CHEM 1412. Review for Test 1 (chapter 13, 14, 15). Ky75

1. A solution is prepared by adding 40.3 g of $Mg(NO_3)_2$ to 127 g of water. Calculate the mole fraction and molality of magnesium nitrate in this solution.

2. What is the boiling point of an aqueous solution of a nonelectrolyte that has an osmotic pressure of 10.50 atm at 25°C? K_b of water is 0.52°C/m. Assume the density of the solution is the same as that of pure water.
   A) 0.22°C
   B) 0.429°C
   C) 100.43°C
   D) 99.78°C
   E) 100.22°C

3. Which of the following compounds should be soluble in CCl_4?
   A) NaCl
   B) H_2O
   C) NaOH
   D) C_8H_{18}
   E) None of these

4. Arrange the following aqueous solutions in order of increasing boiling points: 0.050 m $Mg(NO_3)_2$; 0.100 m ethanol; 0.090 m NaCl.
   A) $Mg(NO_3)_2$ < NaCl < ethanol
   B) ethanol < $Mg(NO_3)_2$ < NaCl
   C) ethanol < NaCl < $Mg(NO_3)_2$
   D) NaCl < ethanol < $Mg(NO_3)_2$
   E) $Mg(NO_3)_2$ < ethanol < NaCl

5. The density of a 20.3 M CH_3OH (methanol) solution is 0.858 g/mL. What is the molality of this solution? H_2O is the solvent.
   A) 17.4 m
   B) 20.8 m
   C) 23.7 m
   D) 70.0 m
   E) 97.6 m

6. Explain the following, on the basis of osmosis or osmotic pressure: When sprinkled with sugar, a dish of sliced fruit will form its own juice.

7. What is the mass percent CH_3OH of a 0.256 m $CH_3OH(aq)$ solution.
   A) 0.814 %
   B) 0.992 %
   C) 1.23 %
   D) 1.29 %
   E) 1.51 %

8. 0.102 g of an unknown compound dissolved in 100. mL of water has an osmotic pressure of 28.1 mmHg at 20°C. Calculate the molar mass of the compound.
   A) 663 g/mol
   B) 0.872 g/mol
   C) 1.15 g/mol
   D) 727 g/mol
   E) 1.10×10^2 g/mol

9. How many grams of water are needed to dissolve 27.8 g of ammonium nitrate NH_4NO_3 in order to prepare a 0.452 m solution?
   A) 769 g
   B) 36.2 g
   C) 100. g
   D) 0.157 g
   E) 157 g

10. The vapor pressure of water at 20°C is 17.5 mmHg. What is the vapor pressure of water over a solution prepared from 2.00×10^2 g of sucrose ($C_{12}H_{22}O_{11}$) and 3.50×10^2 g water?
    A) 0.51 mmHg
    B) 16.0 mmHg
    C) 17.0 mmHg
    D) 18.0 mmHg
    E) 19.4 mmHg

11. Maple syrup is mostly a solution of sucrose in water. Calculate the molality of the syrup if a sample freezes at –0.50°C, assuming the solute is pure sucrose. [For water, K_f is 1.86°C/m.]

12. What is the freezing point of a solution prepared from 50.0 g ethylene glycol ($C_2H_6O_2$) and 85.0 g H_2O? K_f of water is 1.86°C/m.
    A) 17.6°C
    B) –176°C
    C) –1.50°C
    D) 1.50°C
    E) –17.6°C

13. According to Raoult's law, which statement is *false*?
    A) The vapor pressure of a solvent over a solution decreases as its mole fraction increases.
    B) The solubility of a gas increases as the temperature decreases.
    C) The vapor pressure of a solvent over a solution is less than that of pure solvent.
    D) The greater the pressure of a gas over a solution the greater its solubility.
    E) Ionic solutes dissociate in solution causing an enhancement of all colligative properties.

14. A saturated solution
    A) contains more solute than solvent.
    B) contains more solvent than solute.
    C) contains equal moles of solute and solvent.
    D) contains the maximum amount of solute that will dissolve in that solvent at that temperature.
    E) contains a solvent with only sigma bonds and no pi bonds (i.e. only single bonds, with no double or triple bonds).

15. A 100. mL sample of water is taken from the Great Salt Lake, and the water is allowed to evaporate. The salts that remain (mostly NaCl) have a mass of 31.9 g Calculate the original concentration of NaCl, in g per liter, in each water sample.

