Name: ___________________________

SID: ______________________________

1) **(15 pts)** The following kinetic data were obtained for the reaction:

$$2ICl(g) + H_2(g) \rightarrow I_2(g) + 2HCl(g)$$

	Initial Concentration (mmol L^{-1})		
Experiment	$[ICl]_0$	$[H_2]_0$	Initial Rate (mol L^{-1} s^{-1})
1	1.5	1.5	3.7×10^{-7}
2	3.0	1.5	7.4×10^{-7}
3	3.0	4.5	2.2×10^{-6}
4	4.7	2.7	??

(a) Write the rate law for the reaction (5 pts)

(b) From the data, determine the value of the rate constant (5 pts)

(c) Predict the reaction rate for Experiment 4 (5 pts)

Name: ___________________________

SID: ______________________________

2) **(20 pts)** The mechanism for the decomposition for NO_2Cl is:

$$NO_2Cl \underset{k_{-1}}{\overset{k_1}{\rightleftarrows}} NO_2 + Cl$$

$$NO_2Cl + Cl \overset{k_2}{\rightarrow} NO_2 + Cl_2$$

Write out the differential rate law under the following conditions (make sure to eliminate intermediates from your answer):

a) high concentration of NO_2 (10 pts)

b) low concentration of NO_2 (10 pts)

Name: ___________________________

SID: ______________________________

3) **(15 pts)** A common scheme used to describe reactions in liquids is:

$$A + B \underset{k_{-1}}{\overset{k_1}{\rightleftarrows}} (AB^*) \overset{k_2}{\rightarrow} P$$

Write the expression for the rate law in the activation-controlled limit.

Name: ___________________________

SID: _____________________________

4) **(15 pts)** The decomposition of benzene diazonium chloride

$$C_6H_5N_2Cl \xrightarrow{k_1} C_6H_5Cl + N_2$$

follows first order kinetics with a rate constant of $4.3 \times 10^{-5}\ s^{-1}$ at 20°C. If the initial partial pressure of $C_6H_5N_2Cl$ is 0.0088 atm, calculate its partial pressure after 10.0 hours.

Name: ___________________________

SID: _____________________________

5) **(10 pts)** Estimate the steric factor P for the following reaction at 355° C

$$H_2 + C_2H_4 \rightarrow C_2H_6$$

given the following experimental factors: A = 1.24×10^{6} L mol^{-1} s^{-1} , σ = 0.50×10^{-18} m^2 , and μ = 1.9×10^{-3} kg mol^{-1}

Name: ________________________

SID: __________________________

6) **(10 pts)** The hydrolysis of sucrose is a part of the digestive process. To investigate how strongly the rate depends on our body temperature, calculate the rate constant for the hydrolysis of sucrose at 35.0°C, given that k=1.0 mL mol^{-1} s^{-1} at 37.0°C (normal body temperature), and the activation energy of the reaction is 108 kJ mol^{-1}.

Name: ______________________

SID: ______________________

7) **(15 pts)** Certain bacteria use the enzyme penicillinase to decompose penicillin and render it inactive. The Michaelis–Menten constants for this enzyme and substrate are:

$$K_m = 5.3 \times 10^{-5} \text{ mol L}^{-1}$$
$$k_2 = 2.6 \times 10^{3} \text{ s}^{-1}.$$

a) At what substrate concentration will the rate of decomposition be half of the maximum rate? Must show all work for full credit (10 pts)

b) What is the significance of k_2 in the Michaelis-Menten model of enzyme kinetics (one sentence)? (5 pts)