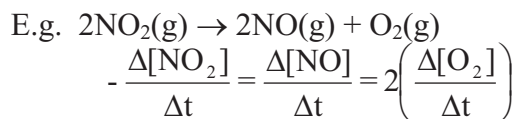


# Chemical Kinetics

## Reaction Rates

Rate =  $\frac{\Delta[A]}{\Delta t}$  → Slope of tangent line of concentration vs. time graph



## Rate Laws-Introduction

Differential Rate Law-rate depends on concentration

Rate =  $k[\text{NO}_2]^n$  → k & n found experimentally

→ rate law under conditions that only forward reaction takes place at a reasonable rate

Integrated Rate Law-describes how concentrations depend on time

## Determining the Form of the Rate Law

### Method of Initial Rates

E.g.  $\text{NH}_4^+(\text{aq}) + \text{NO}_2^-(\text{aq}) \rightarrow \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$  → see Table 12.4 on page 569 for data

Rate =  $-\frac{\Delta[\text{NH}_4^+]}{\Delta t} = k[\text{NH}_4^+]^n[\text{NO}_2^-]^m$  → from data in Table 12.4, n = 1, m = 1,

and  $k = 2.7 \times 10^{-4} \text{ L/mol}\cdot\text{s}$

Rate =  $(2.7 \times 10^{-4} \text{ L/mol}\cdot\text{s})[\text{NH}_4^+][\text{NO}_2^-]$

## The Integrated Rate Law

E.g.  $a\text{A} \rightarrow \text{products}$  where kinetics is first order

Rate =  $-\frac{\Delta[A]}{\Delta t} = k[A]$

$\frac{d[A]}{dt} = k[A]$  → Calculus derivation

$\frac{d[A]}{[A]} = kdt$

$\int_{A_0}^A \frac{d[A]}{[A]} = - \int_0^t kdt$

$\ln[A] \Big|_{A_0}^A = -kt \Big|_0^t$

$\ln[A] - \ln[A_0] = -k(t - 0)$

$$\boxed{\ln[A] = -kt + \ln[A_0]}$$
  
 $y = mx + b$

→ graph of  $\ln[A]$  vs.  $t$  should produce a straight line with a slope of  $-k$  & a y-intercept of  $\ln[A_0]$  where kinetics are FIRST order.