



# Polytechnic Tutoring Center

## Final Exam REVIEW – CM 1003, Fall 2021

**Disclaimer:** This mock exam is only for practice. It was made by tutors in the Polytechnic Tutoring Center and is not representative of the actual exam given by the Academic Department.

The Exam is designed to test concepts, not exact knowledge so please do not worry if some questions seem outside of what you have learned. Watch the solution video when uploaded to see the method of solving each of these problems. The main focus is to understand the approach to problem solving.

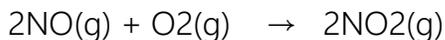
1. Consider the following equilibrium process:



Predict the direction of the shift in equilibrium (right, left, no change) when

- a) the temperature is raised
  - b) more chlorine gas is added to the reaction mixture
  - c) some  $\text{PCl}_3$  is removed from the mixture
  - d) the pressure on the gas is increased
  - e) a catalyst is added to the reaction mixture
2. Glacial acetic acid, pure  $\text{HC}_2\text{H}_3\text{O}_2$ , has a concentration of 17.53M. If 85.5 ml of glacial acetic acid are diluted to 250 ml, what is the acetic acid concentration?
    - a. 4.8M
    - b. 5.2M
    - c. 4.3M
    - d. 6.0M
    - e. 5.6M
  3. If 26 ml of this diluted acid are further diluted to exactly 800ml, the solution pH is 2.74, what is the  $K_a$  for acetic acid
    - a.  $1.7 \times 10^{-5}$
    - b.  $2.4 \times 10^{-4}$
    - c.  $6.1 \times 10^{-5}$
    - d.  $8.2 \times 10^{-4}$
    - e.  $5.7 \times 10^{-5}$
  4. If 13.2g  $\text{NaC}_2\text{H}_3\text{O}_2$  are added to the 800 ml of solution in previous problem, what is the resulting pH?
    - a. 6.6
    - b. 3.6
    - c. 4.5
    - d. 6.8
    - e. 4.8

5. At 430 degree C, an equilibrium mixture consist of 0.020 mole of O<sub>2</sub>, 0.040 mole of NO, and 0.96 mole of NO<sub>2</sub>. What is the K<sub>p</sub> for the reaction, given that the total pressure is 0.20 atm.



- 4.1 E5
  - 3.7 E5
  - 1.5 E5
  - 6.8 E4
  - 4.8 E4
6. Consider the following reaction:
- $$\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \leftrightarrow 2\text{NO}(\text{g})$$
- What is the equilibrium concentration of NO if 4.20M of N<sub>2</sub> and 4.20M of O<sub>2</sub> are added to the reaction flask and the K<sub>c</sub> of the reaction is 0.01?
- .42M
  - .38M
  - .45M
  - .29M
  - .55M
7. A 12.26 g sample of a diprotic acid was dissolved into water. It took 50ml of 5M KOH solution to neutralize the diprotic acid. What is the molar mass of the diprotic acid?
- 98.1 g/mol
  - 73.4 g/mol
  - 120 g/mol
  - 101.2 g/mol
  - 69 h/mol

Consider the following reaction for Questions 8-10:

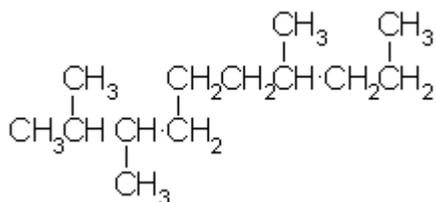
When 75.0mL of 0.100M Na<sub>2</sub>SO<sub>4</sub>(aq) and 25.0mL of 0.200M AgNO<sub>3</sub>(aq) are mixed together in a beaker, a white precipitate is formed. Assume that both solutions are initially at 25°C, and the final volume of the solution is 100.0mL.

8. What is the net ionic equation for the reaction that occurs?
9. What is the limiting reagent in this reaction?
- AgNO<sub>3</sub>
  - Na<sub>2</sub>SO<sub>4</sub>
  - Both are equal, therefore no limited reagent
  - NaNO<sub>3</sub>
  - Ag<sub>2</sub>SO<sub>4</sub>

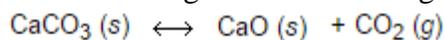
10. What is the theoretical yield in grams for the precipitate formed?

