CH 123
General Chemistry

Exam 1
July 8, 2002

Name:_____
(please print)

SSN: * * * - * * -_____
(last 4 digits)

Each question is worth 1 point.
Circle your answer clearly, otherwise no credit will be given.
Circle only one answer. If you circle two or more, you will receive no credit.

1. What is the molality of a 5.45% by weight Na_2SO_4 (molar mass = 142.06 g/mol) solution?
   c. 0.406 m

2. What is the weight percent $FeCl_3$ (molar mass = 162.22 g/mol) in a solution which is 1.84 m?
   e. 23.0%

3. Which of the following solutions would have a freezing point closest to that of a 1 molal solution of $CaCl_2$?
   c. 1 m Na_2SO_4

4. Which of the following would have the highest freezing point?

   e. pure H_2O

5. You need a solution that is 0.15 m in ions. How many grams of $MgCl_2$ (molar mass = 95.2 g/mol) must you dissolve in 400. g of water? (Assume total dissociation of the ionic salt.)
   b. 1.9 g

6. The osmotic pressure of blood is 7.65 atm at 37 ºC. How many grams of glucose ($C_6H_{12}O_6$, molar mass = 180.2 g/mol) are needed to prepare 1.00 liter of a solution for intravenous injection that has the same osmotic pressure as blood?
   e. 56.0 g

7. For the gas phase reaction, $3H_2 + N_2 \rightarrow 2NH_3$, how does the rate of disappearance of H_2 compare to the rate of production of NH_3?
   c. The rate of disappearance of H_2 is 3/2 the rate of appearance of NH_3.

8. The reaction

   $$CH_3CHO(g) \rightarrow CH_4(g) + CO(g)$$

   proceeds via the rate expression $\Delta[CO]/\Delta t = [CH_3CHO]^{3/2}$. What is the overall order of the reaction?
   e. three-halves-order

9. The half-life for a first-order reaction at 550 ºC is 85 seconds. How long would it take for 23% of the reactant to decompose?
   c. 32 seconds

10. The decomposition of phosphine, PH_3, follows first-order kinetics:

    $$4PH_3(g) \rightarrow P_4(g) + 6H_2(g)$$

    The half-life for the reaction at 550 ºC is 81.3 seconds. How long does it take for the reaction to be 78.5% complete?
    e. 180 seconds

11. What is the half-life of a first-order reaction which is 15% complete after 210 seconds?
    e. 895 seconds

12. In basic solution, $(CH_3)_3CCl$ reacts according to the equation

$$(CH_3)_3CCl + OH^- \rightarrow (CH_3)_3COH + Cl^-$$

The accepted mechanism for the reaction is

$$(CH_3)_3CCl \rightarrow (CH_3)_3C^+ + Cl^- \text{ (slow)}$$
$$(CH_3)_3C^+ + OH^- \rightarrow (CH_3)_3COH \text{ (fast)}$$

What is the rate law expression for the reaction?

d. rate = $k[(CH_3)_3CCl]$

13. Calculate the activation energy, Eº, for

$$N_2O_5(g) \rightarrow 2NO_2(g) + 1/2\ O_2(g)$$

given k (at 25 ºC) = 3.46×10^{-5}/s and k (at 50 ºC) = 1.10×10^{-3}/s.

b. 111 kJ

14. In which case does the reaction go farthest to completion?

a. $K = 10^4$

15. For the reaction below, what is the expression for K_C?

$$2H_2(g) + 2FeO(s) \leftrightarrow 2Fe(s) + 2H_2O(g)$$

d. $K_C = [H_2O]^2/[H_2]^2$

16. Consider the reaction $2A(g) \leftrightarrow B(g)$ where $K_C = 0.5$ at the temperature of the reaction. If 2.0 moles of A and 2.0 moles of B are introduced into a 1.00 liter flask, what change in concentrations (if any) would occur in time?
e. [A] and [B] remain the same

17. Consider the reaction $A(g) \leftrightarrow 2B(g)$ where $K_c = 1.5$ at the temperature of the reaction. If 3.0 moles of A and 3.0 moles of B are introduced into a 1.00 liter flask, what change in concentrations (if any) would occur in time?
b. [A] increases and [B] decreases

18. Exactly 0.50 mole of sulfur trioxide, 0.10 mole of sulfur dioxide, 0.20 mole of nitrogen monoxide and 0.30 mole nitrogen dioxide are sealed in a 1.0-L flask at 1500 ºC. The equilibrium constant K_C is 0.24 for the following reaction.

$$SO_3(g) + NO(g) \leftrightarrow SO_2(g) + NO_2(g) \qquad K_C = 0.24$$

When equilibrium is achieved, what changes in concentrations of SO_3 and NO will be observed?
a. [SO_3] increases; [NO] increases

19. A flask contains the following system at equilibrium:

$$Mg(OH)_2(s) \leftrightarrow Mg^{2+}(aq) + 2\ OH^-(aq)$$

Which of the following reagents could be added to increase the solubility of $Mg(OH)_2$?

c. HCl

20. For the equilibrium system

$$H_2O(g) + CO(g) \leftrightarrow H_2(g) + CO_2(g) \quad \Delta H = -42 \text{ kJ/mol}$$

K equals 0.62 at 1260 K. If 0.10 mol each of H_2O, CO, H_2 and CO_2 (all at 1260 K) were placed in a 1.0 L thermally insulated vessel which was also at 1260 K, then when the system came to equilibrium

a. the temperature would decrease and the mass of CO would increase.