Name: _____

Reaction Kinetics

1. In the nuclear industry, chlorine trifluoride is used to prepare uranium hexafluoride, a volatile compound of uranium used in the separation of uranium isotopes. Chlorine trifluoride is prepared by the reaction

$$Cl_2\,(g) + 3\,F_2\,(g) \rightarrow 2\,ClF_3\,(g)$$

Write the equation that relates the rate expressions for this reaction in terms of the disappearance of Cl_2 and F_2 and the formation of ClF_3.

2. A study of the rate of dimerization of C_4H_6

$$2\,C_4H_6 \rightarrow C_8H_{12}$$

gave the data shown in the table:

Time (s)	0	1600	3200	4800	6200
$[C_4H_6]$ (M)	1.00×10^{-2}	5.04×10^{-3}	3.37×10^{-3}	2.53×10^{-3}	2.08×10^{-3}

a. Determine the average rate of dimerization between 0 s and 1600 s, and between 1600 s and 3200 s.

b. Plot a graph of time versus $[C_4H_6]$. Estimate the instantaneous rate of dimerization at 3200 s from the graph. What are the units of this rate?

c. Determine the average rate of formation of C_8H_{12} at 1600 s and the instantaneous rate of formation at 3200 s from the rates found in parts (a) and (b).

3. Consider the following reaction in aqueous solution:

$$5\ Br^{-}\ (aq) + BrO_3^{-}\ (aq) + 6\ H^{+}\ (aq) \rightarrow 3\ Br_2\ (aq) + 3\ H_2O\ (l)$$

If the rate of disappearance of Br^{-} (aq) at a particular moment during the reaction is $3.5\ \ 10^{-4}$ mol L^{-1} s^{-1}, what is the rate of appearance of Br^{2} (aq) at that moment?

4. Doubling the concentration of a reactant increases the rate of a reaction four times. With this knowledge, answer the following questions:

   a. What is the order of the reaction with respect to that reactant?

   b. Tripling the concentration of a different reactant increases the rate of a reaction three times. What is the order of the reaction with respect to that reactant?

5. Nitrogen monoxide reacts with chlorine according to the equation

$$2\ NO\ (g) + Cl_2\ (g) \rightarrow 2\ NOCl\ (g)$$

The following initial rates of reaction have been observed for certain reactant concentrations:

[NO] (mol/L)	**[Cl2] (mol/L)**	**Rate (mol L^{-1} h^{-1})**
0.50	0.50	1.14
1.00	0.50	4.56
1.00	1.00	9.12

   a. What is the rate law that describes the rate's dependence on the concentrations of NO and Cl_2?

   b. What is the rate constant?

   c. What are the orders with respect to each reactant?