16. What is the molarity of a solution of 10% by mass cadmium sulfate, $CdSO_4$ (molar mass = 208.46 g/mol) by mass? The density of the solution is 1.10 g/mL.
    A) 0.528 M
    B) 0.436 M
    C) 0.479 M
    D) 0.048 M
    E) 22.9 M

17. What is the percent by mass of sodium phosphate in a 0.142 M Na_3PO_4(aq) solution that has a density of 1.015 g/mL?

18. Explain the following, on the basis of osmosis or osmotic pressure: An effective way to kill a snail or slug in your garden is to sprinkle it with salt.

19. Thyroxine, an important hormone that controls the rate of metabolism in the body, can be isolated from the thyroid gland. If 0.455 g of thyroxine is dissolved in 10.0 g of benzene, the freezing point of the solution is 5.144°C. Pure benzene freezes at 5.444°C and has a K_f of 5.12°C/m. What is the molar mass of thyroxine?

20. For water K_f = 1.86°C/m. Therefore, the freezing points of 1.0 M aqueous KCl and C_2H_5OH (ethanol) solutions are the same.
    A) True
    B) False

21. The solubility of oxygen in lakes high in the Rocky Mountains is affected by the altitude. If the solubility of O_2 from the air is 2.67×10^{-4} M at sea level and 25°C, what is the solubility of O_2 at an elevation of 12,000 ft where the atmospheric pressure is 0.657 atm? Assume the temperature is 25°C, and that the mole fraction of O_2 in air is 0.209 at both 12,000 ft and at sea level.
    A) 1.75×10^{-4} M
    B) 2.67×10^{-4} M
    C) 3.66×10^{-5} M
    D) 4.06×10^{-4} M
    E) None of the above.

22. A 15.00 % by mass solution of lactose ($C_{12}H_{22}O_{11}$, 342.30 g/mol) in water has a density of 1.0602 g/mL at 20°C. What is the molarity of this solution?
    A) 0.03097 M
    B) 0.4133 M
    C) 0.4646 M
    D) 1.590 M
    E) 3.097 M

23. What is the molarity and molality of a solution that is 10.00 % by mass potassium hydrogen carbonate ($KHCO_3$, 100.11 g/mol) and has a density of 1.0650 g/mL?

24. What is the percent CsCl by mass in a 0.711 M CsCl solution that has a density of 1.091 g/mL?
    A) 3.87×10^{-4} %
    B) 3.87×10^{-1} %
    C) 11.0 %
    D) 1.10 %
    E) 6.50×10^{-2} %

25. Aspirin, $C_9H_8O_4$, slowly decomposes at room temperature by reacting with water in the atmosphere to produce acetic acid, $HC_2H_3O_2$, and 2-hydroxybenzoic acid, $C_7H_6O_3$ (this is why old bottles of aspirin often smell like vinegar):

$$C_9H_8O_4 + H_2O \rightarrow HC_2H_3O_2 + C_7H_6O_3$$

Concentration and rate data for this reaction are given below.

[$C_9H_8O_4$] (M)	**[H_2O] (M)**	**Rate (M/s)**
0.0100	0.0200	2.4×10^{-13}
0.0100	0.0800	9.6×10^{-13}
0.0200	0.0200	4.8×10^{-13}

Write the rate law for this reaction and calculate k (be sure to include the correct units).

26. For the hypothetical reaction $A + 3B \rightarrow 2C$, the rate of appearance of C given by $(\Delta[C]/\Delta t)$ may also be expressed as
    A) $\Delta[C]/\Delta t = \Delta[A]/\Delta t$
    B) $\Delta[C]/\Delta t = -(3/2)\,\Delta[B]/\Delta t$
    C) $\Delta[C]/\Delta t = -(2/3)\,\Delta[B]/\Delta t$
    D) $\Delta[C]/\Delta t = -(1/2)\,\Delta[A]/\Delta t$

27. A certain first-order reaction $A \rightarrow B$ is 25% complete in 42 min at 25°C. What is its rate constant?
    A) $6.8 \times 10^{-3}\ min^{-1}$
    B) $8.3 \times 10^{-3}\ min^{-1}$
    C) $3.3 \times 10^{-2}\ min^{-1}$
    D) $-3.3 \times 10^{-2}\ min^{-1}$
    E) $11\ min^{-1}$

28. The rate constant for a certain first-order reaction is 0.40/min. What is the initial rate in mole/L·min, if the initial concentration of the compound involved is 0.50 mol/L?

