

PBL Project

May I Take your
(Reaction) Order?

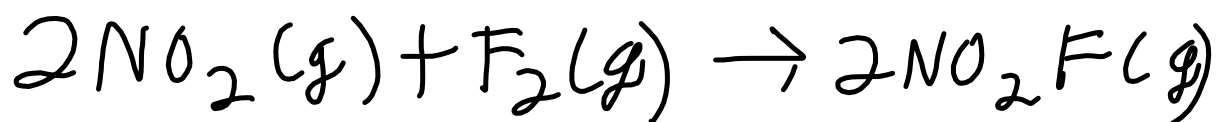
Assigned Activities

1. Determine the order of your reaction.
2. Determine the rate at a few different temperatures
3. Determine the activation energy of your reaction.

Extra Credit

Determine the frequency factor (A) of your reaction

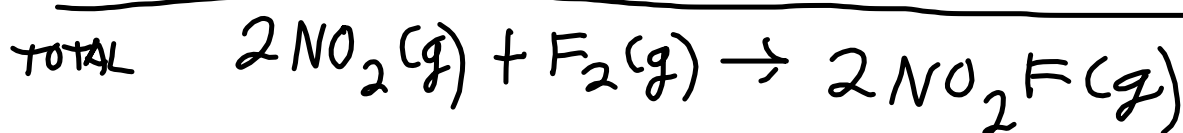
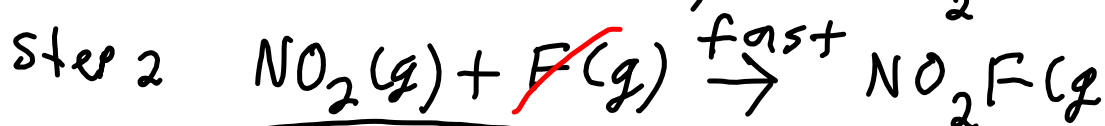
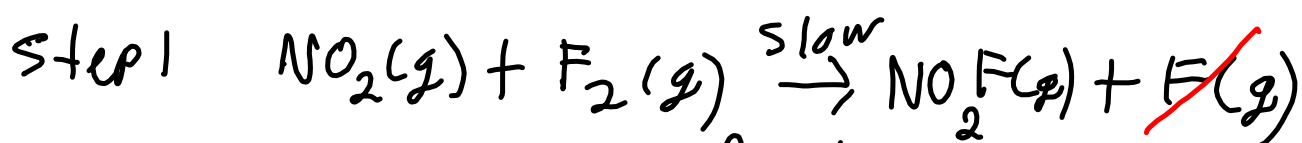
Due: Thu. Apr. 23



$$R = k[\text{NO}_2][\text{F}_2]$$

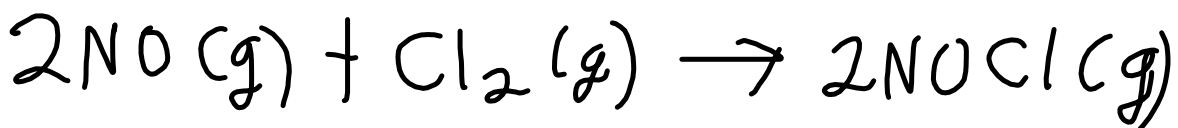
(experimentally determined)

Proposed mechanism:



Predicted Rate Law:

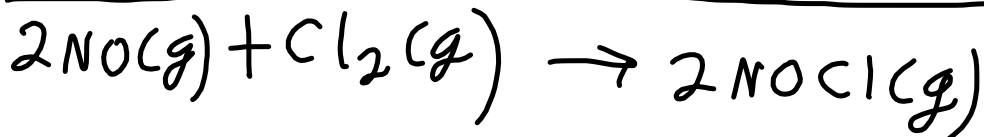
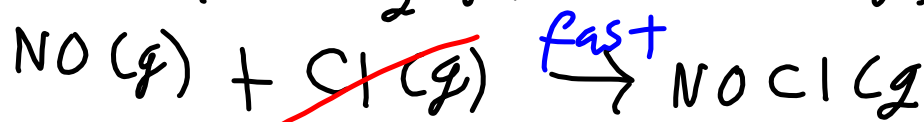
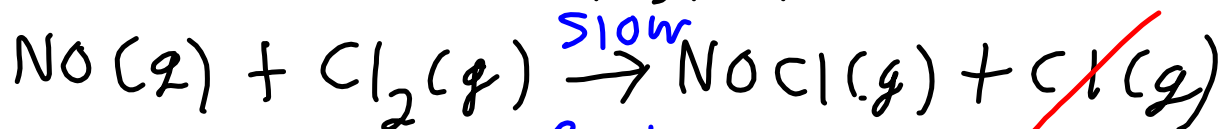
$$R = k[\text{NO}_2][\text{F}_2]$$



