Practice Exam 2

1. In the following reaction

$$HF(aq) + H_2O(l) \leftrightarrow H_3O^+(aq) + F^-(aq)$$

   a. HF is an acid and H_3O^+ is its conjugate base.
   b. H_2O is an acid and H_3O^+ is its conjugate base.
   c. HF is an acid and F^- is its conjugate base.
   d. H_2O is an acid and H_3O^+ is its conjugate base.
   e. HF is an acid and H_2O is its conjugate base.

2. What is the pH of a 4.2×10^{-4} M HBr solution at 25 ºC?

   a. 2.80
   b. 3.38
   c. 3.80
   d. 4.20
   e. 4.62

3. Which is the strongest acid?

   a. Ascorbic acid, $K_a = 8.0 \times 10^{-5}$
   b. Benzoic acid, $K_a = 6.5 \times 10^{-5}$
   c. 3-chlorobenzoic acid, $K_a = 1.5 \times 10^{-4}$
   d. 2-hydroxybenzoic acid, $K_a = 1.1 \times 10^{-3}$
   e. Chloroacetic acid, $K_a = 1.4 \times 10^{-3}$

4. Knowing that H_2S is a stronger acid than HCN, determine, if possible, in which direction the following equilibrium lies.

$$HCN(aq) + HS^-(aq) \leftrightarrow CN^-(aq) + H_2S(aq)$$

   a. equilibrium lies to the left
   b. equilibrium lies to the right
   c. equilibrium is perfectly balanced left and right
   d. can be determined if the relative acidity of HS€ is given
   e. cannot be determined

5. We have a 4.63×10^{-4} M solution of HCl. What is the pH of this solution at 25 ºC?

   a. 3.33
   b. 4.00
   c. 4.63
   d. 8.37
   e. 9.25

6. What is the pH of a 3.18 M CH_3COOH solution at 25 ºC? $K_a = 1.8 \times 10^{-5}$?

   a. 2.12
   b. 2.75
   c. 1.40
   d. 4.24
   e. 4.74

7. What is the % ionization of a 3.14 M CH_3CO_2H solution at 25 ºC? For CH_3CO_2H, $K_a = 1.8 \times 10^{-5}$.

   a. 0.24%
   b. 0.57%
   c. 1.8%
   d. 3.2%
   e. 7.5%

8. Which of the following acid-base reactions will lie predominantly toward the products?

   Reaction 1: $HF(aq) + NH_3(aq) \leftrightarrow NH_4^+(aq) + F^-(aq)$
   Reaction 2: $NH_3(aq) + H_2O(l) \leftrightarrow NH_4^+(aq) + OH^-(aq)$
   Reaction 3: $HF(aq) + H_2O(l) \leftrightarrow H_3O^+(aq) + F^-(aq)$

   a. 1 only
   b. 2 only
   c. 1 and 2 only
   d. 2 and 3 only
   e. 1, 2, and 3

9. We add 1.00 mL of 10.0 M HNO_3 to 100. mL of 0.10 M NaHCOO. What is the pH of the resulting solution? $K_a(HCOOH) = 1.8 \times 10^{-4}$

   a. 2.37
   b. 3.45
   c. 4.27
   d. 4.35
   e. 11.60

10. If you mix 100. mL of 0.11 M HCl with 50.0 mL of 0.22 M NH_3, what is the pH of the resulting solution? For NH_4^+, $K_a = 5.6 \times 10^{-10}$

   a. 4.63
   b. 5.19
   c. 6.02
   d. 8.37
   e. 9.37

11. If you mix 125. mL of 0.50 M CH_3CO_2H with 75.0 mL of 0.83 M NaOH, what is the pH of the resulting solution? For CH_3COO^-, $K_b = 5.6 \times 10^{-10}$

   a. 4.88
   b. 5.01
   c. 8.99
   d. 9.12
   e. 9.76

12. What effect will the addition of the reagent in each of the following have on the pH of the CH_3CO_2H solution respectively?

