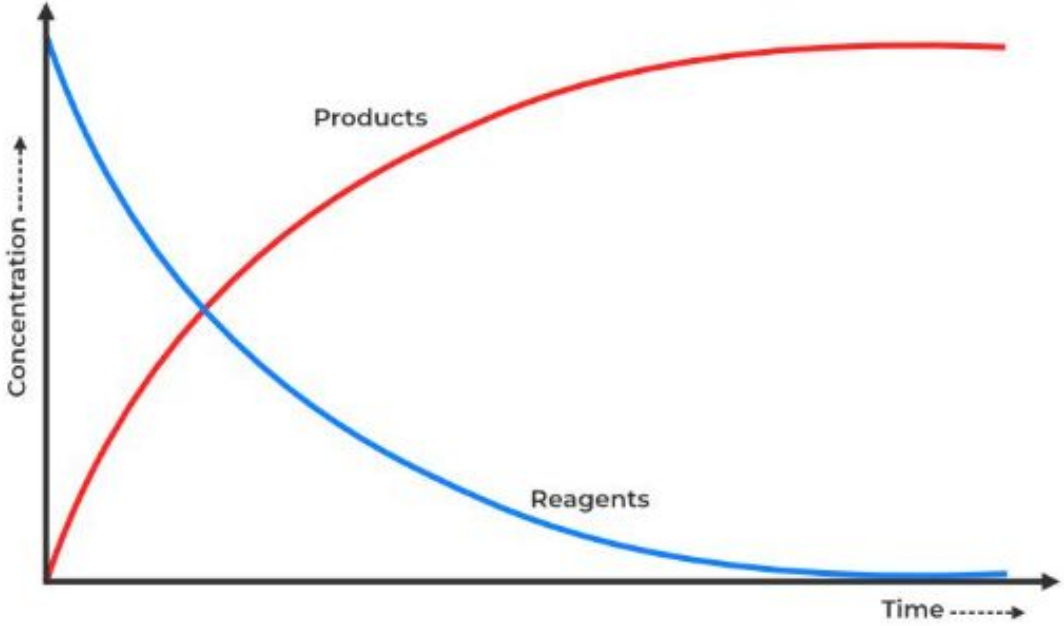
$aA + bB \rightarrow cC$



$$\text{Rate} = \frac{-1}{a}(\Delta A/\Delta t) = \frac{-1}{b}(\Delta B/\Delta t)$$

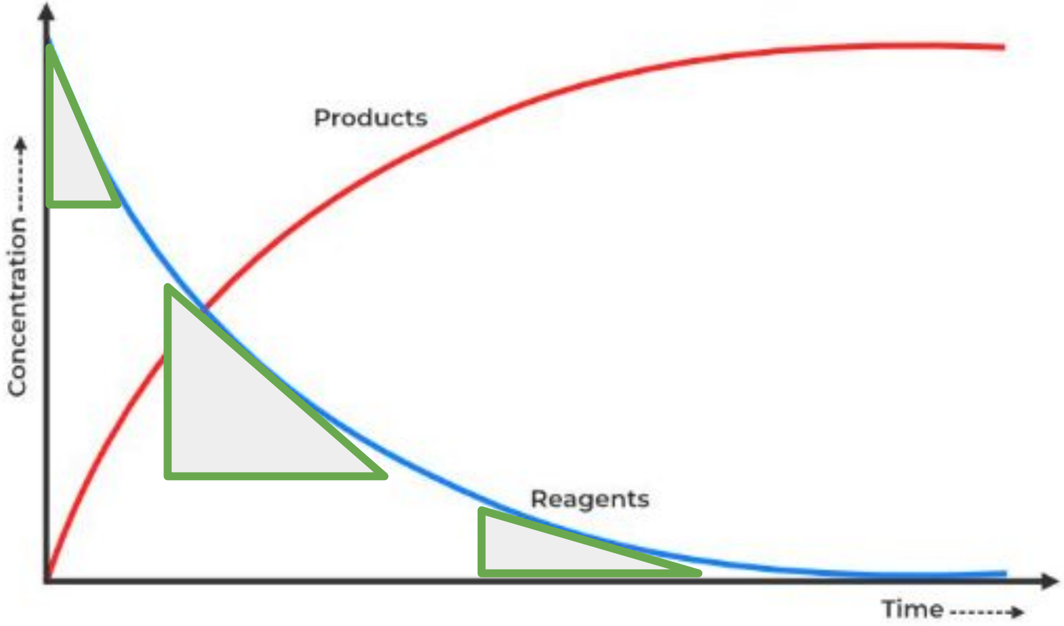
Rates cannot be negative!

