A.P. Chemistry Practice Problems- Part B

IMFs ( Ch 11)

1. Which type of IMF operates between
	1. All molecules?
	2. Polar molecules?
	3. The hydrogen atom of a polar bond and a nearby small electronegative atom?
2. What type of IMFs must be overcome to convert each of the following from a liquid or solid to a gas:
	1. I2
	2. CH3CH2OH
	3. H2Se
3. Propyl alcohol (CH3CH2CH2OH) and isopropyl alcohol [(CH3)2CHOH], whose models are shown below have boiling points of 97.2°C and 82.5°C, respectively. Explain why the boiling point of propyl alcohol is higher, even though both have the molecular formula C3H8O.

 

propyl alcohol isopropyl alcohol

Solids and Liquids (Ch 11)

1. Why do surface tension and viscosity decrease when the temperature increases?
2. Distinguish between cohesive and adhesive forces. What adhesive and cohesive forces are involved when a paper towel absorbs water?
3. Label the phase change diagram. Solid, liquid, gas, melting/freezing, evaporating/condensing, heat of vaporization, heat of fusion.



1. True or false:
	1. CBr4 is more volatile than CCl4.
	2. CBr4 has a higher boiling point than CCl4.
	3. CBr4 has weaker IMFs than CCl4.
	4. CBr4 has a higher vapor pressure at the same temperature than CCl4.
2. What kinds of attractive forces exist between the particles in
	1. Molecular crystals
	2. Covalent-network crystals
	3. Ionic crystals
	4. Metallic crystals
3. What type of crystal (See #77) make up each of the following solids?
	1. CaCO3 d. C12H22O11 (table sugar)
	2. Pt e. benzene, C6H6
	3. ZrO2 (melting pt = 2677°C)

Solutions (Ch 13)

1. Use the solubility curve below to answer these questions.
	1. If you add 50g of KNO3 to 100g of water 40°C, is the solution unsaturated, saturated, or supersaturated?
	2. If you added 30g of KClO3 to 100 g of water at 70°C, is the solution unsaturated, saturated, or supersaturated?
	3. What is the solubility of NaCl in 100g of water at 10°C?



1. Which is more likely to be soluble in hexane, C6H14. Why?:
	1. CCl4 or CaCl2
	2. Benzene (C6H6) or glycerol (CH2(OH)CH(OH)CH2OH
2. A sulfuric acid solution containing 571.6g of H2SO4 per liter of solution. What is the molarity of the solution?
3. Ascorbic acid (Vitamin C, C6H8O6) is a water-soluble vitamin. A solution containing 80.5g of ascorbic acid is dissolved in 210g of water has a density of 1.22g/mL. What is the molarity?

Kinetics (ch 14)

1. The rate of disappearance of HBr was measured for the following reaction:

CH3OH (aq) + HBr (aq) 🡪 CH3Br (aq) + H2O (l)

The following data were collected.

Time (min.) [HBr] (M)

0.0 1.85

54.0 1.58

107.0 1.36

215.0 1.02

430.0 0.580

* 1. Calculate the average rate of reaction, in M/min, for the time interval between each measurement.
	2. Graph [HBr] versus time, and determine the instantaneous rates in M/min at t = 75.0 min and t = 250.0 min.
1. Consider the following reaction: 2NO(g) + 2H2(g) 🡪 N2(g) + 2H2O(g)
	1. The rate law for this reaction is first order in H2 and second order in NO. Write the rate law.
	2. If the rate constant for this reaction at 1000K is 6.0 × 104 M-2s-1, what is the rate of the reaction when [NO] is 0.035M and [H2] is 0.015M?
2. The iodide ion reacts with the hpochlorite ion in the following way: OCl- + I- 🡪 OI- + Cl-. The rapid reaction gives the following data:

[OCl-] [I-] Rate (M/s)

0.0015 0.0015 0.000136

0.0030 0.0015 0.000272

0.0015 0.0030 0.000272

* 1. Write the rate law for this reaction.
	2. Calculate the rate constant.
	3. Calculate the rate when [OCl-] = 2.0 × 10-3M and [I-] = 5.0 × 10-4M
1. The gas phase decomposition of NO2, 2NO2(g) 🡪 2NO(g) + O2(g), is studied at 383°C. The following information is given:

Time (s) [NO2](M)

0 0.100

5.0 0.017

10.0 0.0090

15.0 0.0062

20.0 0.0047

* 1. Is the reaction first or second order with respect to the concentration of NO2?
	2. What is the value of the rate constant?
1. A certain first order reaction has a rate constant of 2.75 × 10-2s-1 at 20°C. What is the value of the k at 60°C if Ea = 75.5kJ/mol?
2. The following mechanism has been proposed for the gas phase reaction of H2 with ICl:

H2 (g) + ICl(g) 🡪 HI(g) + HCl(g)

HI(g) + ICl(g) 🡪 I2(g) + HCl(g)

* 1. Write the balanced equation for the overall reaction.
	2. Identify any intermediates.
	3. Write the rate laws for each elementary reaction in the mechanism.
	4. If the first step is slow and the second one is fast, what rate law do you expect to be observed for the overall reaction?
1. Given the following proposed mechanism:

Step 1: 2NO <-> N2O2 fast

Step 2: N2O2 + H2 🡪 N2O + H2O slow

Step 3: N2O + H2 🡪 N2 + H2O fast

* 1. Determine the overall reaction.
	2. What are the intermediates in this mechanism>
	3. Determine the rate law.
	4. What is the molecularity of the rate-determining step?

Equilibrium (ch 15)

1. When the following reactions come to equilibrium, does the equilibrium mixture contain mostly reactants or products?
	1. N2(g) + O2(g) 🡪 2NO(g) Kc = 1.5 × 10-10
	2. 2SO2(g) + O2(g) 🡪 2SO3(g) Kp = 2.5 × 109
2. A mixture of 0.10mol of NO, 0.050mol of H2, and 0.10mol of H2O is placed in a 1.0L vessel at 300K. The following equilibrium is established:

2NO(g) + 2H2(g) <-> N2(g) + 2H2O(g)

At equilibrium [NO] is 0.062M.

* 1. Calculate the equilibrium concentrations of H2, N2, and H2O.
	2. Calculate Kc.
1. For the equilibrium 2NO(g) <-> N2(g) + O2(g) at 2000°C, Kc = 2.4 × 103. If the initial concentration of NO is 0.200M, what are the equilibrium concentrations of NO, N2, and O2?
2. Consider the following equilibrium, for which ΔH < 0: 2SO2(g) + O2(g) <-> 2SO3(g). How will each of these changes affect the equilibrium?
	1. O2 gas is added to the system.
	2. The reaction mixture is heated.
	3. The volume of the reaction vessel is doubled.
	4. A catalyst is added to the mixture.
	5. The total pressure of the system is increased by adding a noble gas.
	6. SO3(g) is removed from the system.

Acid/Base Equilbrium

1. Complete the following table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **[H+]** | **[OH-]** | **pH** | **pOH** | **acidic or basic?** |
| **7.5 × 10-3** |  |  |  |  |
|  | **3.6 × 10-10** |  |  |  |
|  |  | **8.25** |  |  |
|  |  |  | **5.70** |  |

1. Name the 7 strong acids and 8 strong bases. What makes them strong?
2. Saccharin, a sugar substitute, is a weak acid with a Ka = 0.00479. It ionized in aqueous solution as follows: HNC7H4SO3(aq) <-> H+(aq) + NC7H4SO3-(aq)

What is the pH of a 0.10M solution of this substance?