29. The first-order decomposition of SO_2Cl_2 to sulfur dioxide gas and chlorine gas at 320°C has a half-life of 8.75 hr. If one begins with 600. mmHg of pure SO_2Cl_2 in a 5.00-L flask at 320°C, how long does it take for the total pressure in the flask to rise to 1.000 atm?
    A) 6.45 hr
    B) 11.1 hr
    C) 3.91 hr
    D) 20.3 hr
    E) 6.91 hr

30. The rate constant for the first-order decomposition of C_4H_8 at 500°C is 9.2×10^{-3} s^{-1}. How long will it take for 10.0% of a 0.100 M sample of C_4H_8 to decompose at 500°C?

31. For a second order reaction, the half-life is equal to
    A) $t_{1/2} = 0.693/k$
    B) $t_{1/2} = k/0.693$
    C) $t_{1/2} = 1/k[A]_o$
    D) $t_{1/2} = k$
    E) $t_{1/2} = [A]_o/2k$

32. The activation energy for a certain reaction is 113 kJ/mol. By what factor (how many times) will the rate constant increase when the temperature is raised from 310 K to 325 K?

33. The following initial rate data apply to the reaction below.
    $F_2(g) + 2Cl_2O(g) \rightarrow 2FClO_2(g) + Cl_2(g)$

Expt. #	$[F_2]$ (M)	$[Cl_2O]$ (M)	Initial rate (M/s)
1	0.05	0.010	5.0×10^{-4}
2	0.05	0.040	2.0×10^{-3}
3	0.10	0.010	1.0×10^{-3}

    Which of the following is the rate law (rate equation) for this reaction?
    A) rate = $k[F_2]^2[Cl_2O]^4$
    B) rate = $k[F_2]^2[Cl_2O]$
    C) rate = $k[F_2][Cl_2O]$
    D) rate = $k[F_2][Cl_2O]^2$
    E) rate = $k[F_2]^2[Cl_2O]^2$

34. Chlorine dioxide reacts in basic water to form chlorite and chlorate according to the following chemical equation:

$$2ClO_2(aq) + 2OH^-(aq) \rightarrow ClO_2^-(aq) + ClO_3^-(aq) + H_2O(l)$$

Under a certain set of conditions, the initial rate of disappearance of chlorine dioxide was determined to be 2.30×10^{-1} M/s. What is the initial rate of appearance of chlorite ion under thos same conditions?

A) 5.75×10^{-2} M/s
B) 1.15×10^{-1} M/s
C) 2.30×10^{-1} M/s
D) 4.60×10^{-1} M/s
E) 9.20×10^{-1} M/s

35. At a certain temperature, the data below were collected for the reaction below.
$2ICl + H_2 \rightarrow I_2 + 2HCl$.
Determine the rate law for the reaction.

Initial concentrations (M)		Inital Rate of Formation of I_2
[ICl]	$[H_2]$	mol/L·s
0.10	0.10	0.0015
0.20	0.10	0.0030
0.10	0.050	0.00075

36. A certain first-order reaction $A \rightarrow B$ is 25% complete in 42 min at 25°C. What is the half-life of the reaction?

A) 21 min
B) 42 min
C) 84 min
D) 20 min
E) 101 min

37. The Arrhenius equation is $k = Ae^{-Ea/RT}$. The slope of a plot of ln k vs. 1/T is equal to

A) –k
B) k
C) E_a
D) $-E_a/R$
E) A

38. For the reaction $C_6H_{14}(g) \rightarrow C_6H_6(g) + 4H_2(g)$, $\Delta P(H_2)/\Delta t$ was found to be 2.5×10^{-2} atm/s, where $\Delta P(H_2)$ is the change in pressure of hydrogen. Determine $\Delta P(C_6H_{14})/\Delta t$ for this reaction at the same time.
    A) 2.5×10^{-2} atm/s
    B) -6.2×10^{-3} atm/s
    C) -2.5×10^{-2} atm/s
    D) 0.10 atm/s
    E) 6.2×10^{-3} atm/s

39. At a certain temperature, the data below were collected for the reaction below.
    $2ICl + H_2 \rightarrow I_2 + 2HCl$.
    Determine the rate constant for the reaction.

