Introduction to Natural Science, Spring 2007
Chemistry Workshop – Week 4

1. The following table presents data for the reaction: $2\ H_{2(g)} + 2\ NO_{(g)} \rightarrow\ 2\ H_2O_{(g)} + N_{2(g)}$
   Rate constant for the reaction is k_1 and the temperature is held constant. Determine the rate law for this reaction.

Expt.	Initial Concentration ($mol \cdot L^{-1}$)	Initial Concentration ($mol \cdot L^{-1}$)	Initial rate
	$[NO] \times 10^{-3}$	$[H_2] \times 10^{-3}$	Arbitrary units
I	6.0	1.0	18
II	6.0	2.0	36
III	1.0	6.0	3
IV	2.0	6.0	12

2. For the reaction between gaseous chlorine and nitric oxide: $2NO_{(g)} + Cl_{2(g)} \rightarrow 2NOCl_{(g)}$
   Doubling the concentration of chlorine doubles the rate of reaction. Doubling the concentrations of both reactants increases the rate by a factor of eight. Determine the order of the reaction.

3. Substance **A** undergoes a first order reaction **A** $\rightarrow$ **B** with a half-life of 20 min at 25 °C. If the initial concentration of **A** in a sample is 1.6 M, what will be the concentration of **A** after 80 min?

4. The reaction $H_2 + Br_2 \rightarrow 2HBr$ proceeds by this chain mechanism:

   Step I $Br_2 + h\nu$ (ultraviolet) $\rightarrow 2Br\bullet$

   Step II $Br\bullet + H_2 \rightarrow HBr + H\bullet$

   Step III $H\bullet + Br_2 \rightarrow HBr + Br\bullet$

   Which would break the chain? (A) $Br\bullet + H_2 \rightarrow HBr + H\bullet$ (B) $Br\bullet + Br\bullet \rightarrow Br_2$
   (C) $H\bullet + Br_2 \rightarrow HBr + Br\bullet$ (D) $Br_2 + H_2 \rightarrow 2HBr$

5. A 1.00 L flask was filled with 2.00 mol gaseous SO_2 and 2.00 mol gaseous NO_2 and heated. After equilibrium was reached, it was found that 1.30 mol gaseous NO was present. Assume that the reaction $SO_2\ (g) + NO_2\ (g) \leftrightarrow\ SO_3\ (g)\ + NO\ (g)$ occurs under these conditions. Calculate the value of the equilibrium constant for this reaction.

6. Suppose the reaction system $2\ CO\ (g) + O_2\ (g) \leftrightarrow\ 2\ CO_2\ (g)$ has already reached equilibrium. Predict the effect that each of the following changes will have on the equilibrium position. Tell whether the equilibrium will shift to the right, to the left, or will not be affected.
   - Gaseous carbon dioxide is removed
   - Carbon monoxide is added
   - Temperature is increased (the reaction is exothermic)
   - The volume of the container is decreased