CHEM 1F92. Assignment 15. Kinetics Part 1

Assignment 15, Version # 34

1. The kinetics of the following reaction have been studied:

$$10\ F_2 + P_4 \rightarrow 4\ PF_5$$

The rate of of appearance of PF_5 was measured as

$$\Delta[PF_5]/\Delta t = 6.00 \times 10^{-2}\ \text{mol L}^{-1}\ \text{s}^{-1}$$

(a) What is the rate of the reaction in mol L^{-1} s^{-1}?

(b) What is $\Delta[F_2]/\Delta t$ in mol L^{-1} s^{-1}?

(c) What is $\Delta[P_4]/\Delta t$ in mol L^{-1} s^{-1}?

2. The initial rate of the reaction of species A and B

$$A + 2\ B \rightarrow C$$

was measured at a temperature of 25 °C for various initial concentrations of A and B. Data are collected in the table. Determine the rate equation from these data. What is the overall order of the reaction? What is the value of the rate constant? (Give the appropriate units of *k*.)

	Initial Concentrations, mol/L		Initial Rate,
Experiment	[A]	[B]	mol L^{-1} s^{-1}
1	0.050	0.050	4.05×10^{-4}
2	0.100	0.050	8.10×10^{-4}
3	0.050	0.100	8.10×10^{-4}

3. The reaction $A + 2B \rightarrow C$ proceeds according to the rate law,

$$\text{rate} = k[A][B]$$

with $k = 3.21 \times 10^{-3}\ M^{-1}\ min^{-1}$. Assume that at the start of a particular reaction, [A] = 0.385 M, [B] = 0.220 M. What is the initial rate of reaction? What is the rate when half of B has reacted? Give units! [Remember: ln(ab) = ln(a) + ln(b)]

4. The radioactive isotope ^{7}Be has a half-life of 53.3 days.

(a) What is the rate constant for this first-order reaction? (b) What fraction of the isotope remains after 30 days? Assume 3 significant figures in your calculations.

5. The reaction $A \rightarrow B + C$ is known to be first order in A. Below are data showing the concentration of A as a function of reaction time.

Time, h	[A], M
0	2.50×10^{-1}
1	2.21×10^{-1}
2	1.95×10^{-1}
4	1.52×10^{-1}
8	9.23×10^{-2}
10	7.19×10^{-2}
12	5.61×10^{-2}

(a) What is the **average rate** of reaction between 1 and 4 h? Report the units as well as the numbers.

(b) Plot the data above, showing the concentration of A as a function of the time. From your graph, determine the **instantaneous rate** of reaction at 8 h. Report the units as well as the numbers.

(c) Plot ln [A] versus time. Estimate the rate constant for this first-order reaction from your graph. Report the units as well as the numbers.