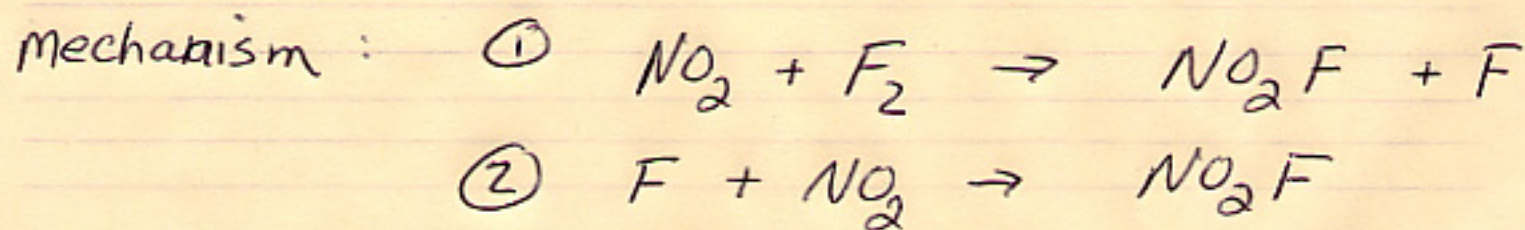
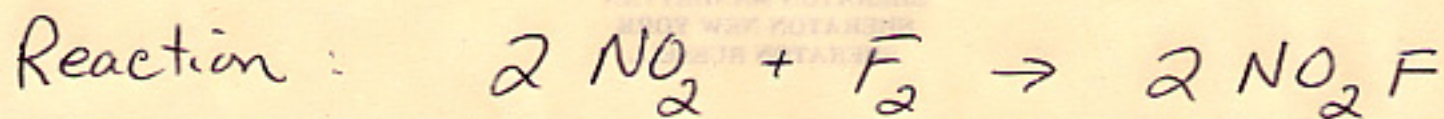


Complicated Mechanism & Rate Law



If step ① is slowest, then:

$$\text{rate (overall)} = k[\text{NO}_2][\text{F}_2] \quad (\text{easy})$$

If step ② is slowest, then:

$$\text{rate (overall)} = k_2[\text{NO}_2][\text{F}]$$

↑
cannot be
part of overall
rate, since
it's an intermediate

So

We assume the fast step (1) is at equilibrium; meaning the forward & reverse of step ① are proceeding at the same rate:

Mathematically:

$$\text{rate } \textcircled{1} = \text{rate } \textcircled{-1}$$

↑
reverse
reaction

$$k_1 [\text{NO}_2] [\text{F}_2] = k_{-1} [\text{NO}_2\text{F}] [\text{F}]$$

↙ rearrange

$$\frac{k_1 [\text{NO}_2] [\text{F}_2]}{k_{-1} [\text{NO}_2\text{F}]} = [\text{F}]$$

$$\frac{k_1 [\text{NO}_2] [\text{F}_2]}{k_{-1} [\text{NO}_2\text{F}]}$$

↖ substitute for $[\text{F}]$ in
overall rate

$$\text{rate (overall)} = \frac{k_2 k_1 [\text{NO}_2] [\text{NO}_2] [\text{F}_2]}{k_{-1} [\text{NO}_2\text{F}]}$$

$$= k_{\text{observed}} \frac{[\text{NO}_2]^2 [\text{F}_2]}{[\text{NO}_2\text{F}]}$$