INITIAL RATES PROBLEMS

1. Given reaction rate data for: $F_2(g) + 2ClO_2(g) \rightarrow 2FClO_2(g)$

Experiment	$[F_2]$(*M*)	$[ClO_2]$(*M*)	Initial Rate (*M*/s)
1	0.10	0.010	1.2×10^{-3}
2	0.10	0.040	4.8×10^{-3}
3	0.20	0.010	2.4×10^{-3}

A. Determine the order of each reactant and the overall reaction order.

B. Write the rate law for the reaction.

C. Calculate the rate constant, k.

2. Given the rate data for: $2O_3(g) \rightarrow 3O_2(g)$

Run	$[O_3]$ (M)	Rate (M/s)
1	0.00600	5.03×10^{-7}
2	0.00300	1.28×10^{-7}
3	0.00150	3.08×10^{-8}

A. What is the rate law for the reaction?

B. Calculate the rate constant, k.

C. What is the rate of reaction when $[O_3] = 0.00500$ M?

FIRST ORDER KINETICS PROBLEMS

1. The rate law for the decomposition of N_2O_5 is Rate = $k[N_2O_5]$, where $k = 5.0 \times 10^{-4}\ s^{-1}$. What is the concentration of N_2O_5 after 1900 s, if the initial concentration is 0.56 M?

2. The first order reaction, $SO_2Cl_2 \rightarrow SO_2 + Cl_2$, has a rate constant of $0.17\ h^{-1}$. If the initial concentration of SO_2Cl_2 is 1.25×10^{-3} M, how many seconds does it take for the concentration to drop to 0.31×10^{-3} M?

3. Cobalt-60 is a radioisotope that decays by first-order kinetics and has a half-life of 5.26 years. The Cobalt-60 in a radiotherapy unit must be replaced when the concentration of Co decreases to 75.0% of its initial value. When does this occur?

4. The first order reaction, $CH_3NC \rightarrow CH_3CN$, has a rate constant of $6.3 \times 10^{-4}\ s^{-1}$ at 230 °C.
   A. What is the half-life of the reaction?

   B. How much of a 10.0 g sample of CH_3NC will remain after 5 half-lives?

   C. How many seconds would be required for 75% of a CH_3NC sample to decompose?

ACTIVATION ENERGY AND REACTION MECHANISMS

1. Draw the potential energy profile for a reaction with $\Delta H = -150$ kJ and $E_a = 100$ kJ.

2. A certain first-order reaction has a rate constant of $1.75 \times 10^{-1}\ s^{-1}$ at 20.0 °C. What is the value of k at 60.0 °C if $E_a = 55.5$ kJ/mol?

3. The following mechanism has been proposed for the reaction: $2SO_2 + O_2 \rightarrow 2SO_3$

   Step 1: $2NO + O_2 \rightarrow 2NO_2$ slow

   Step 2: $2NO_2 + 2SO_2 \rightarrow 2NO + 2SO_3$ fast

   A. Which is the rate determining step?

   B. What is the molecularity of the rate determining step?

   C. Identify the catalyst.

   D. Identify the intermediate.

   E. Write the rate law for the reaction.

   F. What is the overall reaction order?