Chemistry 2710 Spring 2006 Problem Set 1 Solutions

1. Since
$$v = -\frac{1}{2}\frac{d[\mathrm{ClO}]}{dt} = \frac{d[\mathrm{Cl_2}]}{dt},$$
we get
$$\frac{d[\mathrm{Cl_2}]}{dt} = -\frac{1}{2}\left(-1.65\,\mu\mathrm{mol\,L^{-1}s^{-1}}\right) = -0.827\,\mu\mathrm{mol\,L^{-1}s^{-1}}.$$

2. One could argue for either answer here. On the one hand, the reaction is pretty simple, involving only simple reactants and a reasonably straightforward exchange of "dance partners". On the other hand, we have to make two bonds and break two bonds simultaneously to make this work. Furthermore, the collision between the ClO molecules has to have exactly the right geometry if this is going to work in one step. If I were going to lay a wager on this, I would bet that it's a complex reaction, but I probably wouldn't put a lot of money on it.

3.
$$\begin{aligned} k_1[\mathrm{H}][\mathrm{Br_2}] &= k_{-1}[\mathrm{HBr}][\mathrm{Br}]. \\ \therefore K &= \frac{[\mathrm{HBr}][\mathrm{Br}]}{[\mathrm{H}][\mathrm{Br_2}]} = \frac{k_1}{k_{-1}}. \\ \therefore k_{-1} &= \frac{k_1}{K} = \frac{2.09\times10^{8}\,\mathrm{L\,mol^{-1}s^{-1}}}{1.5\times10^{28}} \\ &= 1.4\times10^{-20}\,\mathrm{L\,mol^{-1}s^{-1}}. \end{aligned}$$

4.
$$\begin{aligned} \frac{da}{dt} &= -2k_+a^2 + 2k_-b^3, \\ \frac{db}{dt} &= 3k_+a^2 - 3k_-b^3 \end{aligned}$$