EXPERIMENT 4
CHEMICAL KINETICS
Concentration Dependence & Reactant Order

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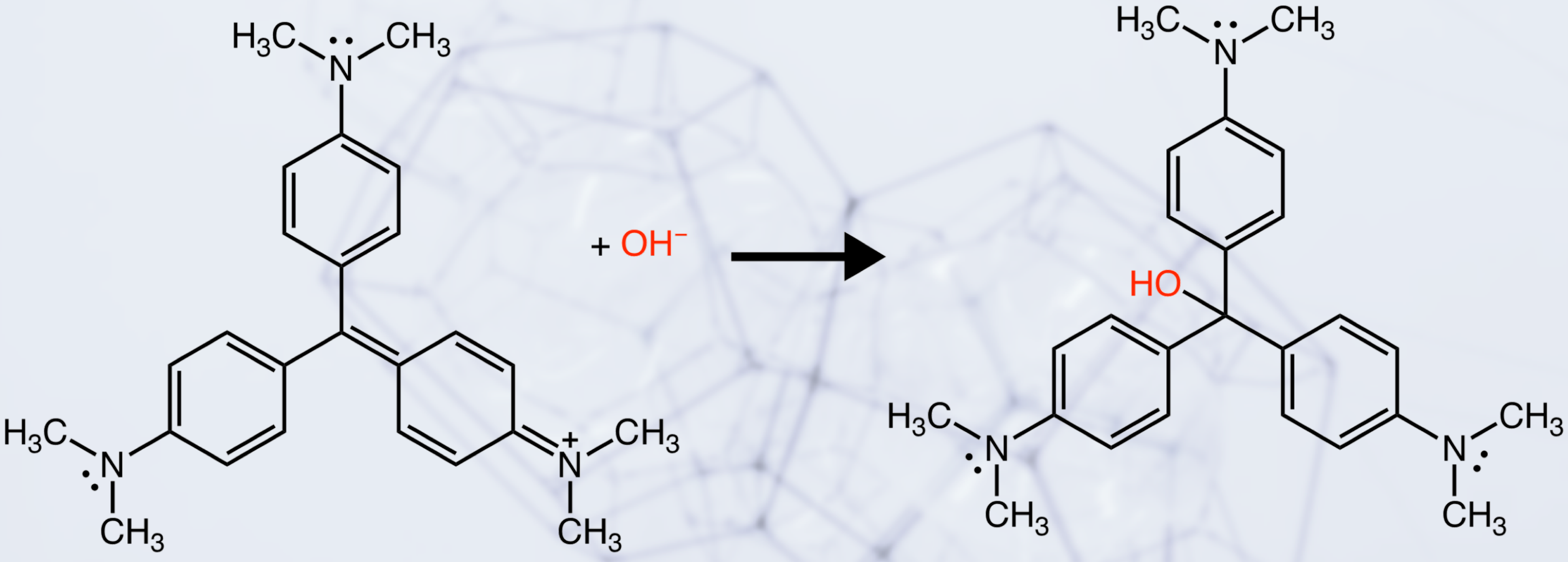


CRYSTAL VIOLET (CV)

COLORLESS

The reaction rate can be expressed as

$$\text{Rate} = -\frac{d[\text{CV}]}{dt} = -\frac{d[\text{OH}^-]}{dt} = -\frac{d[\text{product}]}{dt}$$

