Mechanism Practice Problems
Chem 1B

1. The rate law for Cl$_2$(aq) + H$_2$S(aq) $\rightarrow$ S(s) + 2 HCl(aq) is Rate = k[Cl$_2$][H$_2$S]. Which is the correct mechanism?

a) Cl$_2$ $\rightarrow$ Cl$^+$ + Cl$^-$ (slow)
Cl$^-$ + H$_2$S $\rightarrow$ HCl + HS$^-$ (fast)
Cl$^+$ + HS$^-$ $\rightarrow$ HCl + S (fast)

b) Cl$_2$ + H$_2$S $\rightarrow$ HCl + Cl$^+$ + HS$^-$ (slow)
Cl$^+$ + HS$^-$ $\rightarrow$ HCl + S (fast)

(c) Cl$_2$ $\rightarrow$ Cl + Cl (fast, equilibrium)
Cl + H$_2$S $\rightarrow$ HCl + HS (fast, equilibrium)
HS + Cl $\rightarrow$ HCl + S (slow)

2. Write the overall reaction and predict the rate law for each of the following mechanisms:

a) A + B $\rightarrow$ C + D (slow)
D + B $\rightarrow$ E + F (fast)
F $\rightarrow$ G (fast)

b) A + B $\rightarrow$ C + D (fast, equilibrium)
C + B $\rightarrow$ E + F (slow)
F $\rightarrow$ G (fast)

3. A proposed mechanism for the destruction of Ozone 2O$_3$ $\rightarrow$ 3O$_2$ is:

O$_3$ $\rightarrow$ O + O$_2$
O + O$_3$ $\rightarrow$ 2 O$_2$

What is the rate law for this process, without using the concentration of the intermediate?
Will the reaction speed up or slow down with higher [O$_2$]?

4. For the reaction: X$_2$ + Y + Z $\rightarrow$ XY + XZ it is found that doubling [X$_2$] doubles the reaction rate and increasing [Y] by a factor of 1.87 increases the rate by a factor of 3$^{1/2}$. Increasing [Z] has no effect upon the rate.
   a. What is the rate law for this reaction?
   b. Propose a mechanism for this reaction consistent with the data.