General Chemistry II, CHE 121-003 Instructor: J. H. Niewahner
Test 1. Chapters 12 & 13 (Chang, 7th ed) January 29, 2002

Name _____

1(06) List the three interactions that are involved when a solute dissolves in a solvent.
a) _____
b) _____
c) _____

2(06) Answer either a) or b)
a) Explain in terms of molecular interactions why ethanol (C_2H_5OH) is not soluble in cyclohexane (C_6H_{12}).
b) A miner working 260 m below sea level opened a carbonated soft drink during a lunch break. To his surprise, the soft drink tasted rather "flat". Shortly afterward, the miner took an elevator to the surface. During the trip up, he could not stop belching. Explain the "flatness" and the "belching".

3(08) Indicate whether increasing the temperature and increasing the pressure will increase (I), decrease (D), or have no effect (NE) on the solubility of most ionic solids and gases in water.

	Effect on Solubility	
	Solids	Gases
a) Increasing the temperature	_____	_____
b) Increasing the pressure	_____	_____

4(08) Use the solubility curve on the right to answer the following:
a) How much KNO_3 dissolves in 100. g H_2O at 100°C? _____
b) How much KNO_3 dissolves in 100. g H_2O in 0°C? _____
c) If 50. g KNO_3 were added to 25.g H_2O, at what temperature would all KNO_3 dissolve? _____
d) How many grams of the 50.g KNO_3 would precipitate at 0°C? _____

5(08) Answer either a) or b)
a) Calculate the molality of a solution that is 48.2% by mass KBr. Show all your work.
b) Calculate the molarity of an NH_3 solution made up of 30.0 g NH_3 in 70.0 g H_2O. The density of the solution is 0.982 g/mL. Show all your work.

6(04) Circle all the solvent-solute pairs that you would expect to behave ideally, that is, obey Henry's Law.
a) CH_3OH, $CH_3CH_2CH_2OH$ b) C_6H_{14}, C_8H_{18} c) CH_3OH, C_6H_{14}

7(10) A solution of 2.50 g of a compound having the empirical formula C_6H_5P in 25.0 g benzene is observed to freeze at 4.3°C. Calculate the molar mass of the solute and its molecular formula. The freezing point depression of benzene is 5.12°C/m and its freezing point is 5.50°C. Show all your work.

8(05) Arrange the following solutions in order of decreasing freezing point (highest freezing point on the left, lowest freezing point on the right):
0.10m Na_3PO_4, 0.35m NaCl, 0.20m $MgCl_2$, 0.15m $C_6H_{12}O_6$, 0.15m CH_3COOH

9(06) The reaction $ClCO_2CCl_3(g) \rightarrow 2\ COCl_2(g)$ was followed by measuring the pressure due to $ClCO_2CCl_3(g)$ during the course of the reaction. A graph of lnP vs. time gave a straight line having a negative slope whereas the graph of 1/P vs time gave a curved line having a positive slope.
a) Write the rate law for the reaction.

b) If the rate of disappearance of $ClCO_2CCl_3(g)$ is 25 mm/min, what would the rate of appearance of $COCl_2$ be? _____

10(14) The rate of the following reaction is monitored by measuring the number of moles of Hg_2Cl_2 that precipitate per liter per minute. The data obtained are listed below.

$$2\ HgCl_2(aq) + C_2O_4^{2-}(aq) \rightarrow 2\ Cl^{1-}(aq) + 2\ CO_2(g) + Hg_2Cl_2(s)$$

Exp. No.	$[HgCl_2(aq)]$, M	$[C_2O_4^{2-}(aq)]$, M	Initial Rate M min^{1-}
1	0.105	0.150	1.8×10^{-5}
2	0.105	0.300	7.1×10^{-5}
3	0.052	0.300	3.5×10^{-5}
4	0.052	0.150	8.9×10^{-6}

a) What is the order in $HgCl_2$? _____
b) What is the order in $C_2O_4^{2-}$? _____
c) Write the rate law. _____
d) Calculate the rate constant. _____
e) What would be the initial rate of reactions if $[HgCl_2] = 0.020M$ and $[C_2O_4^{2-}] = 0.22$ M Show all your work.

11(10) Work either 11A or 11B.

11A. The reaction $2\ H_2(g) + 2\ NO(g) \rightarrow N_2(g) + 2\ H_2O(g)$ was found to follow the rate law $R = k[H_2][NO]^2$. The proposed mechanism is:

$$2\ NO(g) = N_2O_2(g)$$
$$N_2O_2(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g) \quad \text{slow}$$
$$N_2O(g) + H_2(g) \rightarrow N_2(g) + H_2O(g) \quad \text{fast}$$

a) Discuss whether or not the mechanism is consistent with the data.

b) Write the formulas for any intermediates.

c) What is the molecularity of the slow step? _____

11B. The decomposition of dimethylether at 504°C is a first order reaction with $t_{½}$ = 27.0 min.

$$(CH_3)_2O \rightarrow CH_4 + H_2 + CO$$

a) What is the first order rate constant? Include the label. Show your work.

b) What will be the pressure of $(CH_3)_2O$ after 60.0 min if its initial pressure was 626 mm Hg? Show your work.

Some useful equations are:

$kt_{½} = 0.693$

$\ln[A]_t = -kt + \ln[A]_0$

$1/[A]_t = kt + 1/[A]_0$

12(08) Give a one sentence explanation for each of the following.

a) Explain on a molecular level how a catalyst affects the rate of a reaction.

b) Explain why a 10°C rise in temperature usually doubles the rate of a reaction.

13(03) Write the name or formula of the compound associated with the following named reactions.

a) Ostwald Process _____

b) Haber Process _____

c) Contact Process _____

14(04) In a catalytic converter, what are the following substances converted to?

a) CO _____ b) Hydrocarbons _____ c) NO _____