Experimentally - determined

$$\text{Rate Law: } R = k[\text{NO}]^2[\text{Cl}_2]$$

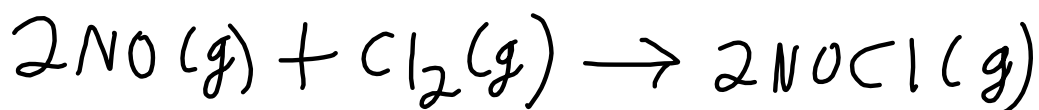
Proposed Mechanism:



Predicted Rate Law:

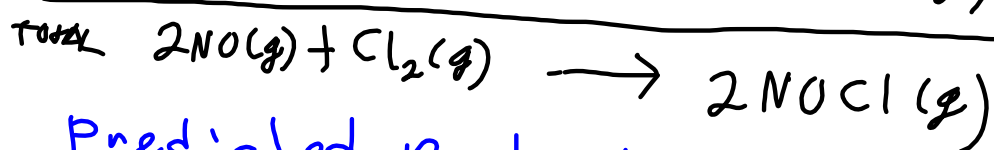
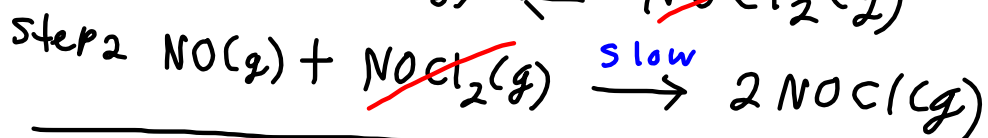
$$R = k[\text{NO}][\text{Cl}_2]$$

This mechanism must be rejected because it cannot account for the experimentally observed rate law.



$$\text{expt'l } R = k[\text{NO}]^2[\text{Cl}_2]$$

Another proposed mechanism:



Predicted Rate Law:

$$R = k[\text{NO}][\text{NOCl}_2]$$

$$R_{1f} = k_{1f}[\text{NO}][\text{Cl}_2]$$

$$R_{1r} = k_{1r}[\text{NOCl}_2]$$

At equilibrium $R_{1r} = R_{1f}$

$$\frac{k_{1r}[\text{NOCl}_2]}{k_{1r}} = \frac{k_{1f}[\text{NO}][\text{Cl}_2]}{k_{1r}}$$

$$[\text{NOCl}_2] = \left(\frac{k_{1f}}{k_{1r}}\right) [\text{NO}][\text{Cl}_2]$$

