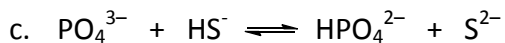
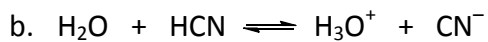
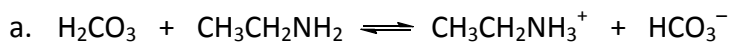


Acids, Bases, and Buffers

1. Label the acid (A), base (B), conjugate acid (CA), and conjugate base (CB) in the reactions below:



2. Calculate $[\text{OH}^-]$ for the following and indicate whether the following solutions are acidic, basic or neutral. Report the answer with the correct number of significant figures.

a. $[\text{H}^+] = 0.0041$

b. $[\text{H}_3\text{O}^+] = 3.50 \times 10^{-9}$

3. Calculate the pH of the following. Report the answer based on the rules for significant figures.

a. 0.0575 M HNO_3

b. 5.0 mL of 1.0 M HCl diluted to 0.700 L

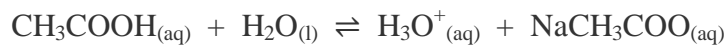
4. Write the K_a expression for ethylammonium ($\text{CH}_3\text{CH}_2\text{NH}_3^+$).

5. Which of the following would you add to $\text{H}_2\text{CO}_{3(\text{aq})}$ to form a buffer? (Choose one)



6. Explain your answer choice for problem 5.

7. Consider the following buffer system with acetic acid and sodium acetate:



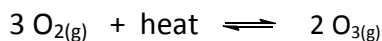
a. How does the buffer react when acid is added?

b. How does the buffer react when base is added?

8. Which of the following represents the strongest acid? Explain.

Acid	K_a
CH_3COOH	1.8×10^{-5}
$\text{HC}_7\text{H}_5\text{O}_2$	6.3×10^{-5}
HNO_2	4.5×10^{-4}
HF	6.8×10^{-4}

9. In the lower atmosphere, oxygen is converted to ozone (O_3) by the energy provided from lightning.



For each of the following changes at equilibrium, indicate whether the system shifts in the direction of the products, reactants, or does not change:

a. add more $\text{O}_{2(\text{g})}$

b. add more $\text{O}_{3(\text{g})}$

c. increase the temperature

Answers

1.

- a. weak acid
- b. strong acid
- c. weak base

2.

- a. A, B, CA, CB
- b. B, A, CA, CB
- c. B, A, CA, CB

3.

a.

$$[\text{OH}^-] = \frac{[1.0 \times 10^{-14}]}{[0.0041]} = 2.4 \times 10^{-12} M$$

acidic

b.

$$[\text{OH}^-] = \frac{[1.0 \times 10^{-14}]}{[3.50 \times 10^{-9}]} = 2.86 \times 10^{-6} M$$

basic

4.

a.

$$\text{pH} = -\log(0.0575) = 1.240$$

b. $(5.0 \text{ mL}) \cdot (1.0 \text{ M}) = C_2 (700 \text{ mL}) \quad \Rightarrow \quad C_2 = 0.0071 \text{ M}$

$$\text{pH} = -\log(0.0071) = 2.15$$

5.

$$K_a = \frac{[\text{CH}_3\text{CH}_2\text{NH}_2] \cdot [\text{H}_3\text{O}^+]}{[\text{CH}_3\text{CH}_2\text{NH}_3^+]}$$

6. C (NaHCO_3)

7. H_2CO_3 is a weak acid and NaHCO_3 is a salt of the conjugate base.

*explanation doesn't have to be exactly as written, but should indicate the same concept.

8.

a. When additional acid is added, it reacts with the base in the buffer (NaCH_3COO).

*explanation doesn't have to be exactly as written, but should indicate the same concept.

b. When additional base is added, it reacts with the acid in the buffer (CH_3COOH).

*explanation doesn't have to be exactly as written, but should indicate the same concept.

9. HF because it has the largest K_a value.

*explanation doesn't have to be exactly as written, but should indicate the same concept.

10.

- a. shifts towards the products
- b. shifts towards the reactants
- c. shifts towards the products