Kinetics/SS **Name:**

For complete credit show all the work for the calculations and give the answers in the correct significant figures. Keep the sheet of formulas handy for this study sheet.

1) Suggest experimental means by which the following reactions can be monitored for rate.
   a) $C_2H_6\,(g) \longrightarrow C_2H_4\,(g) + H_2\,(g)$

   b) $C_2H_5I(g) + H_2O(l) \longrightarrow C_2H_5OH(l) + H^+\,(aq) + I^-(aq)$

2) The initial concentration of H_2O_2 is 0.1108 M and 12 s later the concentration is 0.1060 M. what is the initial rate of this reaction expressed in M s^{-1}. (ans: 4.0 x 10^{-4} M/s)

3) The rate of the following reation in aqueous solution si monitored by measuring the number of moles of Hg_2Cl_2 that precipitate per liter per minute. The data obtained are listed in the table.
   $2HgCl_2 + C_2O_4^{2-} \longrightarrow 2Cl^- + 2CO_2 + Hg_2Cl_2$

Exp	$[HgCl_2]$, M	$[C_2O_4^{2-}]$, M	Initial rate M min^{-1}
1	0.105	0.15	1.8 x 10^{-5}
2	0.105	0.30	7.1 x 10^{-5}
3	0.052	0.30	3.5 x 10^{-5}
4	0.052	0.15	8.9 x 10^{-6}

   a) Determine the order of reaction with respect to $HgCl_2$ and $C_2O_4^{2-}$ and overall. (ans: 1,2,3)
   b) What is the value of the rate constant, k? (ans: 7.6 x 10^{-3} M^{-2} min^{-1})
   c) What would be the intital rate of reaction if $[HgCl_2]$ = 0.094 M and $[C_2O_4^{2-}]$ = 0.19 M? (ans: 2.6 x 10^{-5} M/min)
   d) Are all four experiments necessary to answer parts a through c?

4) A first order reaction A $\longrightarrow$ products, has a rate of reaction of 0.0025 M s^{-1}, when [A] = 0.484 M.
   a) What is the rate constant, k, for this reaction? (ans: 5.17 x 10^{-3} s^{-1})

   b) Does $t_{3/4}$ depend on the initial concentration? Does $t_{4/5}$? Explain?

5) The rate constant for the second order reaction is 0.80 $M^{-1}s^{-1}$ at 10 °C.

$$2NOBr \longrightarrow 2NO + Br_2$$

   a) Starting with a concentration of 0.086 M, calculate the concentration of NOBr after 22 s. (ans: 0.034 M)

   b) Calculate the half lives when [NOBr] = 0.072 M and $[NOBr]_0$ = 0.054 M. (ans: 17 s, 23 s)

6) The second order rate constant of the dimerization of protein P is 6.2 x 10^{-3} $M^{-1}s^{-1}$ at 25 °C.
   $P + P \longrightarrow P_2$. If the concentration of the protein is 2.7 x 10^{-4} M, a) calculate the initial rate (M/s) of the formation of P_2; and b) how long in seconds, will it take to decrease the concentration of P to 2.7 x 10^{-5} M? (ans: 4.5 x 10^{-10} M/s)

Extra Credit

7) For the reaction given below the frequency factor A is $8.7 \times 10^{12}\ s^{-1}$ and the activation energy is 63 KJ/mol. What is the rate constant for the reaction at 75 ^{o}C? (ans: $3.0 \times 10^{3}\ s^{-1}$)

$$NO(g) + O_3(g) \longrightarrow NO_2 + O_2(g)$$