   Flask 1: Addition of $NaCH_3CO_2$ to $CH_3CO_2H(aq)$
   Flask 2: Addition of $Ca(CH_3CO_2)_2$ to $CH_3CO_2H(aq)$

   a. no change, increase
   b. no change, decrease
   c. decrease, no change
   d. decrease, decrease
   e. increase, increase

13. If you add 20.0 mL of 2.30 M NH_3 to 100. mL of a 1.17 M NH_4Cl solution, what is the pH of the resulting solution? For NH□, $K_b = 1.8 \times 10^{-5}$

a. 5.15
b. 6.35
c. 7.10
d. 7.65
e. 8.85

14. We have 250. mL of a 0.56 M solution of $NaCH_3COO$. How many milliliters of a 0.50 M CH_3COOH solution should be added to make a buffer of pH = 4.40? $K_a(CH_3COOH) = 1.8 \times 10^{-5}$

a. 200
b. 230
c. 620
d. 710
e. 750

15. Which of the following is the solubility product constant for $Mn(OH)_2$?

a. $K_{sp} = [Mn^{2+}][OH^-]^2$
b. $K_{sp} = [Mn^{2+}][2OH^-]^2$
c. $K_{sp} = [Mn^{2+}]^2[OH^-]^2$
d. $K_{sp} = [Mn^{2+}]^2[OH^-]$
e. $K_{sp} = [Mn^{2+}]^2[OH^-]^2$

16. Rank the compounds from lowest to highest molar solubility.
$FeCO_3$; $K_{sp} = 3.5 \times 10^{-11}$
$BaSO_4$; $K_{sp} = 1.1 \times 10^{-10}$
$ZnCO_3$; $K_{sp} = 1.5 \times 10^{-11}$

a. $ZnCO_3 < BaSO_4 < FeCO_3$
b. $FeCO_3 < ZnCO_3 < BaSO_4$
c. $ZnCO_3 < FeCO_3 < BaSO_4$
d. $BaSO_4 < ZnCO_3 < FeCO_3$
e. $BaSO_4 < FeCO_3 < ZnCO_3$

17. What is the concentration of SO_4^{2-} in a saturated solution of $BaSO_4$ if $K_{sp} = 1.1 \times 10^{-10}$?

    a. 1.1×10^{-10} M
    b. 5.5×10^{-11} M
    c. 5.0×10^{-5} M
    d. 1.0×10^{-5} M
    e. 9.5×10^{-4} M

18. Which of the following has the highest molar solubility?

    a. $PbCO_3$; $K_{sp} = 1.5 \times 10^{-13}$
    b. PbS; $K_{sp} = 8.4 \times 10^{-28}$
    c. PbI_2; $K_{sp} = 8.7 \times 10^{-9}$
    d. $PbSO_4$; $K_{sp} = 1.8 \times 10^{-8}$
    e. $Pb_3(PO_4)_2$; $K_{sp} = 3.0 \times 10^{-44}$

19. For MgF_2, $K_{sp} = 6.4 \times 10^{-9}$. If you mix 400. mL of 1×10^{-4} M $Mg(NO_3)_2$ and 500. mL of 1.00×10^{-4} M NaF, what will be observed?

    a. A precipitate forms because $Q_{sp} > K_{sp}$.
    b. A precipitate forms because $Q_{sp} < K_{sp}$.
    c. No precipitate forms because $Q_{sp} = K_{sp}$.
    d. No precipitate forms because $Q_{sp} < K_{sp}$.
    e. No precipitate forms because $Q_{sp} > K_{sp}$.

20. For AgI, $K_{sp} = 8.3 \times 10^{-17}$. What is the molar solubility of AgI in a solution which is 5.1×10^{-4} M in $AgNO_3$?

    a. 5.1×10^{-2} mol/L
    b. 1.1×10^{-5} mol/L
    c. 8.3×10^{-11} mol/L
    d. 1.6×10^{-13} mol/L
    e. 4.2×10^{-20} mol/L