- A proposed kinetic model for the reaction of NO(g) with $Br_2(g)$ to form NOBr(g) is as follows. **3**

Step 1 $\quad NO(g) + NO(g) \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} N_2O_2(g)$

Step 2 $\quad N_2O_2(g) + Br_2(g) \xrightarrow{k_2} 2NOBr(g)$

If Step 2 is assumed to be very slow compared to the equilibrium of Step 1, derive the overall rate equation you would expect to see for this mechanism.

If step 1 is at equilibrium, with equilibrium constant, *K*:

$$K = [N_2O_2(g)]/[NO(g)]^2$$

$$[N_2O_2(g)] = K\,[NO(g)]^2$$

Step 2 involves the bimolecular reaction of a N_2O_2 molecule with a Br_2 molecule. The rate of this step is therefore:

$$\text{rate} = k_2[N_2O_2(g)][Br_2(g)]$$

Using the expression for $[N_2O_2(g)]$ from the equilibrium step gives:

$$\text{rate} = k_2K[NO(g)]^2[Br_2(g)] = k[NO(g)]^2[Br_2(g)] \text{ where } k = k_2K$$