

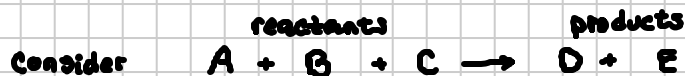
Lecture 4.2 · Reaction Rate Equation

Note Title

1/4/2012

rate_{rxn}: How fast is the reaction going? graph conc. vs time... Slope $\frac{\Delta \text{conc}}{\Delta t}$... rate

.. depends on concentrations of reactants...



rxn rate equation $\text{rate}_{\text{rxn}} = k [A]^x [B]^y [C]^z$

\uparrow rxn rate const.

Example: $\text{rate}_{\text{rxn}} = k [A]^0 [B]^1 [C]^2$

- ... rxn is zeroth order in [A]
- ... rxn is first order in [B]
- ... rxn is second order in [C]
- ... rxn is $0+1+2=3$.. 3rd order overall.

• How does doubling (2x) the [A] affect the rxn rate?

$$\text{rate} = k [A]^0 [B]^1 [C]^2$$

$$\text{rate} = k (2 [A])^0 [B]^1 [C]^2$$

$$\text{rate} = 2^0 \cdot k [A]^0 [B]^1 [C]^2$$

$$\text{rate} = 2^0 \times \text{rate}$$

$$\text{rate} = 1 \times \text{rate} = \text{rate}$$

.. doubling [A] no effect on rxn rate

• How does tripling (3x) the [B] affect the rxn rate?

$$\text{rate} = k [A]^0 [B]^1 [C]^2$$

$$\text{rate} = k [A]^0 (3 [B])^1 [C]^2$$

$$\text{rate} = 3^1 \cdot k [A]^0 [B]^1 [C]^2$$

$$\text{rate} = 3^1 \cdot \text{rate}$$

$$\text{rate} = 3 \cdot \text{rate}$$

1st order tripling [B], triples rate

• How does quadrupling (4x) the [C] affect the rxn rate?

$$\text{rate} = k [A]^0 [B]^1 [C]^2$$

$$\text{rate} = k [A]^0 [B]^1 (4 [C])^2$$

$$\text{rate} = 4^2 \cdot k [A]^0 [B]^1 [C]^2$$

$$\text{rate} = 16 \times \text{rate}$$

2nd rxn 4x conc $\Rightarrow 4^2 = 16 \times$ faster reaction.

• How would all of the above changes to [A], [B] & [C] affect the reaction rate?

$$2 \times [A], 3 \times [B], 4 \times [C]$$

$$\text{rate} = k [A]^0 [B]^1 [C]^2$$

$$\text{rate} = k (2 [A])^0 (3 [B])^1 (4 [C])^2$$

$$\text{rate} = 2^0 \cdot 3^1 \cdot 4^2 \cdot k [A]^0 [B]^1 [C]^2$$

$$\text{rate} = 1 \cdot 3 \cdot 16 \cdot \text{rate}$$

$$\text{rate} = 48 \times \text{rate}$$

rxn goes 48x faster