CH 123
General Chemistry

Exam 1
January 22, 2003

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. An aqueous solution of calcium bromide has a concentration of 0.441 molal. The percent by mass of calcium bromide in the solution is:

   a. 5.00%
   b. 8.10%
   c. 10.10%
   d. 12.15%
   e. 16.20%

2. The melting point of ethanol CH_3CH_2OH is -117.300 ^{0}C at 1 atmosphere (K_f(ethanol) = -1.99 ^{0}C/m). In a laboratory experiment, students synthesized a new compound and found that when 10.60 grams of the compound were dissolved in 241.0 grams of ethanol, the solution began to melt at -117.778 ^{0}C. The compound was also found to be nonvolatile and a non-electrolyte. What is the molecular weight they determined for this compound?

   a. 78 g/mol
   b. 91 g/mol
   c. 183 g/mol
   d. 266 g/mol
   e. 312 g/mol

3. For the decomposition of ammonia on a platinum surface at 856 ^{o}C

   $$2\ NH_3 \longrightarrow N_2 + 3\ H_2$$

   the average rate of disappearance of NH_3 over the time period from t = 0 s to t = 4746 s is found to be 1.50e-6 M s^{-1}. The average rate of formation of H_2 over the same time period is:

   a. $1.00•10^{-6}$ M s^{-1}
   b. $1.50•10^{-6}$ M s^{-1}
   c. $2.25•10^{-6}$ M s^{-1}
   d. $4.50•10^{-6}$ M s^{-1}
   e. $1.50•10^{-5}$ M s^{-1}

4. The gas phase decomposition of nitrogen dioxide at 383 ^{o}C

   $$2\ NO_2 \longrightarrow 2\ NO + O_2$$

   is second order in NO_2 with a rate constant of 0.540 $M^{-1}s^{-1}$. If the initial concentration of NO_2 is $8.76•10^{-2}$ M, the concentration of NO_2 will be $2.19•10^{-2}$ M after how many seconds?

   a. 15.4 s
   b. 31.7 s
   c. 63.4 s
   d. 126.8 s
   e. 160.2 s

5. What is the mol fraction Na_2SO_4 in a solution which is 11.5% by weight Na_2SO_4 (molar mass Na_2SO_4 = 142.06 g/mol and H_2O = 18.016 g/mol)?

   a. 0.0810
   b. 0.0914
   c. 0.0745
   d. 0.0173
   e. 0.0162

6. If the mol fraction NaCl in a solution is 0.0175, what is the weight percent NaCl (molar mass NaCl = 58.44 g/mol and H_2O = 18.016 g/mol)?

   a. 5.46%
   b. 5.77%
   c. 10.2%
   d. 11.5%
   e. 17.7%

7. What is the mol fraction $NaNO_3$ in a solution which is 2.15 m?

   a. 0.0180
   b. 0.0268
   c. 0.0373
   d. 0.09387
   e. 0.0785

8. A 1.34 M $NiCl_2$ (molar mass = 129.6 g/mol) solution has a density of 1.12 g/cm^3. What is the weight percent $NiCl_2$ of the solution?

   a. 1.73%
   b. 8.64%
   c. 15.5%
   d. 25.4%
   e. 29.8%

9. A volumetric flask is necessary for the preparation of which one of the following concentration measurements?

   a. molality
   b. *X*
   c. mass %
   d. molarity
   e. ppm

10. Which of the following solutions would have the lowest vapor pressure?

a. 1 m glucose ($C_6H_{12}O_6$)
b. 1 m $MgCl_2$
c. 1 m $NaNO_3$
d. 1 m NaBr
e. pure H_2O

11. In general, as the temperature increases, the rate of a chemical reaction

a. increases due to an increased activation energy.
b. increases only for an endothermic reaction.
c. increases due to a greater number of effective collisions.
d. increases because bonds are weakened.
e. is not changed.

12. If the activation energy for the forward reaction of a given process is +110 kJ and the activation energy for the reverse reaction of the same process is +60.0 kJ, then the energy change for the overall process is

a. -50 kJ
b. +50 kJ
c. -170 kJ
d. +170 kJ
e. -60 kJ

13. 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?

a. rate = $k[(CH_3)_3C^+],[OH^-]$
b. rate = $k[(CH_3)_3C^+][OH^-]$,
c. rate = $k[Cl^-]$
d. rate = $k[(CH_3)_3CCl]$
e. rate = $k[(CH_3)_3CCl][OH^-]$

14. The reaction X → Y follows first-order kinetics with k = 0.83/min. If the initial concentration of X is 3.6 M, what is the concentration of X after 15 minutes?

a. 0.046 M
b. 0.230 M
c. 1.1×10^{-1} M
d. 1.84×10^{-3} M
e. 1.4×10^{-5} M

15. For a reaction, the rate law is rate = $k[A]^1[B]^0[C]^1$. What are the units for k where the time unit is seconds (s)?

a. (mol/L•s)
b. L/mol•s
c. L^2/mol^2•s
d. mol^2/L^2•s
e. mol^3/L^3•s

16. For the reaction

$$6CH_2O + 4\ NH_3 \rightarrow (CH_2)_6N_4 + 6H_2O$$

the rate is expressed as $1/6(\Delta[H_2O]/\Delta t)$. An equivalent would be

a. $-\Delta[(CH_2)_6N_4]/\Delta t$
b. $6(\Delta[CH_2O]/\Delta t)$
c. $-6(\Delta[CH_2O]/\Delta t)$
d. $-1/4(\Delta[NH_3]/\Delta t)$
e. $-1/6(\Delta[H_2O]/\Delta t)$

17. Given the initial rate data for the reaction A + B → C, determine the rate expression for the reaction.

[A], M	[B], M	Δ[C]/Δt initial M/s
0.10	0.20	5.00
0.20	0.20	10.0
0.10	0.15	2.81

a. $\Delta[C]/\Delta t = 1250[A][B]^2$
b. $\Delta[C]/\Delta t = 250[A][B]$
c. $\Delta[C]/\Delta t = 250[A]^2$
d. $\Delta[C]/\Delta t = 50.0[A]$
e. $\Delta[C]/\Delta t = 5.0[A][B]$

18. After five half-life periods for a first-order reaction, what is the molarity of a reagent initially at 0.366 M?

a. 1.14×10^{-2}
b. 3.12×10^{-2}
c. 6.57×10^{-3}
d. 3.12×10^{3}
e. 7.32×10^{-2}

19. Which of the following reactions will have the greatest rate at 298 K? Assume that the frequency factor A is the same for all reactions.

a. ΔE = +10 kJ/mol E_a = 25 kJ/mol
b. ΔE = -10 kJ/mol E_a = 25 kJ/mol
c. ΔE = -10 kJ/mol E_a = 15 kJ/mol
d. ΔE = -10 kJ/mol E_a = 50 kJ/mol
e. ΔE = -10 kJ/mol E_a = 15 kJ/mol

20. 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?

a. zero-order
b. first-order
c. second-order
d. third-order
e. three-halves-order