**PERIODIC TABLE OF THE ELEMENTS**

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**Reserved**

Pre Vet 2000

Jan Derwell
Formulas and Constants

\[ R = 0.0821 \frac{\text{L atm}}{\text{mol K}} = 8.314 \frac{J}{K \text{ mol}} = 62.4 \frac{\text{L mm Hg}}{\text{mol K}} \quad K = 273.15 + ^\circ C \]

\[ q = \text{(mass)}(\text{specific heat})(\Delta T) \quad k = Ae^{-E_a/RT} \]

\[ m = \frac{\text{mol solute}}{\text{Kg solvent}} \quad M = \frac{\text{mol solute}}{\text{L soln}} \quad w/w\% = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100 \]

\[ \Delta T_b = K_p m_i \quad \Delta T_f = K_p m_i \quad \Pi = MRT / i \quad P = X P^0 \quad P = kC \]

\[ \ln \left( \frac{k_2}{k_1} \right) = \left( \frac{E_2}{R} \right) \left( \frac{1}{T_2} - \frac{1}{T_1} \right) \]

\[ \text{pH} = pK_a + \log \left( \frac{[A^+]^2}{[HA]} \right) \]

\[ K_w = K_a K_b \quad K_w = 1.0 \times 10^{-14} \]

\[ E = E^o - \frac{0.0592}{n} \log Q \]

First Order Rate Stuff

\[ \text{Rate} = -\frac{\Delta [A]}{\Delta t} = k[A] \quad \ln [A] = -kt + \ln [A]_0 \quad t_{1/2} = \frac{0.693}{k} \]

Second Order Rate Stuff

\[ \text{Rate} = -\frac{\Delta [A]}{\Delta t} = k[A]^2 \quad \frac{1}{[A]} = kt + \frac{1}{[A]_0} \quad t_{1/2} = \frac{1}{k[A]_0} \]

Zero Order Rate Stuff

\[ \text{Rate} = -\frac{\Delta [A]}{\Delta t} = k \quad [A] = -kt + [A]_0 \quad t_{1/2} = \frac{[A]_0}{2k} \]
Chemistry 112/113 Exam 3 (100 points)

1. In an aqueous solution of the weak acid, HClO, \((K_a = 3.5 \times 10^{-8})\) which of the following is in the highest concentration.
   a. HClO  
   b. H_3O^+  
   c. OH^-
   d. ClO^-  
   e. Cl^-

2. A strong acid is titrated to the equivalence point with a strong base. The pH of the resulting solution would be:
   a. 7  
   b. between 7 and 12  
   c. between 3 and 7  
   d. > 12  
   e. < 3

3. What is the pH of a solution that is 0.10 \(M\) in ethanoic acid and 0.50 \(M\) in sodium ethanoate. \((K_a,\text{ for ethanoic acid} = 1.8 \times 10^{-5})\)
   a. 0.70  
   b. 2.87  
   c. 4.05  
   d. 4.74  
   e. 5.44

4. You have 500 mL of a saturated solution of Mg(OH)_2 \((K_{sp} = 1.8 \times 10^{-11})\) which contains some undissolved Mg(OH)_2 solid. If you want to dissolve as much Mg(OH)_2 as possible, you could:
   a. Decrease the pH of the solution.  
   b. Increase the pH of the solution.  
   c. Add more Mg(OH)_2 (s) to the solution.  
   d. Add NaCl to the solution.  
   e. None of the other choices, a-d, would cause more Mg(OH)_2 to dissolve.

5. Which of the following is the strongest acid?
   a. HBrO  
   b. HBrO_2  
   c. HBrO_3  
   d. HBrO_4  
   e. HBr

6. Calculate the \([H_3O^+]\) of a solution made by mixing 100. mL of 0.100 \(M\) HCN and 10.0 mL of 0.100 \(M\) KOH? \((K_a \text{ for HCN} = 4.0 \times 10^{-10})\)
   a. \(4.0 \times 10^{-9} M\)  
   b. \(3.6 \times 10^{-9} M\)  
   c. \(9.1 \times 10^{-3} M\)  
   d. \(8.2 \times 10^{-3} M\)  
   e. \(2.0 \times 10^{-8} M\)