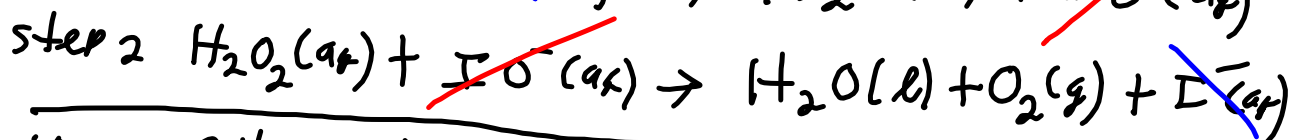
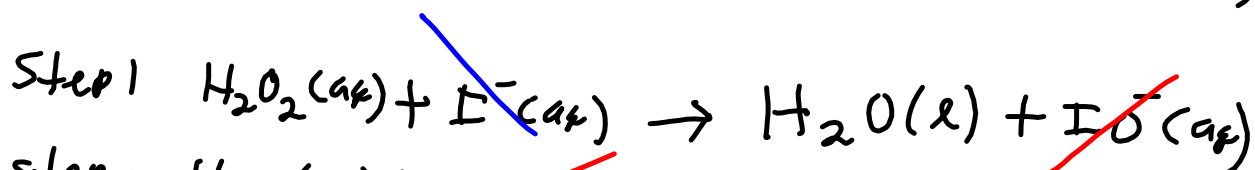
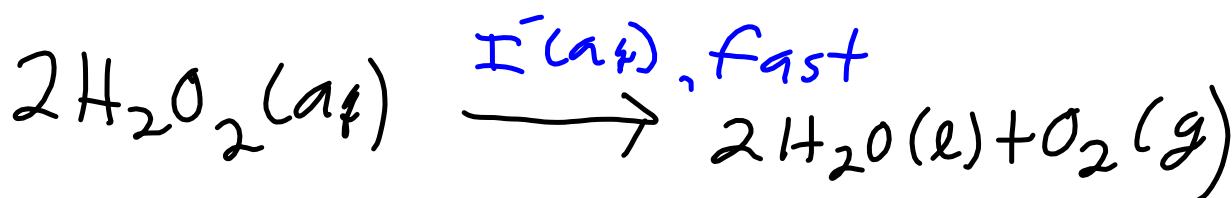
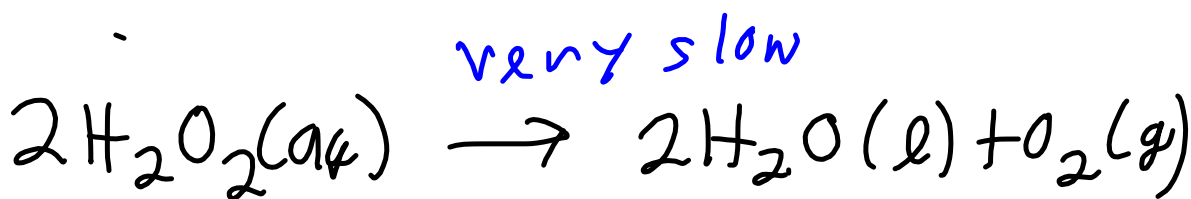
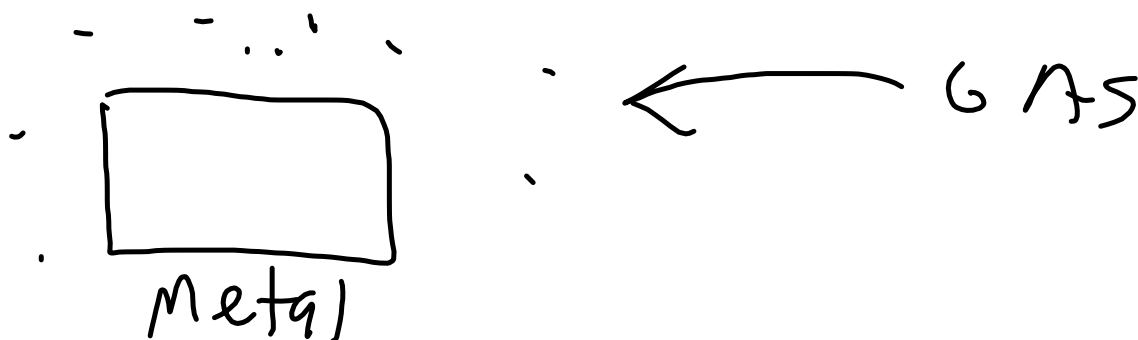
$$R_{2f} = k_{2f} \cdot [\text{NO}][\text{NOCl}_2]$$

$$R_{2f} = k_{2f} \cdot [\text{NO}] \left(\frac{k_{1f}}{k_{1r}}\right) [\text{NO}][\text{Cl}_2]$$

