

Rate laws, orders and half-lives

AP Chemistry · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test lasts 45 minutes and covers rate laws, orders, integrated rate laws and half-lives. Calculators are allowed. Show your working and give units; marks are shown for each question and the total is 20.

Level: AP Chemistry · **Curriculum:** AP Chem Unit 5

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Rate law from data (3 marks)

For $\text{ICl} + \text{H}_2 \rightarrow \text{products}$, initial rates: (1) $[\text{ICl}] = 0.10 \text{ M}$, $[\text{H}_2] = 0.10 \text{ M}$, rate = $1.5 \times 10^{-3} \text{ M/s}$; (2) $[\text{ICl}] = 0.20 \text{ M}$, $[\text{H}_2] = 0.10 \text{ M}$, rate = $3.0 \times 10^{-3} \text{ M/s}$; (3) $[\text{ICl}] = 0.20 \text{ M}$, $[\text{H}_2] = 0.40 \text{ M}$, rate = $1.2 \times 10^{-2} \text{ M/s}$.

- Determine the order in each reactant. (2 marks)
- Calculate k . (1 mark)

Question 2 Units (2 marks)

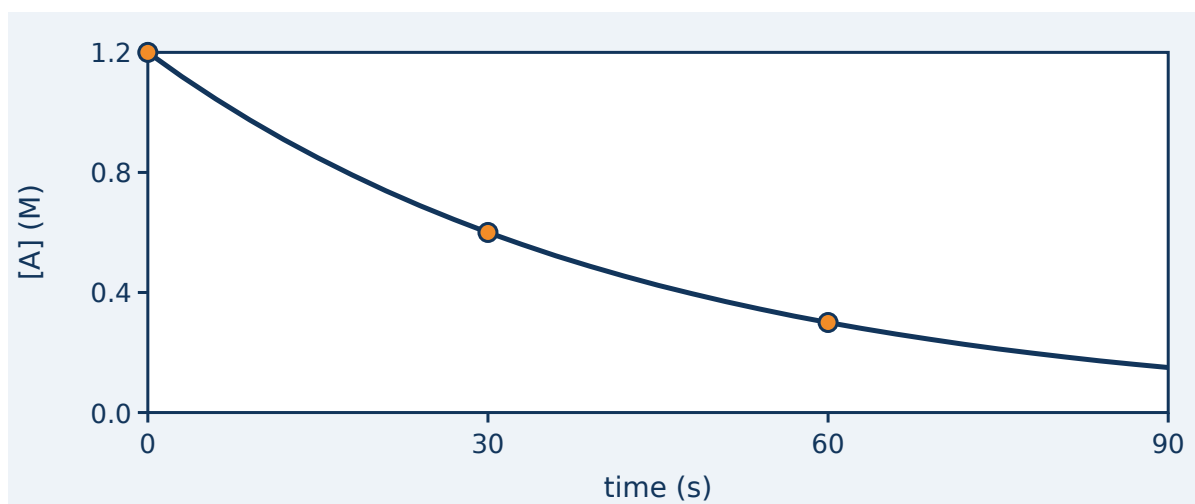
- Give the overall order of the reaction in Question 1 and the units of k . (1 mark)
- State the units of k for a first-order reaction. (1 mark)

Question 3 First-order calculation (3 marks)

A first-order reaction has $k = 5.0 \times 10^{-4} \text{ s}^{-1}$ and $[\text{A}]_0 = 0.250 \text{ M}$.

- Calculate $[\text{A}]$ after 1200 s. (2 marks)
- Calculate the half-life. (1 mark)

Question 4 Graph reading (2 marks)



Concentration of A with time.

- Use the graph to find the half-life and state the order. (1 mark)
- Calculate k . (1 mark)

Question 5 Second-order time (3 marks)

A second-order reaction has $k = 0.40 \text{ M}^{-1} \text{ s}^{-1}$ and $[A]_0 = 0.30 \text{ M}$. Calculate the time for $[A]$ to fall to 0.10 M .

Question 6 Explaining the effect of concentration (2 marks)

Explain, using collisions, why raising the concentration of a reactant usually increases the rate.

Question 7 Plots (2 marks)

A student plots $[A]$, $\ln[A]$ and $1/[A]$ against time. Only the $\ln[A]$ plot is a straight line.

- State the order. (1 mark)
- State what the slope of the line represents, including its sign. (1 mark)

Question 8 Order from half-lives (3 marks)

A reaction has half-lives of 40 s at $[A]_0 = 0.80 \text{ M}$, 80 s at 0.40 M and 160 s at 0.20 M .

- Determine the order and justify it. (1 mark)
- Calculate k with units. (2 marks)