PURPOSE

Concentration dependence and order

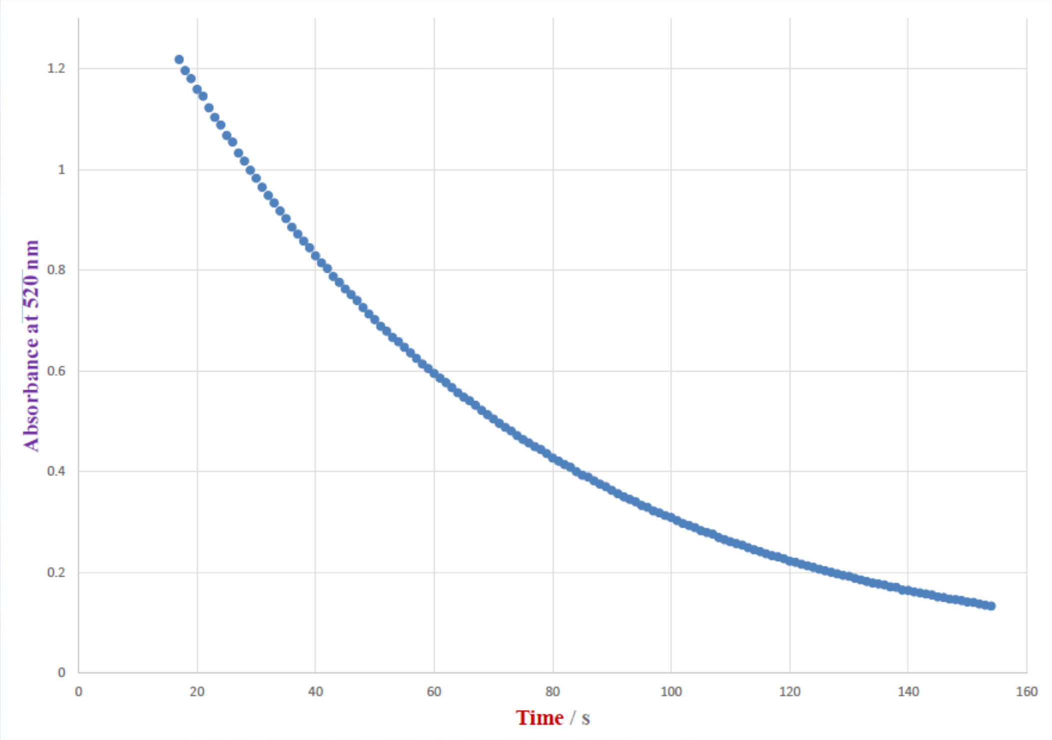
Determination of rate constant value

REACTION ORDER: WHAT IS IT?

$$\text{Rate} = -\frac{d[\text{CV}]}{dt} = k[\text{CV}]^1[\text{OH}^-]^1$$

Determining the rate order:

1. *Initial rate method*
2. *Integrated equation method*
3. *Half-life method*



METHOD OF FLOODING

$$\text{Rate} = -\frac{d[\mathrm{CV}]}{dt} = k[\mathrm{CV}]^1[\mathrm{OH}^-]^1$$

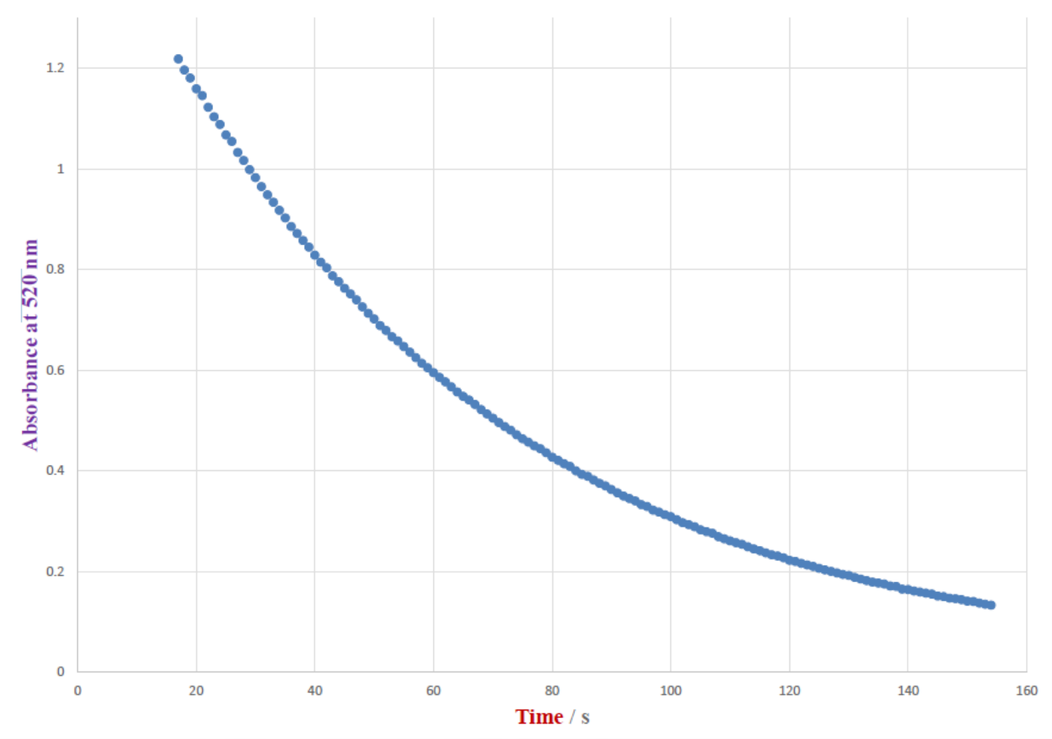
Make $[OH^-]_0 >> [CV]_0$

$[CV]_0 = 3 \times 10^{-5}$ M

$[OH^-]_0 = 0.2$ to 0.05 M

$$\text{Rate} = -\frac{d[\mathrm{CV}]}{dt} \approx k'[\mathrm{CV}]^1$$

$$k' = k[\mathrm{OH}^-]_0$$



INTEGRATION GIVES

$\ln[CV]_t$	=	$\ln[CV]_0$	–	k'	t
$\ln A_t$	=	$\ln A_0$	–	k'	t
y	=	b	+	m	x

If a plot of ln (Absorbance) vs. time is linear,
order with respects to [CV] is 1
and the slope = –k’

Determine order with respects to $[OH^-]_0$
Determine k' for various $[OH^-]_0$

↓

If a plot of k' versus $[OH^-]_0$ is linear,
then order with respects to $[OH^-]$ is 1
and slope = k

VERNIER
SPECTROMETER