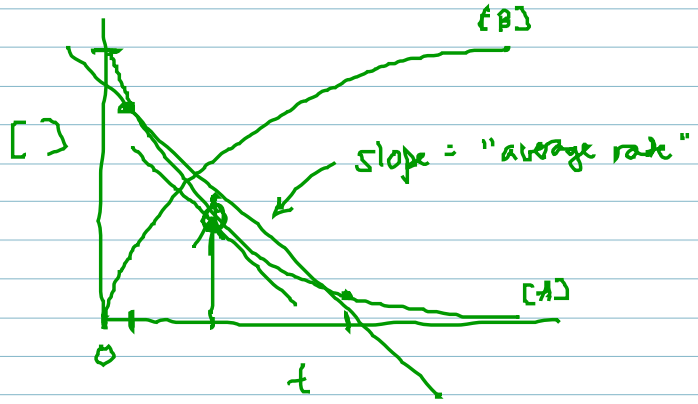
CHAPTER 13 KINETICS (REACTION RATES)

reaction rates $\frac{\Delta[\ ]}{\Delta t}$

$A \longrightarrow B$ as time goes by $[A]\downarrow$ $[B]\uparrow$

"average" rate $= -\frac{\Delta[A]}{\Delta t} = \frac{\Delta[B]}{\Delta t}$

(+)



the rate is changing as time goes by

→ if the time interval shrinks to a single point ⇒ line = tangent

slope of tangent ⇒ "instantaneous" rate

$\left(\frac{d[\ ]}{dt}\right)$

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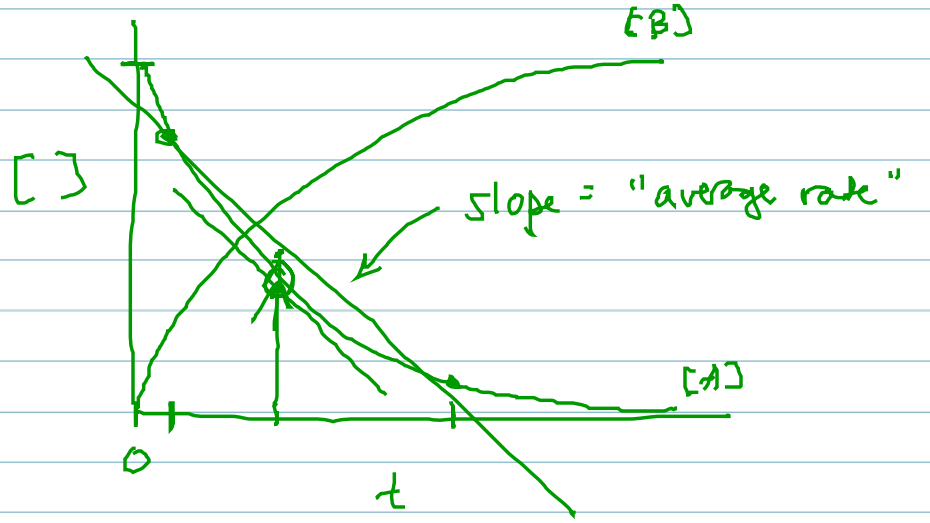

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$aA + bB \longrightarrow cC + dD$

rate law: $\text{rate} = k[A]^{x}[B]^{y}$

- rate constant
  - independent of [ ]
  - T DEPENDENT
    - ↑T k↑
- "orders" of the reaction
  - must be determined experimentally (for an overall reaction)

$$\text{average rate} = -\frac{1}{a}\frac{\Delta[A]}{\Delta t} = -\frac{1}{b}\frac{\Delta[B]}{\Delta t} = \frac{1}{c}\frac{\Delta[C]}{\Delta t} = \frac{1}{d}\frac{\Delta[D]}{\Delta t}$$

$$4\,NH_{3(g)} + 5\,O_{2(g)} \longrightarrow 4\,NO_{(g)} + 6\,H_2O_{(g)}$$

$$\text{"average rate"} = -\frac{1}{4}\frac{\Delta[NH_3]}{\Delta t} = \frac{1}{6}\frac{\Delta[H_2O]}{\Delta t}$$

instantaneous rate: $\text{rate} = k[NH_3]^{x}[O_2]^{y}$

Overall order	k unit
0	$M\,s^{-1}$
1	s^{-1}
2	$M^{-1}\,s^{-1}$
3	$M^{-2}\,s^{-1}$ $\quad L^2\,mol^{-2}\,s^{-1}$
4	$M^{-3}\,s^{-1}$
5	$M^{-4}\,s^{-1}$

rate unit $\Rightarrow$ M/time $\quad \frac{mol}{L \cdot s}$ $\quad mol\,L^{-1}\,s^{-1}$