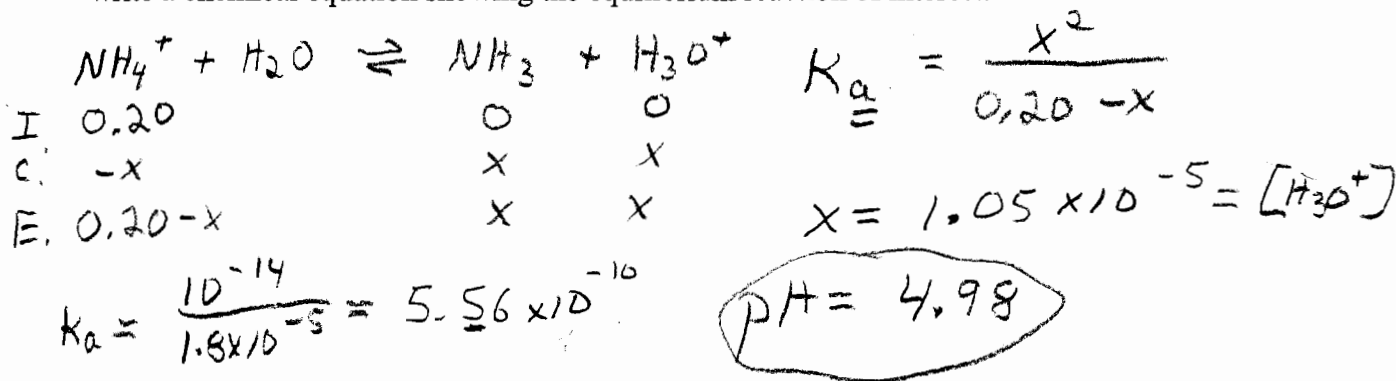


# Key (white)

5. (4 Pts) Calculate the pH of a 0.021 M NaCN solution.  $[K_a(\text{HCN}) = 4.9 \times 10^{-10}]$ . You must first write a chemical equation showing the equilibrium reaction of interest.



6. (4 Pts) What is the pH of a 0.20 M solution of  $\text{NH}_4\text{Cl}$ ?  $[K_b(\text{NH}_3) = 1.8 \times 10^{-5}]$ . You must first write a chemical equation showing the equilibrium reaction of interest.



7. (3 Pts) Which of the following yields an acidic solution when dissolved in water?

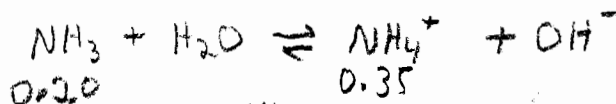
- I.  $\text{NO}_2$
- II.  $\text{NH}_4\text{Cl}$
- III.  $\text{NaCl}$
- IV.  $\text{HNO}_2$

- A) I, II, III, and IV
- B) II and III
- C) I and III
- D) I, II, and IV**
- E) I and IV

8. (4 Pts) Calculate the pH of a solution that is 0.20M  $\text{NH}_3(\text{aq})$  and 0.35 M  $\text{NH}_4\text{Cl}(\text{aq})$ . You must first write a chemical equation showing the equilibrium reaction of interest.

$(K_b(\text{NH}_3) = 1.8 \times 10^{-5})$

Basic Buffer solution



$$K_a = \frac{10^{-14}}{1.8 \times 10^{-5}} = 5.56 \times 10^{-10}$$

$$\text{pH} = -\text{Log } 5.56 \times 10^{-10} + \text{Log } \frac{0.20}{0.35}$$

**$\text{pH} = 9.01$**