**Writing Rate Laws**

 **Worksheet**

Organic Chemistry Tutor

1. Write the overall reaction for the mechanism shown below. (b) Identify any catalysts and intermediates in the reaction mechanism.

(c) Determine the molecularity for each elementary reaction. (d) Write the rate law for the overall reaction.

H2O2 + I- 🡪 H2O + IO- (slow)

IO- + H2O2 🡪 H2O + O2  + I-  (fast)

2. Write the overall reaction for the mechanism shown below. (b) Identify any catalysts and intermediates in the reaction mechanism.

(c) Determine the molecularity for each elementary reaction. (d) Write the rate law for the overall reaction.

NO + Cl2 ↔ NOCl2 (Fast)

NOCl2 + NO 🡪 2NOCl (Slow)

3. Write the rate law expression for the mechanism shown below:

Br2 ↔ 2Br (Fast)

Br + H2 🡪 HBr + H (Slow)

Br2 + H 🡪 HBr + Br (Fast)

2Br ↔ Br2  (Fast)

4. Write the rate law expression for the mechanism shown below:

Cl2 ↔ 2Cl (Fast)

Cl + CO ↔ COCl (Fast)

COCl + Cl2 🡪 COCl2 + Cl (Slow)

2Cl ↔ Cl2 (Fast)

5. Write the rate law expression for the mechanism shown below:

O3 ↔ O2 + O (Fast)

O3 + O 🡪 O2 + O2 (Slow)

6. The reaction shown below was found to be 1st order with respect to A, 2nd order with respect to B, and 3rd order with respect to D. Which of the following steps is the rate determining step?

A + B + D ↔ C

C + 2D ↔ E + F

E + B ↔ F + D

**Answers:**

1a. 2H2O2 🡪 2H2O + O2

1b. Catalyst = I-, Intermediate = IO-

1c. Bimolecular for both steps

1d. Rate = k1 [H2O2]

2a. 2NO + Cl2 🡪 2NOCl

2b. Intermediate = NOCl2

2c. Bimolecular for both steps

2d. Rate = k[NO]2[Cl2]

3. Rate = k [Br2]1/2 [H2]

4. Rate = k [CO] [Cl2]3/2

5. Rate = k [O3]2

6. The 3rd step is the rate determining step.