

Kinetics Problem Sheet

1. The initial rate of the reaction $\text{CO} + \text{Cl}_2 \rightarrow \text{COCl}_2$ at 300 K is given for different initial pressures of the reactants. Determine the rate law.

$[\text{Cl}_2] / \text{atm}$	0.7	0.4	0.5	0.5	0.5
$[\text{CO}] / \text{atm}$	1.0	1.0	1.0	0.5	0.3
$v / \text{atm min}^{-1}$	0.586	0.253	0.354	0.177	0.106

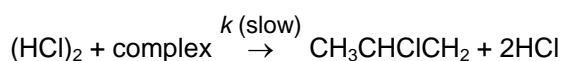
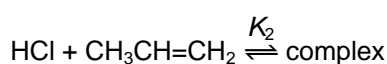
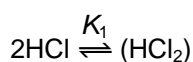
2. The data below refer to the rearrangement of N-bromoacetanilide (A) to 4-bromoacetanilide in chlorobenzene at 288 K. Determine the order of the reaction with respect to A and the rate constant, k . [If you are interested, you can also deduce the work patterns of the scientist!].

time / h	0.0	4.0	10.5	23.0	31.5	45.0	48.0
$10^2[\text{A}] / \text{mol dm}^{-3}$	1.00	0.907	0.762	0.566	0.466	0.348	0.321

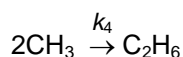
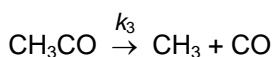
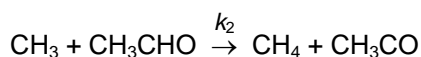
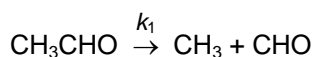
3. Iodine was allowed to react with an equimolar amount of propanone in acidic solution. The transmittance of the solution at a concentration where only I_2 absorbs was followed as a function of time. Determine the order of the reaction and, if possible, obtain the rate constant.

time / mins	0	5	10	15	20
transmission / %	10	19.6	31.6	44.3	56.2

4. A proposed mechanism for the reaction of HCl with propene is shown below. Determine the rate law for this mechanism.



5. The mechanism originally proposed for the pyrolysis of ethanal was as follows:



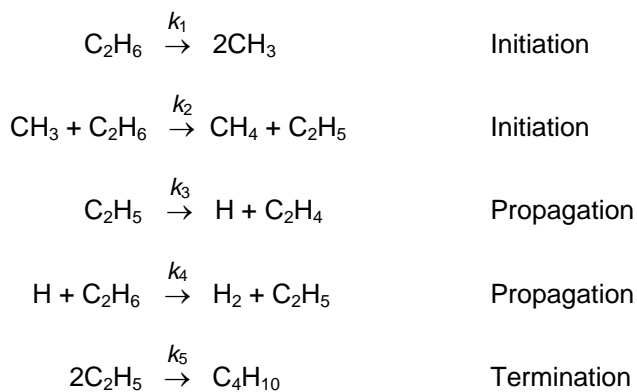
Apply the steady-state approximation to the radicals CH_3 and CH_3CO to obtain the rate law predicted by this mechanism ($v = d[\text{CH}_4]/dt$). Ignore the fate of CHO .

6. The enzyme catalase catalyses the decomposition of hydrogen peroxide. The initial rate of reaction was determined as a function of the initial peroxide concentration $[\text{H}_2\text{O}_2]_0$.

$[\text{H}_2\text{O}_2]_0 / \text{mol dm}^{-3}$	0.001	0.002	0.005
$10^3 v / \text{mol dm}^{-3}$	1.38	2.67	6.00

Determine v_{max} and K_M . Given that the concentration of catalase is $4.0 \times 10^{-9} \text{ mol dm}^{-3}$, calculate the turnover number, k_{cat} .

7. The major reactions in the pyrolysis of ethane to produce ethene and hydrogen at 1100 K are



- Show that the steady-state concentration $[\text{CH}_3]$ is given by $2k_1/k_2$.
- Determine the steady-state concentration of C_2H_5 .
- Determine the rate law for the production of ethene.
- Calculate the chain length.