

# 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  $\text{Na}_2\text{SO}_4$
- B) 0.20 m glucose
- C) 0.25 m sucrose
- D) 0.10 m  $\text{NaCl}$
- E) 0.10 m  $\text{SrSO}_4$

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 ( $\text{H}_3\text{PO}_4$ ) in a 22.1% (by mass) aqueous solution.

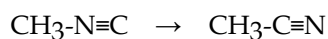
- A) 0.0522 m
- B) 0.0992 m
- C) 0.0248 m
- D) 0.0496 m
- E) The density of the solution is needed to solve the problem.

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



is a first-order reaction. At 230.3 °C,  $k = 6.29 \times 10^{-4}\text{s}^{-1}$ . If  $[\text{CH}_3\text{-N}\equiv\text{C}]$  is  $1.00 \times 10^{-3}$  initially,

$[\text{CH}_3\text{-N}\equiv\text{C}]$  is \_\_\_\_\_ after  $1.000 \times 10^3$  s.

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

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 \_\_\_\_\_.

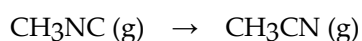
- A) by changing the value of the frequency factor (A)
- B) by increasing the overall activation energy ( $E_a$ ) of the reaction
- C) by lowering the activation energy of the reverse reaction
- D) by providing an alternative pathway with a lower activation energy
- E) All of these are ways that a catalyst 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) zero
- B) first
- C) second
- D) third
- E) one-half

10. At elevated temperatures, methylisonitrile ( $\text{CH}_3\text{NC}$ ) isomerizes to acetonitrile ( $\text{CH}_3\text{CN}$ ):



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 ( $\text{CH}_3\text{NC}$ ) remain. There are \_\_\_\_\_ mol of product ( $\text{CH}_3\text{CN}$ ) in the reaction vessel.

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

## Chapter 15

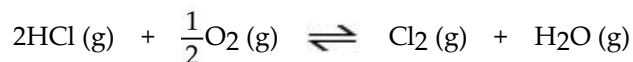
11. At equilibrium, \_\_\_\_\_.

- 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  $K_{\text{eq}}$  for the equilibrium below is  $7.52 \times 10^{-2}$  at  $480.0^\circ\text{C}$ .

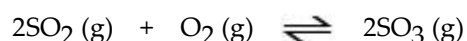


What is the value of  $K_{\text{eq}}$  at this temperature for the following reaction?



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

13 The equilibrium constant for the gas phase reaction

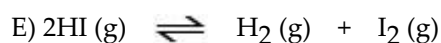
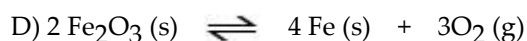
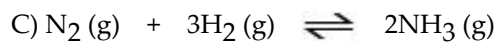
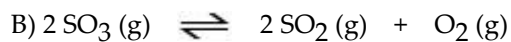
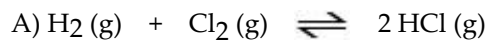


is  $K_{\text{eq}} = 2.80 \times 10^2$  at 999 K. At equilibrium, \_\_\_\_\_.

- 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.



15 The equilibrium constant ( $K_p$ ) for the interconversion of  $\text{PCl}_5$  and  $\text{PCl}_3$  is 0.0121:



A vessel is charged with  $\text{PCl}_5$  giving an initial pressure of 0.123 atm. At equilibrium, the partial pressure of  $\text{PCl}_3$  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 ( $\text{C}_6\text{H}_6$ ) in 282 g of carbon

tetrachloride ( $\text{CCl}_4$ ). The concentration of benzene in this solution is \_\_\_\_\_ molal. The

molar masses of  $\text{C}_6\text{H}_6$  and  $\text{CCl}_4$  are 78.1 g/mol and 154 g/mol, respectively.

A)  $4.54 \times 10^{-4}$

B) 0.454

C) 0.0654

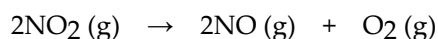
D) 0.0342

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

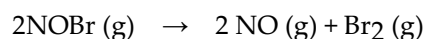


is second order in  $\text{NO}_2$  and the rate constant at 660 K is  $5.23 \text{ M}^{-1}\text{s}^{-1}$ . The reaction half-life at

this temperature when  $[\text{NO}_2]_0 = 0.45 \text{ M}$  is \_\_\_\_\_ s.

- A) 2.4
- B) 7.6
- C) 0.19
- D) 0.13
- E) 0.42

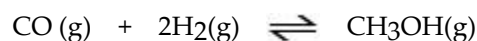
19. The reaction



is a second-order reaction with a rate constant of  $0.80 \text{ M}^{-1}\text{s}^{-1}$  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:



At equilibrium in a particular experiment, the concentrations of CO and  $\text{H}_2$  were 0.15 M and 0.36 M respectively. What is the equilibrium concentration of  $\text{CH}_3\text{OH}$ ? The value of  $K_{\text{eq}}$  for this reaction is 14.5 at the temperature of the experiment.

- A) 14.5
- B)  $7.61 \times 10^{-3}$

C)  $2.82 \times 10^{-1}$

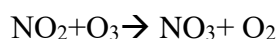
D)  $3.72 \times 10^{-3}$

E)  $1.34 \times 10^{-3}$

#### Short questions for assignment 4

(1) The solubility of NaCl in water is 35.7 g NaCl/100 g H<sub>2</sub>O. 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.

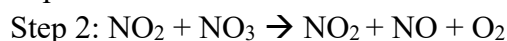
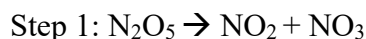


Experiment	Initial [NO <sub>2</sub> ] (mol L <sup>-1</sup> )	Initial [O <sub>3</sub> ] (mol L <sup>-1</sup> )	Initial Rate of Reaction (mol L <sup>-1</sup> s <sup>-1</sup> )
1	$2.3 \times 10^{-5}$	$3.0 \times 10^{-5}$	$1.0 \times 10^{-5}$
2	$4.6 \times 10^{-5}$	$3.0 \times 10^{-5}$	$2.1 \times 10^{-5}$
3	$4.6 \times 10^{-5}$	$6.0 \times 10^{-5}$	$4.2 \times 10^{-5}$

(3) The decomposition of N<sub>2</sub>O<sub>5</sub> is given by the following equation:



The following mechanism is proposed for the above reaction:



(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 ( $\text{Cl}_2$ ) with phosphorus trichloride ( $\text{PCl}_3$ ) to form phosphorus pentachloride ( $\text{PCl}_5$ ) is 33 at  $250^\circ\text{C}$ . If an experiment started with concentrations of 0.050 M  $\text{PCl}_3$  and 0.015 M  $\text{Cl}_2$ , what are the equilibrium concentrations of all three gases? Given:

