Reaction Mechanism Practice

1. The decomposition of hydrogen peroxide is catalyzed by iodide ion. The catalyzed reaction is thought to proceed by a two-step mechanism:

H2O2 (aq)  + I-(aq)\_ 🡪 H2O(l) + IO3- (slow)

IO-(aq) + H2O2 (aq) 🡪 H2O(l) + O2(g) + I-(aq)  (fast)

A. Write the chemical equation for the overall process.

B. Identify the intermediate, if any, in the process.

C. Assuming the first step of the mechanism is rate determining, predict the rate law for the overall process.

2.

HBr(g) + O2(g) 🡪 HOOBr(g)

HOOBr(g) + HBr(g) 🡪 2HOBr(g)

HOBr(g) + HBr(g) 🡪 H2O(g)  + Br2(g)

A. What is the overall reaction?

B. The experimentally determined rate law has been determined. The reaction is first order with respect to HBr and first order with respect to O2. Based on this information, which step is the rate-determining step?

C. What are the intermediates in this reaction?

3.

NO2(g) + SO2(g) 🡪 NO(g) + SO3 (g)

2NO (g) + O2 (g) 🡪 2NO2 (g)

A. Show, that with appropriate coefficients, the two reactions can be summed to give the overall oxidation of SO2 by O2 to give SO3.

B. Is NO2 a catalyst or an intermediate?

C. Would you classify NO as a catalyst or intermediate?