22. (2 pts) Which would lower the freezing point of 2.0 Kg of water more? (Circle letter of answer)

a. 0.20 mol NaCl  
   
   b. 0.20 mol Ba(OH)₂  
   
   c. 0.20 mol Na₃PO₄  
   
   d. 0.65 mol glucose  
   
   e. 0.30 mol NaOH

23. (2 pts) What is the osmolarity of a 0.20 M solution of KCl? (Circle letter of answer)

a. 0.10 Osmol  
   
   b. 0.20 Osmol  
   
   c. 0.30 Osmol  
   
   d. 0.40 Osmol  
   
   e. 0.80 Osmol

24. (3 pts) Acids and Bases

1. What is the conjugate base for HCO₃⁻?  \( \text{CO}_3^{2-} \)

2. What is the conjugate acid for NH₃?  \( \text{NH}_4^+ \)

25. (4 pts) Write the balanced reaction for the neutralization of KOH with sulfuric acid, H₂SO₄:

\[ 2 \text{KOH}(aq) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{K}_2\text{SO}_4(aq) + 2\text{H}_2\text{O} \]

26. (3 pts) What is the [H₃O⁺] concentration of human spinal fluid if the pH is 7.40?

\[ \text{antilog}(-7.40) = 4.0 \times 10^{-8} \text{M} = [\text{H}_3\text{O}^+] \]

27. (3 pts) What is the [OH⁻] concentration of a solution in which the pH is 5.8?

\[ \text{antilog}(-5.80) = 1.6 \times 10^{-6} \text{M} = [\text{H}_3\text{O}^+] \]

\[ [\text{OH}^-] = 10^{-14} [\text{H}_3\text{O}^+] \text{OH}^- = \frac{10^{-14}}{1.6 \times 10^{-6}} = 6.3 \times 10^{-9} \text{M} \]

28. (4 pts) If the Ka (acid dissociation constant) for acetic acid is equal to 1.8 \times 10^{-5}. What would be the pH of a buffer that contains 0.075 M acetic acid and 0.025 M sodium acetate?

\[ \text{Ka} = \frac{[\text{CH}_3\text{COO}^-][\text{H}^+]}{[\text{CH}_3\text{COOH}]} \]

\[ 1.8 \times 10^{-5} = \frac{0.025\text{M}[\text{H}^+]}{0.075\text{M}} \]

\[ [\text{H}^+] = 1.8 \times 10^{-5} \times \frac{0.025\text{M}}{0.075\text{M}} = 5.4 \times 10^{-5} \text{M} \]

\[ \text{pH} = -\log(5.4 \times 10^{-5} \text{M}) \]

\[ \text{pH} = 4.27 \]