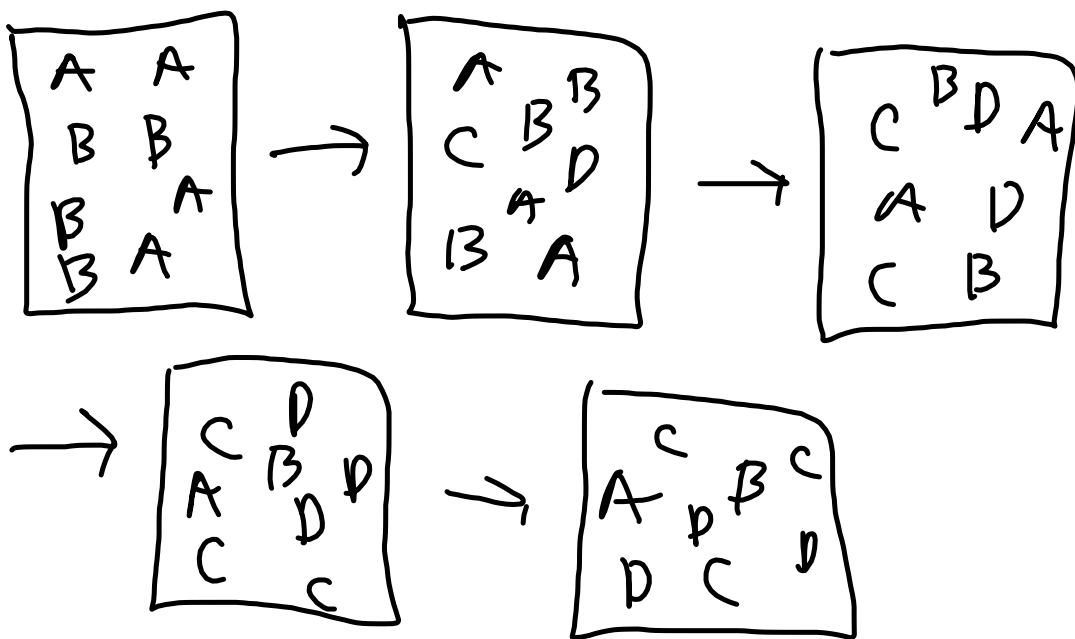
$$R = k[\text{NO}]^2[\text{Cl}_2]$$

CATALYSIS

Heterogeneous

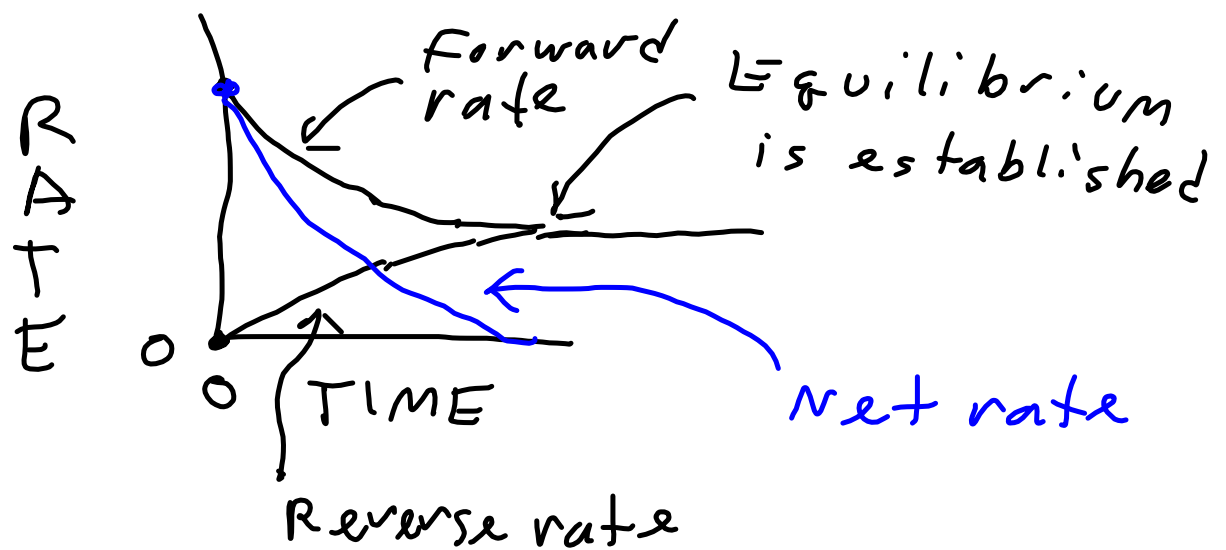


EQUILIBRIUM





$$R_{\text{net}} = R_f - R_r$$





Assume that the reaction is elementary

$$R_f = k_f [A]^a [B]^b$$

$$R_r = k_r [C]^c [D]^d$$

At equilibrium $R_f = R_r$

$$\frac{k_f [A]^a [B]^b}{k_r} = \frac{k_r [C]^c [D]^d}{k_r}$$

$$\frac{\left(\frac{k_f}{k_r}\right) [A]^a [B]^b}{[A]^a [B]^b} = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

$$\left(\frac{k_f}{k_r}\right) = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

$$K_c = \frac{[C]_{eq}^c [D]_{eq}^d}{[A]_{eq}^a [B]_{eq}^b}$$