## Kinetics 3 • Chem 220

Consider the catalyzed reaction and ***proposed*** mechanism below:

Overall: $2\,SO_2 + O_2 \xrightarrow{NO} 2\,SO_3$

| | | |
|---|---|---|
| Step 1: | $NO + O_2 \leftrightarrow NO_3$ | fast, equilibrium |
| Step 2: | $NO_3 + NO \rightarrow 2\,NO_2$ | slow |
| Step 3: | $NO_2 + SO_2 \rightarrow SO_3 + NO$ | fast |

*Note: Step 3 must occur twice for each step 1,2 combination. This does NOT affect the rate law.*

A) Write the differential rate law expression in terms of overall reactant and/or catalyst concentrations only.

B) What is the role of $NO_3$ in this process?

C) Consider the initial rates experiment data below:

| Trial | $[SO_2]_0$ (*M*) | $[O_2]_0$ (*M*) | $[NO]_0$ (*M*) | $-\Delta[SO_2]_0 / \Delta t$ (*M*/s) |
|---|---|---|---|---|
| 1 | 0.150 | 0.0100 | 0.0800 | $6.48 \times 10^{-5}$ |
| 2 | 0.450 | 0.0100 | 0.0800 | $5.81 \times 10^{-4}$ |
| 3 | 0.150 | 0.0100 | 0.1600 | $1.30 \times 10^{-4}$ |
| 4 | 0.150 | 0.0500 | 0.0800 | $6.51 \times 10^{-5}$ |

Write the differential rate law expression for this reaction based on the experimental data.

D) Does the experimentally determined rate law support the mechanism? Which is likely correct? ***Explain briefly.***

E) What is the necessary concentration of $SO_2$ to achieve an initial rate ($-\Delta[O_2]_0/\Delta t$) equal to $2.30 \times 10^{-4}$ *M*/s when $[NO]_0 = [O_2]_0 = 0.200$ *M*?