Polytechnic Tutoring Center
Final Exam REVIEW – CM 1004, Spring 2020

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.

Choose the best answer for each question. (1 hour)

1. Consider the following equilibrium process:
   $PCl_5(g) \longrightarrow PCL_3(g) + Cl_2(g)$ $\triangle H = 92.5$ KJ/Mol
   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 PCL3 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 $HC_2H_3O_2$, 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 Ka for acetic acid
     a. 1.7 E-5
     b. 2.4 E-4
     c. 6.1 E -5
     d. 8.2 E-4
     e. 5.7 E-5

4. If 13.2g NaC2H3O2 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 O2, 0.040 mole of NO, and 0.96 mole of NO2. What is the Kp for the reaction, given that the total pressure is 0.20 atm.
   $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$
     a. 4.1 E-5
     b. 3.7 E-5
     c. 1.5 E-5
     d. 6.8 E-4

e. 4.8 E-4

6. Consider the following reaction:

$N_2 (g) + O_2 (g) \leftrightarrow 2NO(g)$

What is the equilibrium concentration of NO if 4.20M of N2 and 4.20M of O2 are added to the reaction flask and the Kc of the reaction is 0.01?

a. .40M
b. .38M
c. .45M
d. .29M
e. .55M

7. What is the name of the organic compound:

$CH_2=CH-CH-CH=CH_2$
         |
        CH_3

a. 2-methyl-1,5-pentadiene
b. 3-methyl-1,4-pentadiene
c. 3-methyl-1,4-dipentene
d. 1,2-methyl-4-dipentine
e. 2-methyl-2,3-pentadiene

8. 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?

a. 98.1 g/mol
b. 73.4 g/mol
c. 120 g/mol
d. 101.2 g/mol
e. 69 h/mol

Consider the following reaction for Questions 9-13:

When 75.0mL of 0.100M Na2SO4(aq) and 25.0mL of 0.200M AgNO3(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.

9. What is the net ionic equation for the reaction that occurs?

10. What is the limiting reagent in this reaction?
    a. AgNO3
    b. Na2SO4
    c. Both are equal, therefore no limited reagent
    d. NaNO3
    e. Ag2SO4

11. What is the theoretical yield in grams for the precipitate formed?
    a. .72g

b. .78g
c. .95g
d. .39g
e. .55g

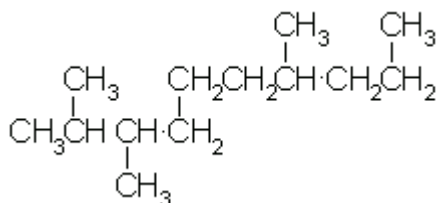12. Given that $\Delta H°f$ for Ag2SO4(s) is -715.2 kJ/mole, calculate the quantity of heat absorbed or released during this reaction.
   a. -0.0443 kJ/mole
   b. -0.0235kJ/mole
   c. -0.0845 kJ/mol
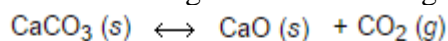   d. -0.0173 kJ/mol
   e. -0.0238 kJ/mol

13. What will be the final temp of the solution, in celsius?
   a. 28.9
   b. 42.6
   c. 21.8
   d. 25.1
   e. 33.2

14. Give the IUPAC name of the following compound:

$$CH_3\text{—}CH\text{·}CH_2$$

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

$$CaCO_3\ (s) \longleftrightarrow CaO\ (s)\ + CO_2\ (g)$$

$\Delta H°_f =$	-1206.9	-635.1	-393.5 kJ
$\Delta S° =$	92.9	38.2	213.7 J/K

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

   a. -42.6 kJ, spontaneous
   b. -24.1 kJ, spontaneous
   c. 25.1 kJ, nonspontaneous
   d. 33.2 kJ, nonspontaneous
   e. -22.7, spontaneous

16. How many structural isomers are there in the alkane C7H16?
   a. 6
   b. 7
   c. 8
   d. 9
   e. 10

17. Draw the structure of 1,3,5-trichlorocyclohexane

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

19. 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 NH4HS remains in the vessel. The decomposition of ammonium hydrogen sulfide that is shown below is an endothermic process.

    NH4HS(s) <-> NH3(g) + H2S(g)
    What is the KP for the reaction?
    a. .124
    b. .347
    c. .865
    d. .126
    e. .264

20. 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%

21. 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

22. 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:

A sample of compound with empirical formula C5H4 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.

23. 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
24. What is the molecular formula of the compound?
    a. C5H4
    b. C10H8
    c. C15H12
    d. C20H16
    e. C25H20
25. 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 BBr3 at 20 degree celsius?
    a. .035atm
    b. .047atm
    c. .025atm
    d. .087atm
    e. .71atm
26. At 20.0 degree celsius, the vapor pressure of pure methanol, CH3OH =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 CH3OH and 25 g H2O?
    a. 57.6 torr
    b. 37.9 torr
    c. 48.7 torr
    d. 64.6 torr
    e. 98.4 torr
27. Which solution would have the lowest boiling point?
    a) 0.18 m KCl
    b) 0.15 m Na2SO4
    c) 0.12 m Ca(NO3)2
    d) Pure water
    e) 0.20 m C2H6O2 (ethylene glycol)