CHM 1001 General Chemistry

Assignment 4

- 20 multiple-choice questions + 4 short answer questions.
- There is only one correct answer for each multiple-choice question.
- Please write your answers in the Assignment Answers Template, which is uploaded with the assignment.
- Upload your answer into Blackboard before the deadline, you can write directly in the template, or by hand and scan it into an electronic version.
- No late submission is allowed.

Deadline: 11:59 pm, Nov 15st (UTC+8)

Chapter13:

1. Which of the following aqueous solutions will have the highest boiling point?

A) 0.10 m Na_2SO_4

B) 0.20 m glucose

C) 0.25 m sucrose

D) 0.10 m NaCl

E) 0.10 m $SrSO_4$

2. In a saturated solution of a salt in water, _____.

A) the rate of crystallization > the rate of dissolution

B) the rate of dissolution > the rate of crystallization

C) seed crystal addition may cause massive crystallization

D) the rate of crystallization = the rate of dissolution

E) addition of more water causes massive crystallization

3. A solution with a concentration higher than the solubility is _____.

A) not possible

B) unsaturated

C) supercritical

D) saturated

E) supersaturated

4. Calculate the molarity of phosphoric acid (H_3PO_4) in a 22.1% (by mass) aqueous solution.

A) 0.0522 m

B) 0.0992 m

C) 0.0248 m

D) 0.0496 m

E) The density of the solution is needed to solve the problem.

5. A solution is prepared by dissolving 0.60 g of nicotine (a nonelectrolyte) in water to make 12 mL of solution. The osmotic pressure of the solution is 7.55 atm at 25 °C. The molecular weight of nicotine is _____ g/mol.

A) 28

B) 43

C) 50

D) 160

E) 0.60

Chapter 14

6. The reaction

$$CH_3\text{-}N{\equiv}C \rightarrow CH_3\text{-}C{\equiv}N$$

is a first-order reaction. At 230.3 °C, k = $6.29 \times 10^{-4} s^{-1}$. If $[CH_3{-}N{\equiv}C]$ is 1.00×10^{-3} initially, $[CH_3{-}N{\equiv}C]$ is _____ after 1.000×10^3 s.

A) 5.33×10^{-4}
B) 2.34×10^{-4}
C) 1.88×10^{-3}
D) 4.27×10^{-3}
E) 1.00×10^{-6}

7. As the temperature of a reaction is increased, the rate of the reaction increases because the _____.

A) reactant molecules collide less frequently
B) reactant molecules collide more frequently and with greater energy per collision
C) activation energy is lowered
D) reactant molecules collide less frequently and with greater energy per collision
E) reactant molecules collide more frequently with less energy per collision

8. A catalyst can increase the rate of a reaction _____.

A) by changing the value of the frequency factor (A)
B) by increasing the overall activation energy (E_a) of the reaction
C) by lowering the activation energy of the reverse reaction
D) by providing an alternative pathway with a lower activation energy
E) All of these are ways that a catalyst might act to increase the rate of reaction.

9. The kinetics of the reaction below were studied and it was determined that the reaction rate did not change when the concentration of B was tripled. The reaction is _____ order in B.

$$A + B \rightarrow P$$

A) zero
B) first
C) second
D) third
E) one-half

10. At elevated temperatures, methylisonitrile (CH_3NC) isomerizes to acetonitrile (CH_3CN):

$$CH_3NC\ (g) \rightarrow CH_3CN\ (g)$$

At the start of an experiment, there are 0.200 mol of reactant and 0 mol of product in the reaction vessel. After 25 min, 0.121 mol of reactant (CH_3NC) remain. There are _____ mol of product (CH_3CN) in the reaction vessel.

A) 0.022
B) 0.121
C) 0.200
D) 0.321
E) 0.079

Chapter 15

11. At equilibrium, _____.

A) all chemical reactions have ceased
B) the rates of the forward and reverse reactions are equal
C) the rate constants of the forward and reverse reactions are equal
D) the value of the equilibrium constant is 1
E) the limiting reagent has been consumed

12 The K_{eq} for the equilibrium below is 7.52×10^{-2} at 480.0 °C.

$$2Cl_2\,(g) + 2H_2O\,(g) \rightleftharpoons 4HCl\,(g) + O_2\,(g)$$

What is the value of K_{eq} at this temperature for the following reaction?

$$2HCl\,(g) + \frac{1}{2}O_2\,(g) \rightleftharpoons Cl_2\,(g) + H_2O\,(g)$$

A) 13.3
B) 3.65
C) -0.0376
D) 5.66×10^{-3}
E) 0.274

13 The equilibrium constant for the gas phase reaction

$$2SO_2\,(g) + O_2\,(g) \rightleftharpoons 2SO_3\,(g)$$

is $K_{eq} = 2.80 \times 10^2$ at 999 K. At equilibrium, _____.

