**Chemical Kinetics**

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## **Factors Influencing Rate of Reaction**

1. Temperature
2. Pressure/Volume/Concentration
3. Catalyst
4. Surface Area
5. Light
6. Sound

Terms:

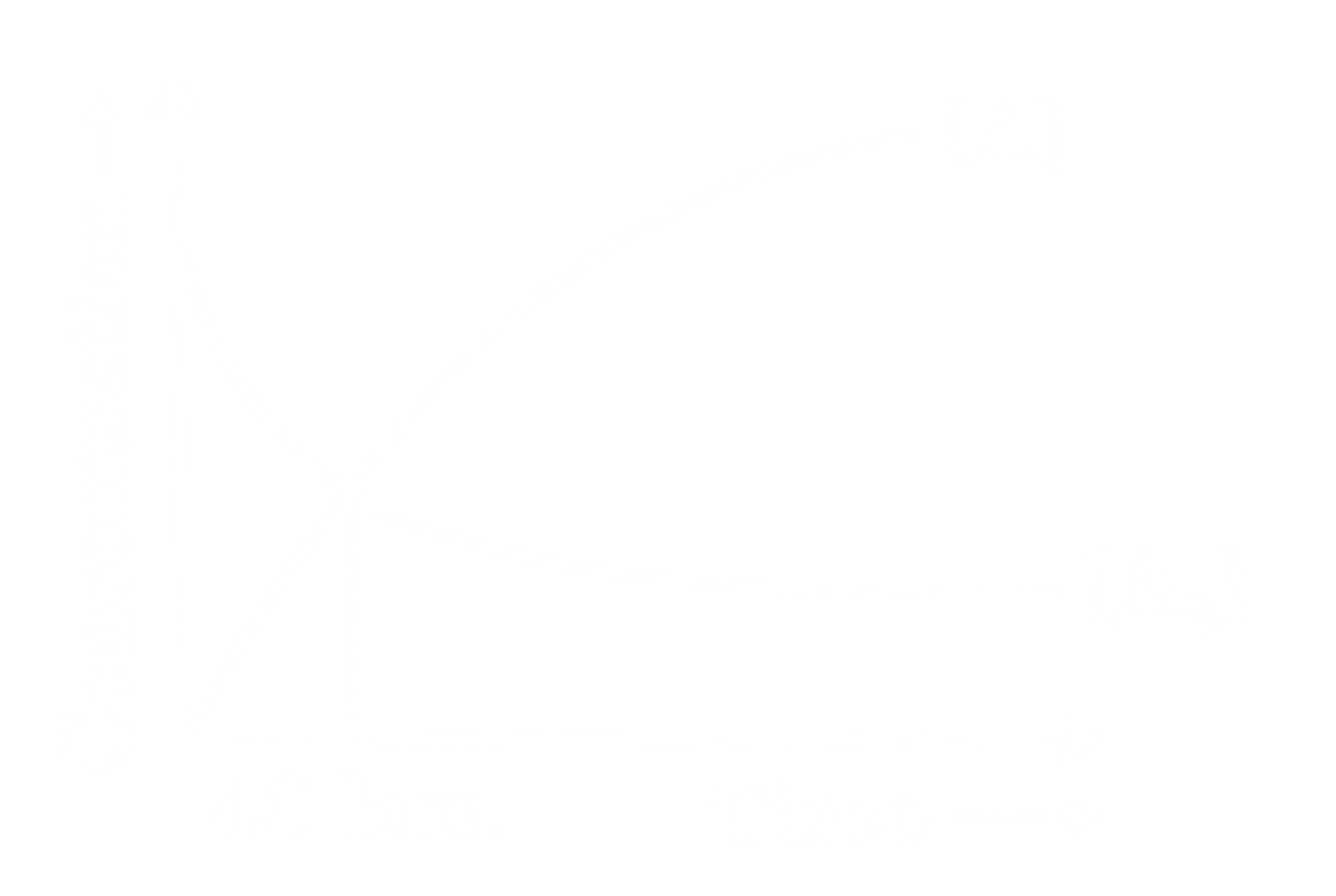
Order – Number of components actively taking part in a reaction; practical

Molecularity – Number of components taking part in a reaction; theoretical

SN2 order – 2 molecularity - 2

SN1 order – 1 molecularity - 2

SN2 – rate depends on 2 components



Rate =

## Law of Mass Action

rate

Here, is the rate constant.

