

Be sure to show all work, use the correct number of significant figures, circle final answers and use correct units in all problems.

1. Consider the data (below) gathered for the following reaction: $A + B \rightarrow C$ (8 points)

$[A]$ (M)	$[B]$ (M)	$\Delta[C]/\Delta t$ (initial) M/s
0.100	0.200	6.80×10^{-6}
0.100	0.400	2.72×10^{-5}
0.200	0.400	5.44×10^{-5}

- What is the order of the reaction with respect to A: _____ B: _____ Overall order: _____
 - What is the numerical value for the rate constant?
 - Write the rate law for the reaction.
 - What is the value of the rate when $[A] = 0.337$ M and $[B] = 0.122$ M?
2. In basic solution, $(CH_3)_3CCl$ reacts according to the equation below.
- $$(CH_3)_3CCl + OH^- \rightarrow (CH_3)_3COH + Cl^-$$
- The accepted mechanism for the reaction is
- $$\begin{array}{ll} (CH_3)_3CCl \rightarrow (CH_3)_3C^+ + Cl^- & \text{(slow)} \\ (CH_3)_3C^+ + OH^- \rightarrow (CH_3)_3COH & \text{(fast)} \end{array}$$
- What is a rate law that is consistent with the mechanism for this reaction? (2 points)
 - Are intermediates present in the reaction? If so, list them. (2 points)
3. For a chemical reaction, the activation energy for the forward reaction is +187 kJ and the activation energy for the backward reaction is +112 kJ. What is the overall energy change for the forward reaction? (4 points)
4. What is the half-life of a first order reaction with a rate constant of 0.457 s^{-1} ? (4 points)

Answers

1. Consider the data (below) gathered for the following reaction: $A + B \rightarrow C$ (8 points)

$[A]$ (M)	$[B]$ (M)	$\Delta[C]/\Delta t$ (initial) M/s
0.100	0.200	6.80×10^{-6}
0.100	0.400	2.72×10^{-5}
0.200	0.400	5.44×10^{-5}

- a. What is the order of the reaction with respect to A: 1 B: 2 Overall order: 3

- b. What is the numerical value for the rate constant?

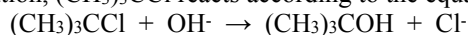
$$k = 1.70 \times 10^{-3}$$

- c. Write the rate law for the reaction. **rate = $k[A][B]^2$**

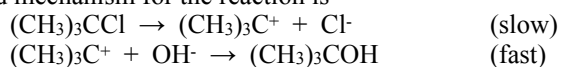
- d. What is the value of the rate when $[A] = 0.337$ M and $[B] = 0.122$ M?

$$\text{rate} = 8.53 \times 10^{-6}$$

2. In basic solution, $(CH_3)_3CCl$ reacts according to the equation below.



The accepted mechanism for the reaction is



- a. What is a rate law that is consistent with the mechanism for this reaction? (2 points)

$$\text{rate} = k [(CH_3)_3CCl] \quad \text{slow step}$$

- b. Are intermediates present in the reaction? If so, list them. (2 points)

yes, $(CH_3)_3C^+$

3. For a chemical reaction, the activation energy for the forward reaction is +187 kJ and the activation energy for the backward reaction is +112 kJ. What is the overall energy change for the forward reaction? (4 points)

forward reaction is endothermic (reverse reaction has lower activation energy)

$$\Delta H = 187 - 112 = +75 \text{ kJ}$$

4. What is the half-life of a first order reaction with a rate constant of 0.457 s^{-1} ? (4 points)

$$t_{1/2} = 1.52 \text{ s}$$