7. What is the equilibrium constant for the reaction shown below? \((K_b \text{ for CH}_3\text{NH}_2 is 4.2 \times 10^{-4})\).
   \[\text{CH}_3\text{NH}_3^+(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{CH}_3\text{NH}_2(aq) + \text{H}_3\text{O}^+(aq)\]
   a. \(2.4 \times 10^{-11}\)  
   b. \(4.2 \times 10^{-10}\)  
   c. \(4.2 \times 10^{-4}\)  
   d. \(4.2 \times 10^{-6}\)  
   e. \(2.4 \times 10^{-3}\)
8. A weak, monoprotic acid solution is titrated with a sodium hydroxide solution. At the equivalence point you would expect:
   a. pH < 7
d. pH = pK
b. pH = 7
e. There isn’t enough information provided to answer this question.
c. pH > 7

9. A 0.10 M aqueous solution of an acid, HX, has a pH of 4.00. What is the value of K for HX?
   a. 1.0 x 10⁻⁴
d. 1.0 x 10⁻³
b. 1.0 x 10⁻⁷
e. 1.0 x 10⁻⁰
   c. 1.0 x 10⁻⁶

10. What is the pH of a solution of 0.2 M sodium propionate, NaC₃H₅O₂? (Kₚ for propionic acid, H₃C₂H₂O₂ is 1.3 x 10⁻⁵.)
    a. 2.7
d. 9.1
b. 4.9
e. 11.1
c. 7.7

11. A large scoop of NaOH is placed into a bucket. Just enough water at 25°C is added to the bucket to dissolve all of the NaOH. You would expect the pH of the resulting solution to be:
    a. > 12
d. less than 5
b. between 10 and 12
e. none of the other answers is correct.
c. between 5 and 7

12. Rank the pH from lowest to highest if you had 0.100 M solutions of each of the following ("I = II" in the answers means the pH of I and II would be equivalent):
   I. NaOH  II. Ca(OH)₂  III. HCl  IV. NH₃
   a. III < IV < I = II
d. III < IV < I < II
b. II < IV < III
e. IV < III < I < II
c. II < I < IV < III

13. Which of the following would have the highest [OH⁻]?
   a. 0.10 M HCl
d. a buffer with pH = 12.0
b. 0.10 M H₂SO₄
e. pure water
c. a buffer with pH = 5.0

14. When NH₃ is dissolved in water, which of the following statements is true about the resulting solution?
   a. [NH₄⁺] > [NH₃]
d. [H₃O⁺] > [OH⁻]
b. [OH⁻] = [H₃O⁺]
e. [NH₄⁺] = [OH⁻]
c. pH < 7

15. For which of the following reactions is the equilibrium constant Kₚ?
   a. HCOOH(aq) + NH₃(aq) ⇋ NH₄⁺(aq) + H₂O(l)
b. H₂O⁺(aq) + H₂O(l) ⇋ 2H₂O(l)
c. HCl(aq) + H₂O(l) ⇋ H₃O⁺(aq) + Cl⁻(aq)
d. HCO₃⁻(aq) + H₂O(l) ⇋ OH⁻(aq) + H₂CO₃(aq)
e. NH₄⁺(aq) + OH⁻(aq) ⇋ NH₃(aq) + H₂O(l)
16. What is the pH of a 0.010 M solution of Ca(OH)₂?

a. 12.00  

b. 2.00  

c. 12.30  

d. 10.7  

e. 13.4

17. Given the following information:

<table>
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<th>Salt</th>
<th>K_{sp}</th>
</tr>
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<tbody>
<tr>
<td>CaCO₃</td>
<td>4.8 x 10^{-9}</td>
</tr>
<tr>
<td>PbI₂</td>
<td>1.1 x 10^{-9}</td>
</tr>
<tr>
<td>AgBr</td>
<td>5 x 10^{-13}</td>
</tr>
<tr>
<td>Fe(OH)₃</td>
<td>8 x 10^{-16}</td>
</tr>
<tr>
<td>Co(OH)₂</td>
<td>2.5 x 10^{-16}</td>
</tr>
</tbody>
</table>

which salt is the least soluble (mol/L)?