- .72g
- .78g
- .95g
- .39g
- .55g

11. Give the IUPAC name of the following compound:



12. Consider the following reaction and the given data at 1273K:



$$\Delta H_f^\circ = \begin{array}{ccc} -1206.9 & -635.1 & -393.5 \text{ kJ} \end{array}$$

$$\Delta S^\circ = \begin{array}{ccc} 92.9 & 38.2 & 213.7 \text{ J/K} \end{array}$$

What is the value of  $\Delta G^\circ$ , and will the reaction be spontaneous?

- 42.6 kJ, spontaneous
- 24.1 kJ, spontaneous
- 25.1 kJ, nonspontaneous
- 33.2 kJ, nonspontaneous
- 22.7, spontaneous

13. How many structural isomers are there in the alkane  $\text{C}_7\text{H}_{16}$ ?

- 6
- 7
- 8
- 9
- 10

14. Draw the structure of 3-methyl-1,4-pentadiene:

15. A 6.1589 g sample of the solid is placed in an evacuated 4.000 L vessel at exactly 24°C. After equilibrium has been established, the total pressure inside is 0.709 atm. Some solid  $\text{NH}_4\text{HS}$  remains in the vessel. The decomposition of ammonium hydrogen sulfide that is shown below is an endothermic process.



What is the  $K_P$  for the reaction?

- a. .124
  - b. .347
  - c. .865
  - d. .126
  - e. .264
16. For the equilibrium reaction above, what is the percent of solid decomposed?
- a. 63.3%
  - b. 84.2%
  - c. 48.3%
  - d. 47.2%
  - e. 24.9%
17. If the volume of the vessel in Q19 were doubled at constant temperature, what would be the final amount of solid in the vessel?
- a. .035mol
  - b. .004mol
  - c. .009mol
  - d. .064mol
  - e. .041mol
18. A solution of 0.79 g of an organic compound in 250.0 g of benzene has a freezing point of 5.06°C. What are the molality of the solution and the molar mass of the solute? (The freezing point of pure of benzene is 5.50°C.)
- a. 0.0347M, 35.7 g/mol
  - b. 0.0595M, 37.2 g/mol
  - c. 0.0753M, 39.9 g/mol
  - d. 0.0783M, 31.3 g/mol
  - e. 0.0859M, 36.8 g/mol

Consider the data below for the following questions 19 and 20:

A sample of compound with empirical formula  $\text{C}_5\text{H}_4$  has a mass of 9.66g. It is dissolved in 284g of benzene and the freezing point is measured to be 1.37 below the freezing point of pure benzene.

19. What is the molar mass of the compound?
- a. 64 g/mol
  - b. 128 g/mol
  - c. 192 g/mol
  - d. 256 g/mol
  - e. 320 g/mol

20. What is the molecular formula of the compound?
- C<sub>5</sub>H<sub>4</sub>
  - C<sub>10</sub>H<sub>8</sub>
  - C<sub>15</sub>H<sub>12</sub>
  - C<sub>20</sub>H<sub>16</sub>
  - C<sub>25</sub>H<sub>20</sub>
21. The molar enthalpy of vaporization of boron tribromide is 30.5 kJ/mol, and its normal boiling point is 91 degree celsius. What is the vapor pressure of BBr<sub>3</sub> at 20 degree celsius?
- .035atm
  - .047atm
  - .025atm
  - .087atm
  - .71atm
22. At 20.0 degree celsius, the vapor pressure of pure methanol, CH<sub>3</sub>OH =93.3 torr and the vapor pressure of the pure water is 17.5 torr. What is the total vapor pressure in a mixture of 50.0 g CH<sub>3</sub>OH and 25 g H<sub>2</sub>O?
- 57.6 torr
  - 37.9 torr
  - 48.7 torr
  - 64.6 torr
  - 98.4 torr
23. Which solution would have the highest boiling point?
- 0.18 m KCl
  - 0.15 m Na<sub>2</sub>SO<sub>4</sub>
  - 0.12 m Ca(NO<sub>3</sub>)<sub>2</sub>
  - Pure water
  - 0.20 m C<sub>2</sub>H<sub>6</sub>O<sub>2</sub> (ethylene glycol)
24. For the chemical XeF<sub>4</sub>, provide the following information:
- draw the Lewis dot structure.
  - VSEPR class
  - Hybridization
  - Electron pair Geometry
  - Molecular Geometry
  - Bond Angle
  - Polar or nonpolar

25. The isomerization of cyclopropane follows first order kinetics. The rate constant at 700K is  $6.2 * 10^{-4}/min$ , and the half-life at 760 K is 29 min. Calculate the activation energy for this reaction.

*First Order reaction half time* =  $\frac{\ln(2)}{k}$ , time unit for half-life is minute here