

Kinetics Problems 2

Method of Initial Rates

1. The initial rate of the reaction $A + B \rightarrow C + D$ is determined for different initial conditions, with the results listed in the following table:

Experiment	[A], M	[B], M	Initial Rate, Ms^{-1}
1	0.185	0.133	3.35×10^{-4}
2	0.185	0.266	1.35×10^{-3}
3	0.370	0.133	6.75×10^{-4}
4	0.370	0.266	2.70×10^{-3}

- a. What is the order of the reaction with respect to A and B?
- b. What is the overall reaction order?
- c. What is the value of the rate constant, k ? (Include the correct units.)

2. The following data are obtained for the initial rates of reaction in the reaction $A + 2B + C \rightarrow 2D + E$:

Experiment	Initial [A], M	Initial [B], M	[C], M	Initial Rate
1	1.40	1.40	1.00	R_1
2	0.70	1.40	1.00	$R_2 = \frac{1}{2} \times R_1$
3	0.70	0.70	1.00	$R_3 = \frac{1}{4} \times R_2$
4	1.40	1.40	0.50	$R_4 = 16 \times R_3$
5	0.70	0.70	0.50	$R_5 = ?$

- a. What are the reaction orders with respect to A, B and C?
- b. What is the value of R_5 in terms of R_1 ?

Reactions of Various Orders

3. In the first-order reaction $A \rightarrow \text{products}$, $[A]=0.816 \text{ M}$ initially and 0.632 M after 16.0 minutes.
- a. What is the value of the rate constant, k ?
- b. What is the half-life of this reaction?
- c. At what time will $[A]=0.235 \text{ M}$?

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- d. What will $[A]$ be after 2.5 h?
4. The half-life of the radioactive isotope ^{32}P (phosphorus-32) is 14.3 days. How long does it take for a sample of ^{32}P to lose 99% of its radioactivity? The decomposition is first order.
5. The reaction $A + B \rightarrow C + D$ is second order in A and zero order in B. The value of k is $0.0103 \text{ M}^{-1} \text{ min}^{-1}$. What is the rate of the reaction when $[A] = 0.116 \text{ M}$ and $[B] = 3.83 \text{ M}$?
6. A reaction is 50% complete in 30.0 min. How long after its start will the reaction be 75% complete if it is first order? Find the answer with and without using an equation and confirm that the answers are the same.