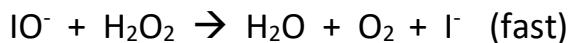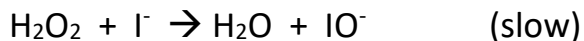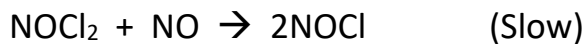# Writing Rate Laws Worksheet

Organic Chemistry Tutor
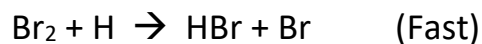
1. Write the overall reaction for the mechanism shown below. (b) Identify any catalysts and intermediates in the reaction mechanism.
(c) Determine the molecularity for each elementary reaction. (d) Write the rate law for the overall reaction.

$H_2O_2 + I^- \rightarrow H_2O + IO^-$ (slow)
$IO^- + H_2O_2 \rightarrow H_2O + O_2 + I^-$ (fast)

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

$Br_2 \leftrightarrow 2Br$ (Fast)
$Br + H_2 \rightarrow HBr + H$ (Slow)
$Br_2 + H \rightarrow HBr + Br$ (Fast)
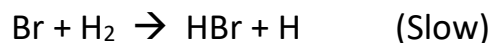$2Br \leftrightarrow Br_2$ (Fast)

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.
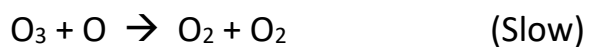
$NO + Cl_2 \leftrightarrow NOCl_2$ (Fast)
$NOCl_2 + NO \rightarrow 2NOCl$ (Slow)

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

$Cl_2 \leftrightarrow 2Cl$ (Fast)
$Cl + CO \leftrightarrow COCl$ (Fast)
$COCl + Cl_2 \rightarrow COCl_2 + Cl$ (Slow)
$2Cl \leftrightarrow Cl_2$ (Fast)

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

$O_3 \leftrightarrow O_2 + O$ (Fast)

$O_3 + O \rightarrow O_2 + O_2$ (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?

$$A + B + D \leftrightarrow C$$
$$C + 2D \leftrightarrow E + F$$
$$E + B \leftrightarrow F + D$$
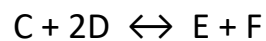
Answers:
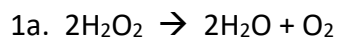
1a. $2H_2O_2 \rightarrow 2H_2O + O_2$
1b. Catalyst = I^-, Intermediate = IO^-
1c. Bimolecular for both steps
1d. Rate = $k_1 [H_2O_2]$

2a. $2NO + Cl_2 \rightarrow 2NOCl$
2b. Intermediate = $NOCl_2$
2c. Bimolecular for both steps
2d. Rate = $k[NO]^2[Cl_2]$

3. Rate = $k [Br_2]^{1/2} [H_2]$

4. Rate = $k [CO] [Cl_2]^{3/2}$

5. Rate = $k [O_3]^2$

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