Initial concentrations (M)		Inital Rate of Formation of I_2
[ICI]	$[H_2]$	mol/L·s
0.10	0.10	0.0015
0.20	0.10	0.0030
0.10	0.050	0.00075

40. The reaction $A + 2B \rightarrow$ products has the rate law, rate = $k[A][B]^3$. If the concentration of B is doubled while that of A is unchanged, by what factor will the rate of reaction increase?
    A) 2
    B) 4
    C) 6
    D) 8
    E) 9

41. The rate law predicted by the following two-step mechanism is rate = k[A][B].
    $A \rightarrow C + B$ *slow*
    $A + B \rightarrow C + E$ *fast*
    A) True
    B) False

42. Calcium carbonate decomposes at high temperatures to give calcium oxide and carbon dioxide.
    $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$
    K_P for this reaction is 1.16 at 800°C. A 5.00 L vessel containing 10.0 g of $CaCO_3(s)$ was evacuated to remove the air, sealed, and then heated to 800°C. Ignoring the volume occupied by the solid, what will be the overall mass percent of carbon in the solid once equilibrium is reached?

43. A solution was prepared such that the initial concentrations of $Cu^{2+}(aq)$ and $CN^{-}(aq)$ were 0.0120 M and 0.0400 M, respectively. These ions react according to the following chemical equation

$Cu^{2+}(aq) + 4CN^{-}(aq) \rightleftharpoons Cd(CN)_4^{2-}(aq)$ $\quad K_c = 1.0 \times 10^{25}$

What will be the concentration of $CN^{-}(aq)$ at equilibrium?

44. For the common allotropes of carbon (graphite and diamond), C(gr) $\rightleftharpoons$ C(dia) with equilibrium constant K = 0.32. The molar volumes of graphite and diamond are, respectively, 5.30 cm^3/mol and 3.42 cm^3/mol; ΔH_f of diamond is 1.90 kJ/mol. This data suggests that the formation of diamond is favored at
    A) low temperatures and low pressures.
    B) high temperatures and low pressures.
    C) low temperatures and high pressures.
    D) high temperatures and high pressures.

45. For the nitrogen fixation reaction $3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g)$, $K_c = 6.0 \times 10^{-2}$ at 500°C. If 0.250 M H_2 and 0.050 M NH_3 are present at equilibrium, what is the equilibrium concentration of N_2?
    A) 0.750 M
    B) 2.7 M
    C) 0.250 M
    D) 0.025 M
    E) 1.85 M

46. At 700 K, the reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ has the equilibrium constant $K_c = 4.3 \times 10^6$, and the following concentrations are present: $[SO_2] = 0.10$ M; $[SO_3] = 10.$ M; $[O_2] = 0.10$ M. Is the mixture at equilibrium? If not at equilibrium, in which direction (as the equation is written), *left to right* or *right to left*, will the reaction proceed to reach equilibrium?
    A) Yes, the mixture is at equilibrium.
    B) No, *left to right*
    C) No, *right to left*
    D) There is not enough information to be able to predict the direction.

47. The equilibrium between carbon dioxide gas and carbonic acid is very important in biology and environmental science.
$CO_2(aq) + H_2O(l) \rightleftharpoons H_2CO_3(aq)$
Which one of the following is the correct equilibrium constant expression (K_c) for this reaction?

A) $K_c = \dfrac{[H_2CO_3]}{[CO_2][H_2O]}$

B) $K_c = \dfrac{[CO_2][H_2O]}{[H_2CO_3]}$

C) $K_c = \dfrac{[H_2CO_3]}{[CO_2]}$

D) $K_c = \dfrac{[CO_2]}{[H_2CO_3]}$

E) $K_c = \dfrac{1}{[H_2CO_3]}$

48. Calculate K_p for the reaction $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$ at 400°C if K_c at 400°C for this reaction is 2.1×10^{-2}.

A) 2.1×10^{-2}
B) 1.7×10^{-3}
C) 0.70
D) 1.2
E) 3.8×10^{-4}

49. Consider the following equilibrium,
$4NH_3(g) + 3O_2(g) \rightleftharpoons 2N_2(g) + 6H_2O(g) + 1531\ kJ$
State whether the concentrations of the reactants would *increase*, *decrease*, or *remain constant* <u>after</u> ammonia was added to the system.

