Chem 112 – 2020 Section 1 Vining

Practice Exam #2

**1.** For a reaction to actually occur, it must be favored by:

a. thermodynamics c. either thermodynamics or kinetics

b. kinetics d. both thermodynamics and kinetics

**2.** a) Is the salt MgSO4 more soluble in water at 5 oC or at 35 oC?

 a) more soluble

 b) less soluble

 c) more information is needed, and that information is: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 b) Describe the states of CO2 solubility for a bottle of Diet Coke:

 i) before it is open: saturated unsaturated supersaturated

 ii) just after opening: saturated unsaturated supersaturated

 iii) after going “flat”: saturated unsaturated supersaturated

 iv) in which state is the solubility of CO2 greater: before opening or after opening

**3.** Of the following compounds, which are expected to be highly soluble in water? Circle all that apply.

CF4 CH3OH SH2 CH3CH3

**4.** Soap is composed of surfactant molecules. Surfactant molecules are:

a) hydrophilic b) hydrophobic c) both hydrophilic and hydrophobic

**5.** What is the primary reason water and oil do not mix?

a) if they did, many strong hydrogen bonds would need to be broken

b) in order to do so, the water would need to first be vaporized, which requires too much energy

c) if they did, the entropy of water would decrease markedly

d) the intermolecular forces between the nonpolar molecules are too strong

**6.** The reaction NH4NCO 🡪 (NH2)2CO was performed and data obtained for the concentration of NH4NCO over time. The following plots were made from the data.



What is the order of the reaction with respect to NH4NCO?

 a. zero order b. first order c. second order d. cannot be determined from the plots alone

**7.** Write the equilibrium constant expression for each reaction:

P4(g) + 6 Cl2(g)  4 PCl3(g)

 NH3(g) + H2S(g)  NH4HS(s)

**8.** The equilibrium 2 SO2Cl2(g)  2 SO2(g) + 2 Cl2(g) has an equilibrium constant of K = 22.6. What is the value of K for the equilibrium written as: SO2(g) + Cl2(g)  SO2Cl2(g)?

 (a) 22.6 (b) 0.0442 (c) 511 (d) 0.00196 (e) 0.210

**9.** The following reaction is 2nd–order in NO2 in and zero–order in CO. Write the rate law for the reaction.

 NO2 + CO  NO + CO2 Rate = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**10.** Two mechanisms are proposed for the reaction,

 (CH3)2C=CH2 + H2O 🡪 (CH3)3COH

Mechanism A: Step 1. (CH3)2C=CH2 + H2O 🡪 (CH3)3COH

Mechanism B: Step 1. (CH3)2C=CH2 + H+ 🡪 (CH3)3C+ (slow)

 Step 2. (CH3)3C+ + H2O 🡪 (CH3)3COH + H+ (fast)

The experimentally determined rate law is: Rate = k[(CH3)2C=CH2][H+]

Which mechanism is supported by the experimental evidence?

a. Mechanism A b. Mechanism B c. neither mechanism d. both mechanisms

**11.** Initial rate data was found for the following reaction:

2 UO2+ + 4 H+ U4+ + UO22+ + 2 H2O



What is the rate law for the reaction?

a. rate = k[UO2+][H+] c. rate = k[UO2+]2[H+]

b. rate = k[UO2+]2[H+]4 d. rate = k[UO2+][H+]/[U4+][ UO22+]

**12.** Using the reaction coordinate diagram below, determine the activation energy and type of enthalpy change for the reaction.



a. Ea = 392 kJ, endothermic c. Ea = 411 kJ, endothermic

b. Ea = 392 kJ, exothermic d. Ea = 411 kJ, exothermic

**13.** The following mechanism is proposed for a reaction:

Step 1: NO2Cl 🡪 NO2 + Cl

Step 2: Cl + NO2Cl 🡪 NO2 + Cl2

Write the overall reaction: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the molecularity of Step 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Give formulas of intermediates (if none, enter “none): \_\_\_\_\_\_\_\_\_\_\_\_

Give formulas of catalysts (if none, enter “none): \_\_\_\_\_\_\_\_\_\_\_

**14.** The reaction coordinate diagram for a reaction and its concentration-time curve are shown for the reaction run at 25 oC.

 

 a. draw a curve on the left plot that has a lower activation energy.

 b. draw a curve on the right plot for the reaction run if the activation energy were lower. Label it **L**.

 c. draw a curve on the right plot for the reaction run at lower temperature. Label it **C**.

 d. If the energy of the products (**B** in the left plot) were lower, the reaction rate would be:

faster slower the same

**Long Answer Questions: Show Your Work**

**15.** A reaction has the following measured rate constants at two temperatures.

k = 22.0 s-1 at 270 K

k = 54.0 s-1 at 300 K

What is the activation energy?

 Ea = \_\_\_\_\_\_\_\_\_ kJ

**16.** Consider the system, 2 CH2Cl2(g)  CH4(g) + CCl4(g), which has an equilibrium constant of

 K = 2.4. If a system has:

 [CH2Cl2] = 0.22 M

 [CH4] = 1.64 M

 [CCl4] = 0.58 M

 What is the value of Q? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Then choose what will happen:

(a) the system is at equilibrium

 (b) the system is not at equilibrium and will react to form more CH2Cl2

 (c) the system is not at equilibrium and will react to form more CH4 and CCl4

**17.** The half-life of U-238 is 4.5 x 109 years. When U-238 decays it undergoes a series of reactions to form Pb-207.

 238U 🡪 🡪 🡪 207Pb

If a rock is found that contains 0.384 g U-238 and 0.122 g Pb-207. If we assume that all the Pb-207 originated by decay of the uranium, how old is the rock?

You can assume the molar masses of the isotopes equal their mass numbers.

 age = \_\_\_\_\_\_\_\_\_\_\_ years

**18.** What is the conjugate base of H2PO4-?

 (a) H3PO4 (b) HPO42- (c) 2 HPO2 (d) PO43-

**19.** Write the formulas of Write the formulas of

 common strong acids: common strong bases:

**20.** Calculate the following for a solution that has a pH of 4.68?

[H3O+] = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol/L

[OH- ] = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ mol/L

pOH = \_\_\_\_\_\_\_\_

**21.** What is the pH of a 0.00248 M solution of Ba(OH)2?

 What is the pH of a 4.8 x 10-4 M solution of HNO3?

 What is the pH of a 3.0 M solution of HCl?

Equations and Constants





pH = -log[H3O+]

[H3O+] = 10-pH

pOH = -log[OH-]

[OH-] = 10-pOH

Kw = 1.0 x 10‑14 at 25 oC