Chapter 14

1. Consider the following reaction between nitrogen dioxide and carbon monoxide:

    $$NO_2 (g) + CO (g) \rightarrow NO (g) + CO_2 (g)$$
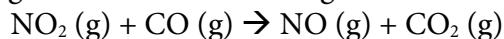
    The initial rate of the reaction was measured at several different concentrations of the reactants with the following results:

$[NO_2]$ (M)	[CO] M	Initial rate (M/s)
0.10	0.10	0.0021
0.20	0.10	0.0082
0.20	0.20	0.0083
0.40	0.10	0.033

    From the data, determine the rate law and the rate constant (k) for the reaction.

2. Consider the equation for the decomposition of SO_2Cl_2: $SO_2Cl_2 (g) \rightarrow SO_2 (g) + Cl_2 (g)$

    The concentration of SO_2Cl_2 was monitored at a fixed temperature as a function of time during the decomposition. The reaction was determined to be first order and has a rate constant of 2.90 x 10^{-4} s^{-1}. If the reaction is carried out at the same temp., and the initial concentration of SO_2Cl_2 is 0.0225 M, what will the SO_2Cl_2 concentration be after 865 sec?

3. The solubility of nitrogen gas in water is 821 µmol/L at 0°C when N_2 pressure above the water is 0.790 atm. (a) What is the Henry's Law constant for N_2 in units of mol/L•atm?

    (b) What is the solubility of N_2 in water when the partial pressure of nitrogen above the water is 1.10 atm at 0°C?

4. A reaction in which A, B, and C react to form products is first order in A, second order in B, and zero order in C.

   a. Write a rate law for the reaction

   b. What is the overall order of the reaction?

   c. By what factor does the rxn rate change if [A] is doubled and the rest stay constant?

   d. By what factor does the rxn rate change if [B] is doubled and the rest stay constant?

   e. By what factor does the rxn rate change if [C] is doubled and the rest stay constant?

   f. By what factor does the rxn rate change if all three concentrations are doubled?

   g. What are the units of the rate constant, k, for the reaction?

5. This reaction was monitored as a function of time: A$\rightarrow$ B + C
   A plot of ln[A] vs. time yields a straight line with slope -0.0045 s^{-1}.

   a. What is the value of the rate constant for this reaction at this temperature?

   b. Write the rate law for the reaction.

   c. What is the half-life?

   d. If the initial concentration of A is 0.250 M, what will be the concentration after 225 s?

6. Calculate the freezing point and boiling point of each aqueous solution, assuming complete dissociation of the solute. For water, K_{bp} = 0.512 °C/m and K_{fp} = 1.86 °C/m.

   a. 0.100 m K_2S in water

   b. 21.5 g of $CuCl_2$ in 4.50 x 10^2 g in water

   c. 5.5% $NaNO_3$, by mass, in water