50. Sodium carbonate, $Na_2CO_3(s)$, can be prepared by heating sodium bicarbonate, $NaHCO_3(s)$.
$2NaHCO_3(s) \rightleftharpoons Na_2CO_3(s) + CO_2(g) + H_2O(g)$ $K_p = 0.23$ at 100ºC
If a sample of $NaHCO_3$ is placed in an evacuated flask and allowed to achieve equilibrium at 100ºC, what will the total gas pressure be?

A) 0.46 atm
B) 0.96 atm
C) 0.23 atm
D) 0.48 atm
E) 0.11 atm

51. For the reaction $SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$, the equilibrium constant is 18.0 at 1,200ºC. If 1.0 mole of SO_2 and 2.0 moles of NO_2 are placed in a 20. L container, what concentration of SO_3 will be present at equilibrium?
    A) 0.48 mol/L
    B) 0.11 mol/L
    C) 0.95 mol/L
    D) 2.22 mol/L
    E) 18 mol/L

52. The reaction $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$ is endothermic. If the temperature is increased,
    A) more SO_3 will be produced.
    B) K_c will decrease.
    C) no change will occur in K_c .
    D) K_c will increase.
    E) the pressure will decrease.

53. K_p for the reaction of $SO_2(g)$ with O_2 to produce $SO_3(g)$ is 3×10^{24} . Calculate K_c for this equilibrium at 25ºC. (The relevant reaction is $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$.)
    A) 3×10^{24}
    B) 5×10^{21}
    C) 2×10^{20}
    D) 5×10^{22}
    E) 7×10^{25}

54. K_c for the reaction $CO_2(g) + H_2(g) \rightleftharpoons H_2O(g) + CO(g)$ is 1.6 at about 990ºC. Calculate the number of moles of carbon dioxide in the final equilibrium system obtained by initially adding 1.00 mol of H_2, 2.00 mol of CO_2, 0.750 mol of H_2O, and 1.00 mol of CO to a 5.00 L reactor at 990ºC.

55. K_c for the reaction $CO_2(g) + H_2(g) \rightleftharpoons H_2O(g) + CO(g)$ is 1.6 at about 990ºC. Calculate the number of moles of hydrogen gas in the final equilibrium system obtained by initially adding 1.00 mol of H_2, 2.00 mol of CO_2, 0.750 mol of H_2O, and 1.00 mol of CO to a 5.00 L reactor at 990ºC.

56. Consider the reaction $N_2(g) + 3H_2(g) \leftrightharpoons 2NH_3(g)$. If we use a catalyst, which way will the reaction shift?

57. 15.00 g of solid ammonium hydrogen sulfide is introduced into a 500.-mL flask at 25°C, the flask is sealed, and the system is allowed to reach equilibrium. What is the partial pressure of ammonia in this flask if $K_p = 0.108$ at 25°C for $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$?
    A) 0.657 atm
    B) 1.25 atm
    C) 0.329 atm
    D) 14.4 atm
    E) 2.50 atm

58. 75.0 g of $PCl_5(g)$ is introduced into an evacuated 3.00 L vessel and allowed to reach equilibrium at 250ºC.
    $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
    If $K_p = 1.80$ for this reaction, what is the total pressure inside the vessel at equilibrium?
    A) 2.88 atm
    B) 2.27 atm
    C) 4.54 atm
    D) 7.42 atm
    E) 9.69 atm

59. Hydrogen iodide decomposes according to the equation:
    $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$, $K_c = 0.0156$ at 400ºC
    A 0.660 mol sample of HI was injected into a 2.00 L reaction vessel held at 400ºC. Calculate the concentration of H_2 equilibrium.

60. For the following reaction at equilibrium in a reaction vessel, which one of these changes would cause the Br_2 concentration to *decrease*?
    $2NOBr(g) \rightleftharpoons 2NO(g) + Br_2(g)$, $\Delta H^o_{rxn} = 30$ kJ/mol
    A) Increase the temperature.
    B) Remove some NO.
    C) Add more NOBr.
    D) Compress the gas mixture into a smaller volume.