$A + B \rightarrow C$

$$\text{Rate} = \frac{-1}{1}(\Delta A/\Delta t) = \frac{-1}{1}(\Delta B/\Delta t)$$

$2A + 3B \rightarrow C$

$$\text{Rate} = \frac{-1}{2}(\Delta A/\Delta t) = \frac{-1}{3}(\Delta B/\Delta t)$$



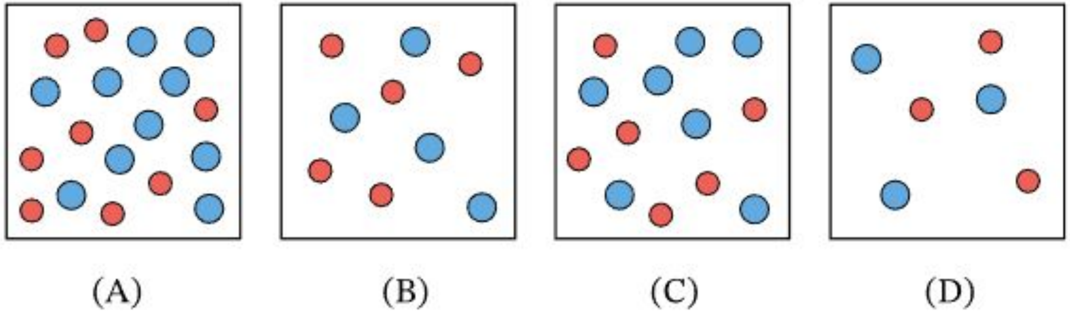
- To find the rate at a given time, we need to find the slope
- Slope is tangential to the curve

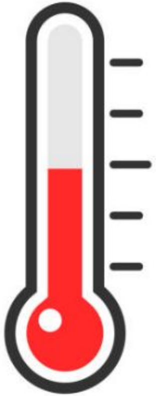
Chemistry

REACTION RATES

What affects the rate?

concentration

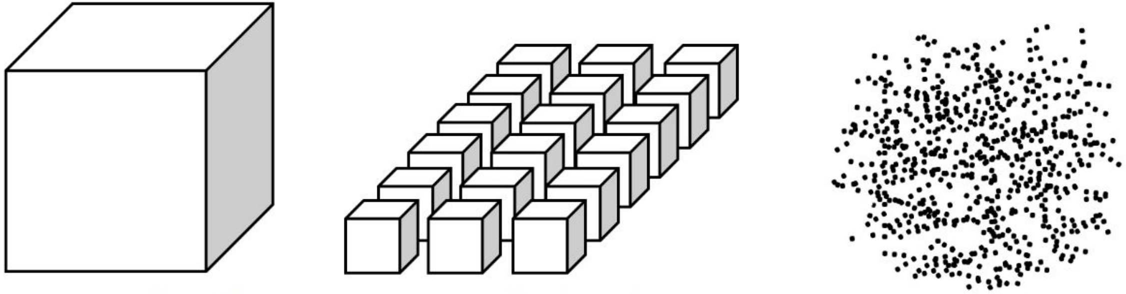




temperature

catalyst

surface area



Large Chunks

Small Chunks

Powder

Rate Equations

Rates are always measured
in M/s or mol/(L·s)

→ rate constant units
are flexible and adjust
for differences

for $A + B \rightarrow C$
$\text{Rate} = [A][B]$
$M/s = M \cdot M$ (?)

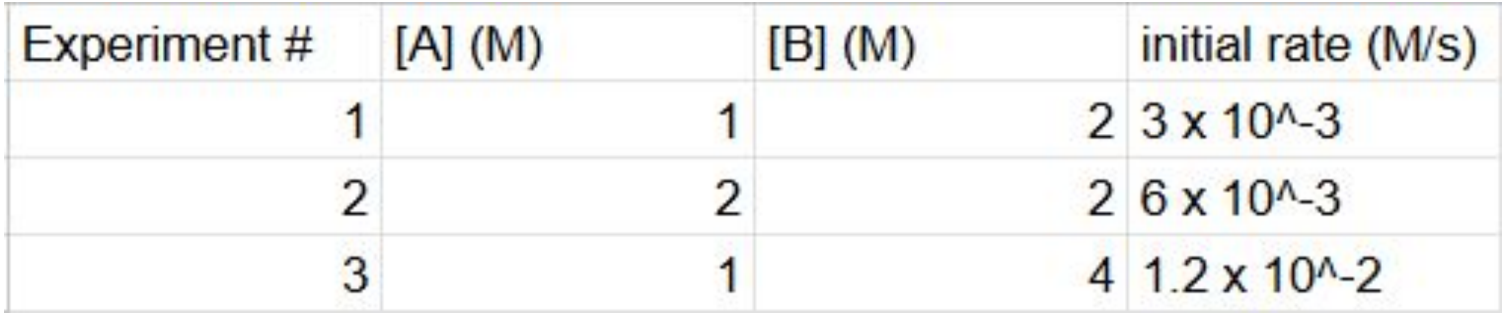
$\text{Rate} = k[A][B]$
where k has units of $1/(M \cdot s)$ or
$L/(mol \cdot s)$
so that:
$M/s = M \cdot M \cdot 1/(M \cdot s)$

Rate Constant (k)

- Experimentally determined
- Adjusts rate equations so that concentration and rate are proportional

- Temperature dependent
  - Due to Arrhenius equation (relates activation energy to reaction rate; don’t worry about it now)

- Large rate constant means a faster reaction
- Small rate constant means a slower reaction



Experiment #	[A] (M)	[B] (M)	initial rate (M/s)
1	1	2	3 x 10^-3
2	2	2	6 x 10^-3
3	1	4	1.2 x 10^-2

Example of experimental data

- Double concentration of A results in doubled rate
- What about B?

→ Next week: orders of reactions