A) products predominate
B) reactants predominate
C) roughly equal amounts of products and reactants are present
D) only products are present

E) only reactants are present

14 Of the following equilibria, only _____ will shift to the right in response to a decrease in volume.

A) H_2 (g) + Cl_2 (g) $\rightleftharpoons$ 2 HCl (g)

B) 2 SO_3 (g) $\rightleftharpoons$ 2 SO_2 (g) + O_2 (g)

C) N_2 (g) + $3H_2$ (g) $\rightleftharpoons$ $2NH_3$ (g)

D) 2 Fe_2O_3 (s) $\rightleftharpoons$ 4 Fe (s) + $3O_2$ (g)

E) 2HI (g) $\rightleftharpoons$ H_2 (g) + I_2 (g)

15 The equilibrium constant (K_p) for the interconversion of PCl_5 and PCl_3 is 0.0121:

$$PCl_5\ (g) \rightleftharpoons PCl_3\ (g) + Cl_2\ (g)$$

A vessel is charged with PCl_5 giving an initial pressure of 0.123 atm. At equilibrium, the partial pressure of PCl_3 is _____ atm.

A) 0.0782
B) 0.0455
C) 0.0908
D) 0.0330
E) 0.123

16 A solution is prepared by dissolving 10.0 g of benzene (C_6H_6) in 282 g of carbon tetrachloride (CCl_4). The concentration of benzene in this solution is _____ molal. The molar masses of C_6H_6 and CCl_4 are 78.1 g/mol and 154 g/mol, respectively.

A) 4.54×10^{-4}
B) 0.454
C) 0.0654
D) 0.0342
E) 3.42

17. Calculate the freezing point of a 0.09500 m aqueous solution of glucose. The molal freezing-point-depression constant of water is 1.86 °C/m.

A) 0.0475

B) 0.106

C) -0.0562

D) -0.177

E) -0.354

18.The elementary reaction

$$2NO_2\,(g) \rightarrow 2NO\,(g) + O_2\,(g)$$

is second order in NO_2 and the rate constant at 660 K is 5.23 $M^{-1}s^{-1}$. The reaction half-life at this temperature when $[NO_2]_0$ = 0.45 M is _____ s.

A) 2.4

B) 7.6

C) 0.19

D) 0.13

E) 0.42

19. The reaction

$$2NOBr\,(g) \rightarrow 2\,NO\,(g) + Br_2\,(g)$$

is a second-order reaction with a rate constant of 0.80 $M^{-1}s^{-1}$ at 11 °C. If the initial concentration of NOBr is 0.0440 M, the concentration of NOBr after 6.0 seconds is _____.

A) 0.0276 M

B) 0.0324 M

C) 0.0363 M

D) 0.0348 M

E) 0.0402 M

20.Consider the following chemical reaction:

$$CO\,(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

At equilibrium in a particular experiment, the concentrations of CO and H_2 were 0.15 M and 0.36, M respectively. What is the equilibrium concentration of CH_3OH? The value of K_{eq} for this reaction is 14.5 at the temperature of the experiment.

A) 14.5

B) 7.61×10^{-3}

C) 2.82×10^{-1}

D) 3.72×10^{-3}

E) 1.34×10^{-3}

Short questions for assignment 4

(1) The solubility of NaCl in water is 35.7 g NaCl/100 g H_2O. Suppose that you have 500.0 g of NaCl. What is the minimum volume of water you would need to dissolve it all? (Given: the density of water is 1.0 g/ml.

(2) The followings are the experimental data for studying the kinetics for the reaction below. Determine the rate law and rate constant for the reaction.

$NO_2 + O_3 \rightarrow NO_3 + O_2$

Experiment	Initial $[NO_2]$ (mol L^{-1})	Initial $[O_3]$ (mol L^{-1})	Initial Rate of Reaction (mol $L^{-1}s^{-1}$)
1	2.3×10^{-5}	3.0×10^{-5}	1.0×10^{-5}
2	4.6×10^{-5}	3.0×10^{-5}	2.1×10^{-5}
3	4.6×10^{-5}	6.0×10^{-5}	4.2×10^{-5}

(3) The decomposition of N_2O_5 is given by the following equation:

$2\ N_2O_5(g) \rightarrow 4\ NO_2(g) + O_2$

The following mechanism is proposed for the above reaction:

Step 1: $N_2O_5 \rightarrow NO_2 + NO_3$
Step 2: $NO_2 + NO_3 \rightarrow NO_2 + NO + O_2$
Step 3: $NO + NO_3 \rightarrow 2\ NO_2$

(a) Does this mechanism plausible as written and provide the correct stoichiometry?
(b) Identify all intermediates in the mechanism
(c) Identify the molecularity of each step in the mechanism

(4) The equilibrium constant for the reaction of Chlorine gas (Cl_2) with phosphorus trichloride (PCl_3) to form phosphorus pentachloride (PCl_5) is 33 at 250°C. If an experiment started with concentrations of 0.050 M PCl_3 and 0.015 M Cl_2, what are the equilibrium concentrations of all three gases? Given:

$$Cl_2\,(g) + PCl_3(g) \rightleftharpoons PCl_5(g)$$