61. When the reaction $2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$ is carried out at 1065°C, $K_p = 0.012$. Starting with pure H_2S at 1065°, what must the initial pressure of H_2S be if the equilibrated mixture at this temperature is to contain 0.250 atm of $H_2(g)$?
    A) 1.06 atm
    B) 1.86 atm
    C) 0.94 atm
    D) 0.90 atm
    E) 1.52 atm

62. At 340 K, $K_p = 69$ for the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$. 50.0 g of HI is injected into an evacuated 5.00-L rigid cylinder at 340 K. What is the total pressure inside the cylinder when the system comes to equilibrium?
    A) 2.60 atm
    B) 1.76 atm
    C) 0.424 atm
    D) 2.18 atm
    E) 10.9 atm

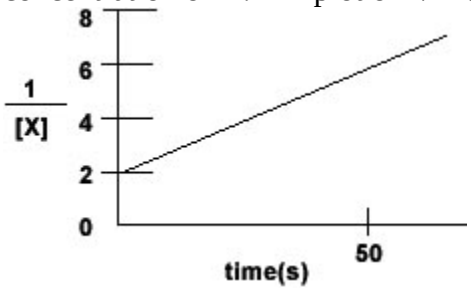
63. Calcium carbonate decomposes at high temperatures to give calcium oxide and carbon dioxide.
    $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$
    K_P for this reaction is 1.16 at 800°C. A 5.00 L vessel containing 10.0 g of $CaCO_3(s)$ was evacuated to remove the air, sealed, and then heated to 800°C. Ignoring the volume occupied by the solid, what will be the mass of the solid in the vessel once equilibrium is reached?

64. 4.21 moles of S_2Cl_4 are introduced into a 2.0 L vessel.
    $S_2Cl_4(g) \rightleftharpoons 2SCl_2(g)$
    At equilibrium, 1.25 moles of S_2Cl_4 are found to remain in the container. Calculate K_c for this reaction.

65. If the reaction $2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$ is carried out at 1065°C, $K_p = 0.0120$. Starting from pure H_2S introduced into an evacuated vessel at 1065°C, what will the total pressure in the vessel be at equilibrium if the equilibrated mixture contains 0.300 atm of $H_2(g)$?
    A) 1.06 atm
    B) 1.36 atm
    C) 2.39 atm
    D) 4.20 atm
    E) 1.51 atm

66. The dissociation of solid silver chloride in water to produce silver ions and chloride ions has an equilibrium constant of 1.8×10^{-18}. Based on the magnitude of the equilibrium constant, is silver chloride very soluble in water? Why?

67. For the reaction $X + Y \rightarrow Z$, the reaction rate is found to depend only upon the concentration of X. A plot of 1/X verses time gives a straight line.



What is the rate law for this reaction?

A) rate = k [X]
B) rate = k $[X]^2$
C) rate = k [X][Y]
D) rate = k $[X]^2$[Y]

68. For the first-order reaction $2N_2O_5 \rightarrow 2N_2O_4 + O_2$ at a particular temperature, the half-life of N_2O_5 is 0.90 hr. What fraction of the initial concentration of N_2O_5 will remain after 2.4 hours?

69. For the first-order reaction, A $\rightarrow$ products, if half of the initial concentration of A reacts in 20 min, then the remaining half will completely react in the next 20 min.

A) True
B) False

70. The rate law for the reaction $H_2O_2 + 2H^+ + 2I^- \rightarrow I_2 + 2H_2O$ is rate = $k[H_2O_2][I^-]$. The following mechanism has been suggested.

$H_2O_2 + I^- \rightarrow HOI + OH^-$ *slow*
$OH^- + H^+ \rightarrow H_2O$ *fast*
$HOI + H^+ + I^- \rightarrow I_2 + H_2O$ *fast*

Identify all intermediates included in this mechanism.