Let

rate

Here is the order, is the molar concentration, and is the rate constant.

This is known as the Rate Law.

rate

rate

If the reaction is considered to be a 2-step reaction,

- slower, rate determining step

- faster step

rate - first order

## First Order Reactions

moles moles

At , moles moles

rate or

This is the kinetic equation for a first order reaction in differential form.

This is the kinetic equation for a first order reaction in linear form.

If the graph of this equation gives a straight line, the reaction is 1st order, with a slope of .

This is the kinetic equation for a first order reaction in exponential form.

This is the kinetic equation for a first order reaction in integral form.

Tests for First Order Reactions

1. Integral Method: Same value of rate constant for different initial concentration values, under same condition.

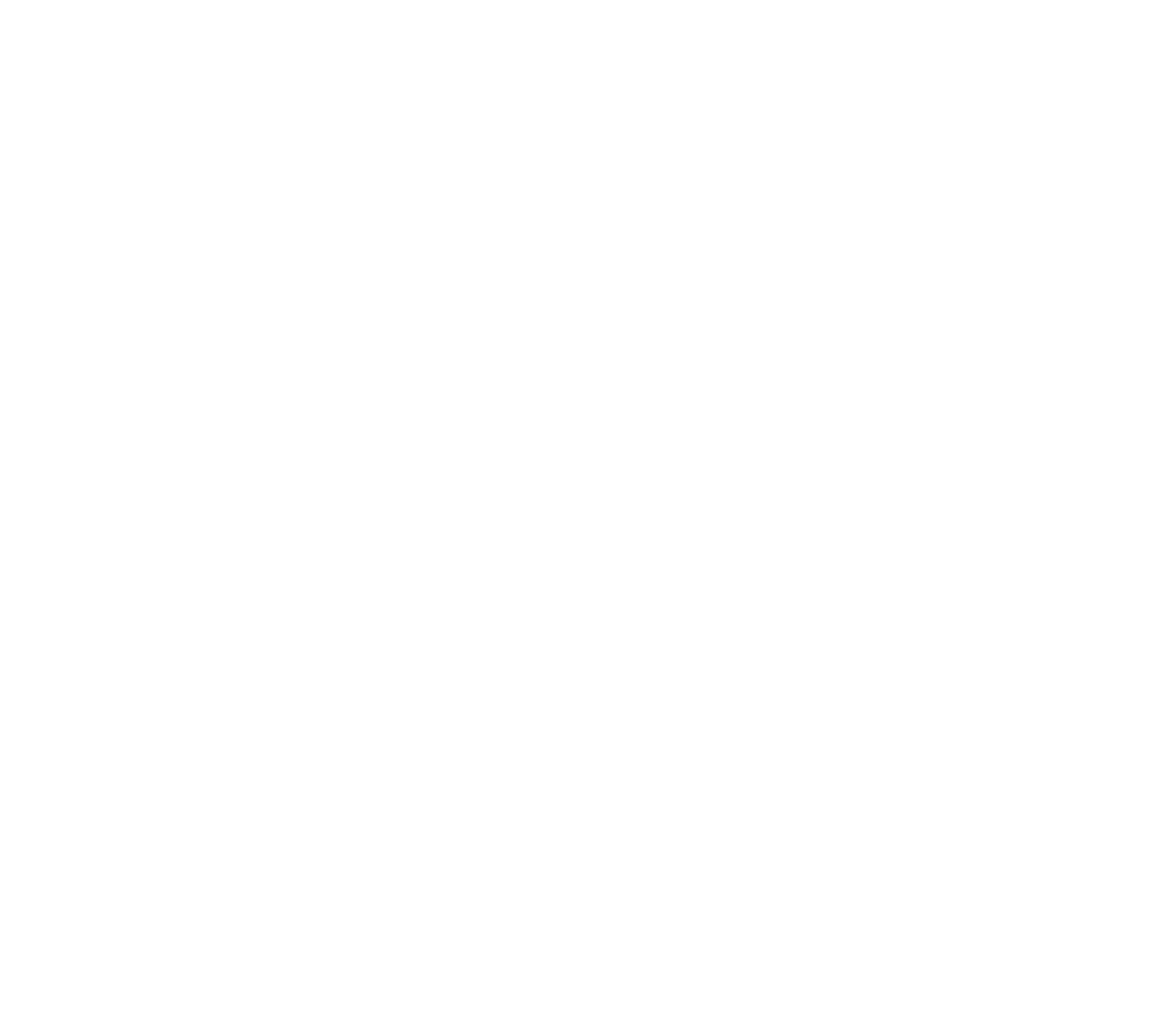
2. Graphical Method: Straight line graph

