Reading: Averill 4.6; 8.7; 16.1-4; 19.1-2; 19.5; 19.7

1. Limitations of Brønsted-Lowry

Averill Chapter 4, Section 6, Conceptual Problem 1

Why was it necessary to expand on the Arrhenius definition of an acid and a base? What specofic point does the Brønsted-Lowry definition address?

2. Acid, base, or salt?

Averill Chapter 4, Section 6, Conceptual Problem 2

State whether each compound is an acid, a base, or a salt.

a) $CaCO_3$
b) $NaHCO_3$
c) H_2SO_4
d) $CaCl_2$
e) $Ba(OH)_2$

3. Calculating pH

Averill Chapter 4, Section 6, Numerical Problem 4 What is the pH of each solution?

a) 5.8×10^{-3} mol of HNO−3 in 257 mL of water
b) 0.0079 mol of HI in 750 mL of water
c) 0.011 mol of $HCLO_4$ in 500 mL of water
d) 0.257 mol of HBr in 5.00 L of water

4.Concentration and pH from weight percent and dissolution

Averill Chapter 4, Section 6, Numerical Problem 8 Vinegar is primarily an aqueous solutino of acetic acid. Commercial vinegar typically contains 5.0 g of acetic acid in 95.0 g of water. What is the concentration of commercial vinegar? If only 3.1% of the acetic acid dissociates to $CH_3CO_2^-$, and H^+, what is the pH of the solution? (Assume the density of the solution is 1.00g/mL)

5. Acid strength

Averill Chapter 16, Section 3, Conceptual Problem 3

Explain why H_2Se is a weaker acid than HBr.

6. pH from pK_a

Averill Chapter 16, Section 4, Numerical Problem 8

The pK_a of Cl_3CCO_2H is 0.64. What is the pH of a 0.580 M solution? What percentage of the Cl_3CCO_2H is dissociated?

7. pH from pK_a

Averill Chapter 16, Section 4, Numerical Problem 15

Calculate the pH of a 0.24 M solution of sodium lactate. The pK_a of lactic acid is 3.86.

8. pH of solutions

Averill Chapter 16, Section 5, Numerical Problem 1

Calculate the pH of each solution.

a) A volume of 25.0 mL of 6.09 M HCl is added to 100.0 mL of distilled water

b) A volume of 5.0 mL of 2.555 M NaOH is added to 75.0 mL of distilled water.

9. K_a from pH

Averill Chapter 16, Section 5, Numerical Problem 3a

Salicylic acid is used in the synthesis of acetylsalicylic acid, or aspirin. One gram dissolves in 460 mL of water to create a saturated solution with a pH of 2.40.

a) What is the K_a of salicylic acid?

10. Expressions for K_{sp}

Averill Chapter 17, Section 1, Conceptual Problem 1

Write an expression for K_{sp} for each salt.

a) AgI
b) CaF_2
c) $PbCl_2$
d) Ag_2CrO_4

11. Common ion effect

Averill Chapter 17, Section 1, Conceptual Problem 6

Describe the effect of a common ion on the solubility of a salt. Is this effect similar to the common ion effect found in buffers? Explain your answer.

12. Molar solubility from K_{sp}

Averill Chapter 17, Section 1, Numerical Problem 2

Predict the molar solubility of each compound using the K_{sp} values given.

a) Li_3PO_4: 2.37×10^{-11}
b) $Ca(IO_3)_2$: 6.47×10^{-6}
c) $Y(IO_3)_3$: 1.12×10^{-10}

13. K_{sp} from molar solubility

Averill Chapter 17, Section 1, Conceptual Problem 10

In a saturated silver chromate solution, the molar solubility of chromate is 6.54×10^{-5}. What is the K_sp?

14. Will it precipitate?

Averill Chapter 17, Section 1, Numerical Problem 18

Silver nitrate eye drops were formerly administered to newborn infants to guard against eye infections contracted during birth. Although silver nitrate is highly water soluble, silver sulfate has a K_{sp} of 1.20×10^{-5} at 25°C. If you add 25.0 mL of 0.015 M $AgNO_3$ to 150 mL of 2.8×10^{-3} M Na_2SO_4, will you get a precipitate? If so, what will its mass be?

15. Maximum solubility

Averill Chapter 17, Section 1, Numerical Problem 2

Given 300 mL of a solution that is 0.056 M in lithium nitrate, what mass of solid sodium carbonate can be added before precipitation occurs (assuming that the volume of solution does not change after adding the solid)? $K_{sp} = 8.15 \times 10^{-4}$ for Li_2CO_3.

16. Conjugate acid/base pairs

a) Identify the conugate acid-base pairs in the following reactions:
   i) $HI\ (aq) + H_2O\ (l) \rightarrow H_3O^+\ (aq) + I^-\ (aq)$
   ii) $CH_3COOH\ (aq) + OH^-\ (aq) \rightarrow CH_3COO^-\ (aq) + H_2O\ (l)$
   iii) $NH_3\ (aq) + H_2O\ (l) \rightarrow NH_4^+\ (aq) + OH^-\ (aq)$
b) Identify which of the following cannot be a Brønsted base and give a reason for your choices:
H_3O^+, $AlCl_4^-$, CN^-, O_2^-, SiH_4, AsH_3
c) Estimate the pH and pHO of a 0.03091 M solution of hydroiodic acid ($K_a \approx 10^9$).

17. How much will dissolve?

Bi_2S_3 dissolves in water according to the following reaction:

$$Bi_2S_3(s) \leftrightarrow 2Bi^{3+}(aq) + 3S^{2-}(aq)$$

for which the solubility product K_{sp} has the value of 1.6×10^{-72} at room temperature.
   a) At room temperature, how many moles of Bi_2S_3 will dissolve in 3.091×10^6 liters of water?
   b) How many Bi^{3+} ions will be found in the solution described in part (a)?

18. Calculating solubility

a) Strontium fluoride, SrF_2, has a K_{sp} value in water of 2.45×10^{-9} at room temperature. Calculate the solubility of SrF_2 in water. Express your answer in units of molarity.
b) Calculate the solubility of SrF_2 in 0.03 M NaF (aq). Express your answer in units of molarity. Assume that NaF is completely dissociated in water.

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