

3.2.3 Order of a Reaction

$$\text{Rate} = k[A]^x[B]^y$$

[\[Experimental Kinetics\]](#)[\[Exam Revision\]](#)

Order with Respect to a Reactant



Order with respect
to reactant A

Rate Constant

Order with respect
to reactant B

What do they mean?

Exponents x and y indicate how sensitive the reaction rate is to a change in the concentration of A and B.

[Determined Experimentally]

These exponents may or may not be equal to the **stoichiometric coefficients** (a and b) in the balanced chemical equation.

Defining the Overall Order of Reaction

The sum of powers of the concentration of the reactants in the rate law expression is called the order of that chemical reaction.



(Order of A)

+



(Order of B)

=



(Overall Order)

[Mathematical Rule]

Simply add the individual exponents from the experimental rate expression to find the total order.



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$$E=mc^2$$



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Possible Values for Reaction Order

[Integers]

1, 2, 3

Standard rate dependence. For a first-order reaction (**$n=1$**), doubling concentration doubles the rate.

[Zero Order]

0

The rate is completely independent of the concentration of reactants.

$$\text{Rate} = k[A]^0 = k$$

[Fractional]

e.g., 1/2, 3/2

Indicates a complex, multi-step reaction mechanism.

[Negative]

e.g., -1

An inverse relationship. Increasing the concentration of this specific reactant decreases the rate.

Solved Examples from Rate Expressions

Calculate overall order.

$$\text{Rate} = k[\text{A}]^{1/2} [\text{B}]^{3/2}$$



$$\text{Order} = x + y \rightarrow 1/2 + 3/2 = 4/2$$

[Second Order (n=2)]

Calculate overall order.

$$\text{Rate} = k[\text{A}]^{3/2} [\text{B}]^{(-1)}$$



$$\text{Order} = x + y \rightarrow 3/2 + (-1) = 1/2$$

[Half Order (n=1/2)]

Notice how straightforward the math is once the experimental rate expression is given.

Final Recap: Where Does Order Come From?



Balanced Chemical Equation



Merely looking at the stoichiometric coefficients (a and b) theoretically tells you nothing about the actual rate or order.

Experimental Rate Law

$$\text{Rate} = k[A]^x[B]^y$$

Order ONLY comes from the experimentally determined exponents (x and y).

The Golden Rule

Order is an experimental quantity representing the sum of powers in the rate law expression, not the stoichiometric coefficients of a balanced equation.