a. CaCO₃  

b. PbI₂   

c. AgBr   

d. Fe(OH)₃  

e. Co(OH)₂

18. Which of the following would be a buffer solution?

a. A 1.0 L solution containing 0.100 mol of NaCl and 0.100 mol of NaOH  

b. A 1.0 L solution containing 0.100 mol HCN and 0.09 mol of NaBr  

c. A 1.0 L solution containing 0.100 mol HF and 0.075 mol of KF  

d. A 1.0 L solution containing 0.100 mol H₂C₂H₂O₂ and 0.080 mol of HCl  

e. A 1.0 L solution containing 0.100 mol NaCN and 0.080 mol of NaOH

19. Which of the following reactions would have the largest equilibrium constant?

a. HCN(aq) + H₂O(l) ⇌ H₂O + OH⁻  

b. F(aq) + H₂O(l)  

c. H₂O(l) + H₂O(l)  

d. HCl(aq) + CN(aq)  

e. CN(aq) + H₂O(l) → HCN + OH⁻

20. Which of the following would you expect to have the greatest solubility in 1.0 L of a nearly saturated aqueous solution of CsF @ 25°C (CsF is very soluble at 25°C)?

a. BaF₂ with a K_{sp} = 1.0 x 10^{-6}  

b. CaF₂ with a K_{sp} = 3.4 x 10^{-11}  

c. CaSO₄ with a K_{sp} = 9.1 x 10^{-6}  

d. BaSO₄ with a K_{sp} = 1.1 x 10^{-10}  

e. BaCrO₄ with a K_{sp} = 1.2 x 10^{-10}

21. 1.0 L of solution is prepared with concentrations of 0.0100 M HA and 0.0020 M NaA. Next, 0.0010 additional mol of NaA are added to this solution with no appreciable change in volume. Calculate the pH of this solution. (K_a for HA is 9.0 x 10^{-6}).

a. 4.00  

b. 5.05  

c. 4.35  

d. 4.57  

e. 5.52
Consider the following information about four sulfides:

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<td>CdS</td>
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<td>ZnS</td>
<td>4.9 x 10^-14</td>
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<td>CuS</td>
<td>8.7 x 10^-34</td>
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<tr>
<td>PbS</td>
<td>8.4 x 10^-8</td>
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Four, 1.0 L saturated solutions are prepared with each of the above sulfides. Then, 100 mL of an approximately 0.01 M Na₂S is added to each solution. In looking at each of the resulting solutions, which of the following ions would exist in the lowest concentration after the addition of the Na₂S?

- a. Cd²⁺
- b. Zn²⁺
- c. Cu²⁺
- d. Pb²⁺
- e. S²⁻

3. Each of the following would be expected to behave as a Lewis base except:

- a. OH⁻
- b. H₂O
- c. CH₃⁻
- d. NH₃
- e. PF₃

4. The correct Kₚ expression for CaF₂ dissolving in water is:

- a. Kₚ = [Ca²⁺][2F⁻]
- b. Kₚ = [Ca²⁺][F⁻]
- c. Kₚ = [Ca²⁺][F⁻]^2
- d. Kₚ = [Ca²⁺][F⁻]^2
- e. Kₚ = [Ca²⁺][F⁻]^2

25. 1.0 L of a 0.100 M acetic acid (HC₃H₅O₂) solution is placed into a container. Between 0.09 and 0.12 mol of sodium acetate, NaC₂H₃O₂, is then added to the solution. Which of the following describes the pH of the solution?

- a. The solution was acidic prior to the addition of the NaC₂H₃O₂, and basic after.
- b. The solution was acidic prior to the addition of the NaC₂H₃O₂, and still acidic after.
- c. The solution was basic prior to the addition of the NaC₂H₃O₂, and acidic after.
- d. The solution was basic prior to the addition of the NaC₂H₃O₂, and still basic after.
- e. None of the other answers can truly be known unless the exact number of moles of NaC₂H₃O₂ added to the solution are specified.

26. You are using Form D of this exam. Please answer this question by correctly filling in the blank.
I am using _________ of this exam.

- a. Form A
- b. Form B
- c. Form C
- d. Form D
- e. Form E