3. Half-Life Method: is constant.

## Second Order Reactions

Let, at time , moles moles

At time moles moles



Applying the Law of Mass Action,

rate

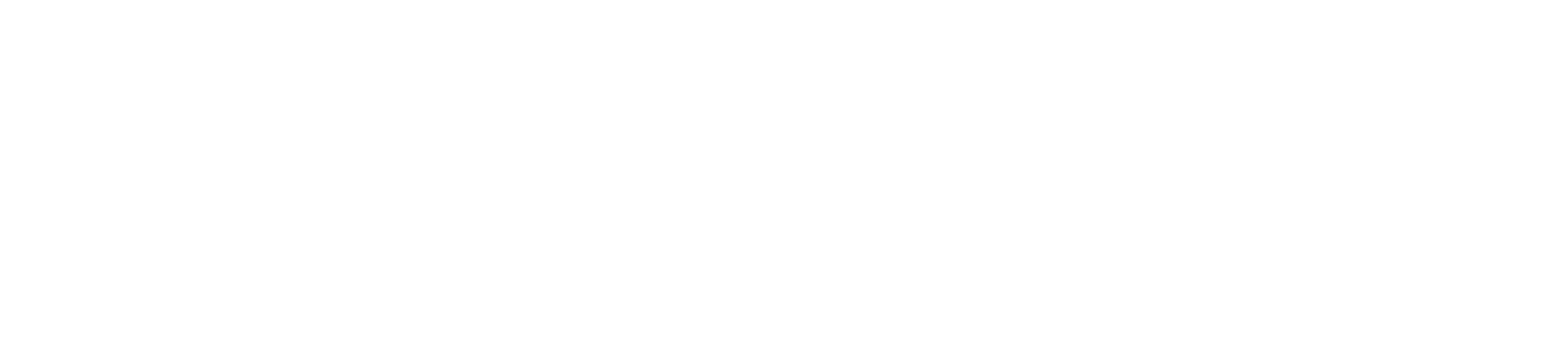
This is the kinetic equation for a second order reaction in differential form.

This is the kinetic equation of a second order reaction in linear form.

If the graph of this equation is a straight line, then the reaction is second order. The slope is .

This is the kinetic equation of a second order reaction in integral form.

SN2



SN1

The SN1 method cannot follow the same process as SN2, since the molecules attached to the atom are larger. The ion cannot reach the atom.

### Tests for Second Order Reactions

1. Integral Method

2. Graphical Method

3. Half-Life Method

4. Isolation Method

In the isolation method, all reactants except for one are taken in excess, thus removing the effect of their concentrations.

Here, is taken in excess, and is irrelevant.

So the original rate equation, rate becomes rate since only the effect of the concentration of is prominent. Thus, .

5. Differential Method

Here, is the order, from the graph.

## Relationship Between and Temperature: Arrhenius Equation

Generally,

Activation Energy increases, slower reaction

- Arrhenius Parameter or Frequency Number

Heating provides kinetic energy to cross the barrier.

## Catalysis

Relationship of and ( is constant)

decreases, increases and vice versa

Relationship of and ( is constant)

increases, increases and vice versa

## Chemical Equation

The reaction could be homogenous or heterogenous, and the states of each component must be stated. If all states are the same, the reaction is homogenous. Else, it is heterogenous.

Using the Law of Mass Action,

Equilibrium Constant , given that condition remain the same

at a constant temperature

Relationship Between and

Applications:

I] When ,

II]

III]