Worksheet 8

1. Butadiene (C_4H_6) reacts with itself to form a dimer with the formula C_8H_{12}. The reaction is second order in C_4H_6. If the rate constant at a particular temperature is 4.0×10^{-2} M^{-1} s^{-1} and the initial concentration of C_4H_6 is 0.0200 M.

(a) What is its molarity after a reaction time of 1.00 hour?

(b) What is the time (in hours) when the C_4H_6 concentration reaches a value of 0.0020 M?

(c) What is the half-life (in minutes) of the reaction when the initial C_4H_6 concentration is 0.0200 M? How many minutes does it take for the concentration of C_4H_6 to drop from 0.0100 M to 0.0050 M?

2. At 25°C, the half-life of a certain first-order reaction is 248 s. What is the value of the rate constant at this temperature?

3. A reaction of the type A → B + C has a rate constant $k = 3.6 \times 10^{-5}$ M/s.

(a) What is the order of the reaction?

(b) What is the molarity of A after a reaction time of 30.0 min if the initial concentration of A is 0.096 M?

(c) What is the half-life (in minutes) of the reaction in part (b)?

4. The half-life for the first-order decomposition of N_2O_4 is 1.3×10^{-5} s.

$$N_2O_4(g) \rightarrow 2\ NO_2(g)$$

If N_2O_4 is introduced into an evacuated flask at a pressure of 17.0 mm Hg, how many seconds are required for the pressure of NO_2 to reach 1.3 mm Hg?

5. The rate constant for the decomposition of gaseous NO_2 to NO and O_2 is 4.7/(M • s) at 383°C. Consider the decomposition of a sample of pure NO_2 having an initial pressure of 746 mm Hg in a 5.00 L reaction vessel at 383°C.

(a) What is the order of the reaction?

(b) What is the initial rate of formation of O_2 in g/(L • s)?

(c) What is the mass of O_2 in the vessel after a reaction time of 1.00 min?