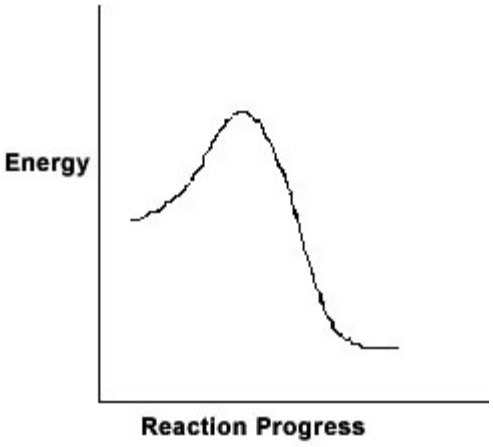
A) H^+ and I^-
B) H^+ and HOI
C) HOI and OH^-
D) H^+ only
E) H_2O and OH^-

71. Substitute natural gas can be synthesized by passing carbon monoxide and hydrogen over Ni or Co at 400°C.

$$CO(g) + 3H_2(g) \xrightarrow[\text{catalyst}]{\text{Ni or Co}} CH_4(g) + H_2O(g)$$

This process is an example of homogeneous catalysis.
A) True
B) False

72. For the chemical reaction system described by the diagram below, which statement is true?



A) The forward reaction is endothermic.
B) The activation energy for the forward reaction is greater than the activation energy for the reverse reaction.
C) At equilibrium, the activation energy for the forward reaction is equal to the activation energy for the reverse reaction.
D) The activation energy for the reverse reaction is greater than the activation energy for the forward reaction.
E) The reverse reaction is exothermic.

73. The isomerization of cyclopropane follows first order kinetics. The rate constant at 700 K is $6.20 \times 10^{-4}\ min^{-1}$, and the half-life at 760 K is 29.0 min. Calculate the activation energy for this reaction.
A) 5.07 kJ/mol
B) 27.0 kJ/mol
C) 50.7 kJ/mol
D) 60. kJ/mol
E) 270. kJ/mol

74. Peroxodisulfate ion can oxidize iodide ions to iodine according to the balanced equation $S_2O_8^{2-} + 2I^- \rightarrow 2SO_4^{2-} + I_2$.
The reaction is catalyzed by certain chemical species. Identify the catalyst in the following mechanism:
step 1: $Fe^{3+} + 2I^- \rightarrow Fe^{2+} + I_2$
step 2: $S_2O_8^{2-} + Fe^{2+} \rightarrow 2SO_4^{2-} + Fe^{3+}$
A) Fe^{3+}
B) I^-
C) $S_2O_8^{2-}$
D) Fe^{2+}
E) SO_4^{2-}

75. An aqueous dextrose solution having a density of 1.04 g/cm^3 freezes at –1.15°C. Find the osmotic pressure of this solution at 25°C. K_f of water is 1.86 °C/m; molecular mass of dextrose = 180.16 g/mol.
A) 13.8 atm
B) 14.1 atm
C) 15.1 atm
D) 12.9 atm
E) 120 atm

Answer Key……CHEM 1412. Review for Test 1 (chapter 13, 14, 15). Ky75

1. mole fraction = 0.0371; molality = 2.14 m
2. E
3. D
4. B
5. E
6. The water inside the fruit cells passes through cell membranes, trying to dilute the sugar on the outside.
7. A
8. A
9. A
10. C
11. 0.27 m
12. E
13. A
14. D
15. 319 g/L
16. A
17. 2.29 %
18. The water leaves the snails cells to dilute the salt, and the snail becomes dehydrated and dies.
19. 777 g/mol
20. B
21. A
22. C
23. 1.064 M and 1.110 m
24. C
25. The rate law is rate = $k[C_9H_8O_4][H_2O]$, and the rate constant is 1.2×10^{-9}.
26. C
27. A
28. 0.20
29. C
30. 11 s
31. C
32. 7.6
33. C
34. B
35. rate = $k[ICl][H_2]$
36. E
37. D
38. B
39. 1.5×10^{-1} L/mol·s
40. D
41. B
42. 5.76% carbon by mass

43. 8.4×10^{-7} M
44. D
45. B
46. B
47. C
48. D
49. decrease
50. B
51. A
52. D
53. E
54. 1.6 mol
55. 0.62 mol
56. Addition of a catalyst will have no effect on the position of the equilibrium.
57. C
58. D
59. 0.033 M
60. D
61. A
62. D
63. 7.1 g of solid
64. $K_c = 14.0$
65. E
66. K_c here will be $[Ag^+(aq)][Cl^-(aq)]$. If K_{eq} is very small, then the concentrations of the dissolved ions must also be small, implying that AgCl is not very soluble.
67. B
68. 0.16
69. B
70. C
71. B
72. D
73. E
74. A
75. B