## Reaction Mechanisms

1. The decomposition of dinitrogen oxide, $N_2O$ is believed to occur by the following two-step mechanism:

$N_2O\ (g) \rightarrow N_2\ (g) + O\ (g)$ (slow)

$N_2O\ (g) + O\ (g) \rightarrow N_2\ (g) + O_2\ (g)$ (fast)

a) Write an equation for the overall reaction

$2\ N_2O\ (g) \rightarrow 2\ N_2\ (g) + O_2\ (g)$

b) Write the rate law for the overall reaction

rate = $k[N_2O]$

2. Below is the proposed mechanism for the gas phase reaction of chloroform, $CHCl_3$ and chlorine.

$Cl_2\ (g) \underset{k_{-1}}{\overset{k_1}{\rightleftarrows}} 2\ Cl\ (g)$ (fast)

$Cl\ (g) + CHCl_3\ (g) \xrightarrow{k_2} HCl\ (g) + CCl_3$ (slow)

$Cl\ (g) + CCl_3\ (g) \xrightarrow{k_3} CCl_4\ (g)$ (fast)

a) Write the overall reaction

$Cl_2\ (g) + CHCl_3 \rightarrow HCl\ (g) + CCl_4\ (g)$

b) What is the rate law?

rate = $k_2[Cl][CHCl_3]$

$rate_F = rate_R$ $\quad k_1[Cl_2] = k_{-1}[Cl]^2$

$[Cl] = \sqrt{k_1/k_{-1}[Cl_2]}$ $\quad rate = k_2\sqrt{k_1/k_{-1}}\ \sqrt{Cl_2}\ [CHCl_3]$

**rate = $k[Cl_2]^{1/2}[CHCl_3]$**

d) Are there intermediates in the reaction? If so what are they?

The intermediates are Cl and $CCl_3$.

e)What is the molecularity of each elementary reaction?

1) Unimolecular and 2) and 3) bimolecular