

Exercise walk-through

5.3

Concentration Changes Over Time

AP Chemistry

Concentration over time

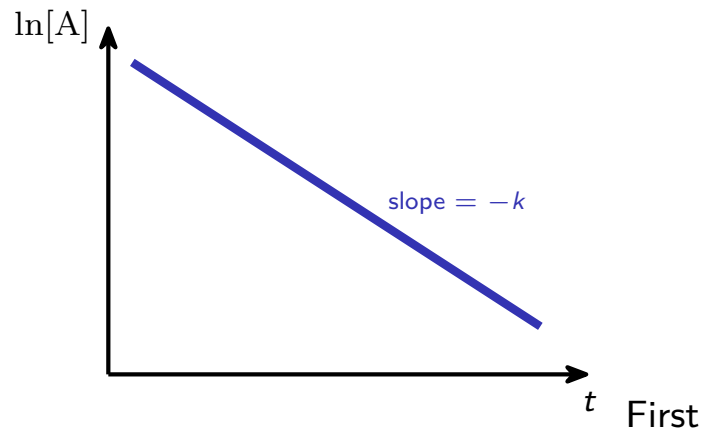
The **integrated rate law**

gives concentration at any time – and a **straight-line plot** that reveals the order:

Which plot is linear?

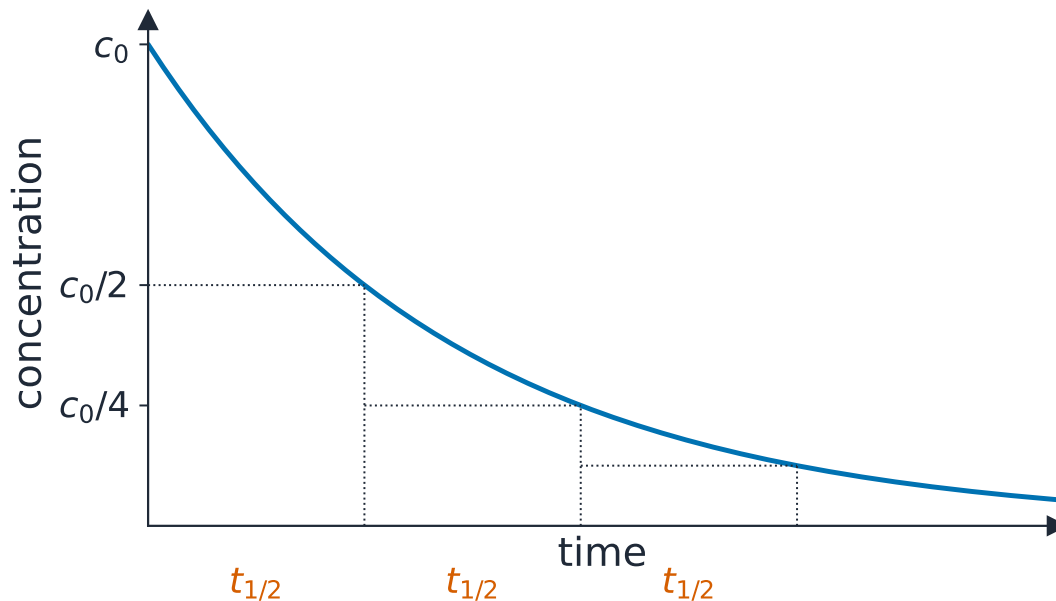
0: $[A]$ vs t 1st: $\ln[A]$ vs t 2nd: $1/[A]$ vs t

First-order **half-life** is constant: $t_{1/2} = \frac{0.693}{k}$.



order: $\ln[A]$ falls linearly.

A first-order reaction has a constant half-life



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Exercises 2.1-2.3

2.1 Which plot is linear for a first-order reaction?

[1]

2.2 Find the half-life of a first-order reaction with $k = 0.100 \text{ s}^{-1}$.

[2]

2.3 For a first-order reaction, does the half-life depend on the starting concentration? [1]

Exercises 2.1-2.3

2.1 Which plot is linear for a first-order reaction?

[1]

2.1

- $\ln[A]$ vs t
-

2.2 Find the half-life of a first-order reaction with $k = 0.100 \text{ s}^{-1}$.

[2]

2.2

- $t_{1/2} = \frac{0.693}{0.100} = 6.93 \text{ s}$
-

2.3 For a first-order reaction, does the half-life depend on the starting concentration? [1]

2.3

- No – it is constant (independent of starting concentration)

Exercise 3.1

3.1 A plot of $\frac{1}{[A]}$ vs time is linear. The reaction is

[1]

☐

A zero order

B first order

C second order

D third order

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3.1 C

- a linear $\frac{1}{[A]}$ plot means second order

Exercise 3.2 (a)

3.2 A first-order reaction has a half-life of 30 s.

(a) Find the rate constant k .

[2]

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(a)

- $$k = \frac{0.693}{30} = 0.0231 \text{ s}^{-1}$$

Exercise 3.2 (b)

3.2 A first-order reaction has a half-life of 30 s.

(b) What fraction of the reactant remains after 60 s?

[2]

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(b) What fraction of the reactant remains after 60 s?

[2]

(b)

- 60 s is two half-lives, so $\left(\frac{1}{2}\right)^2 = \frac{1}{4}$ remains

Exercise 3.3

3.3 A student plots $[A]$, $\ln[A]$, and $\frac{1}{[A]}$ against time; only the $\ln[A]$ plot is straight. State the order and how to find k from the graph. [2]

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3.3

- First order; the slope of the $\ln[A]$ vs t line is $-k$