AP Chem- Chapter 13- Kinetics Name_____

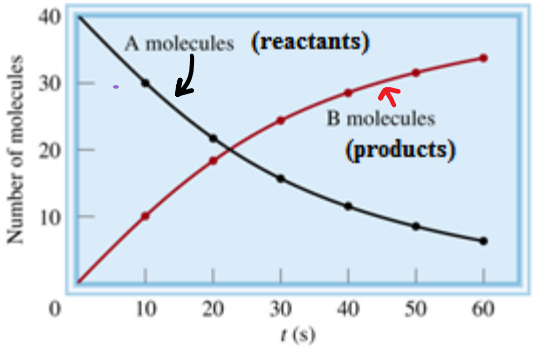
Notes-Day 1- **The Rate of a Reaction [13.1]**

Chapter 13: Kinetics: Rates of reactions--How fast does a reaction occur?

Chapter 18: Thermodynamics (ΔG): Does a reaction occur? Is it favorable to occur?

Reaction rate [13.1]: the change in concentration of a reactant or product with time (M/s)

a) **Example Rxn: A → B**



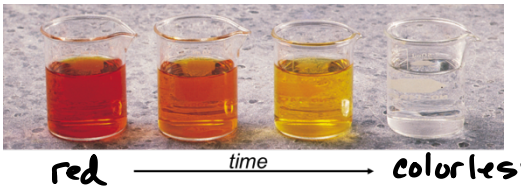
$$\text{Rate of disappearance of A} = -\frac{\Delta[\text{A}]}{\Delta \text{t}} = -\frac{[\text{A}]_f - [A]_i}{\text{t}_f - t_i}$$

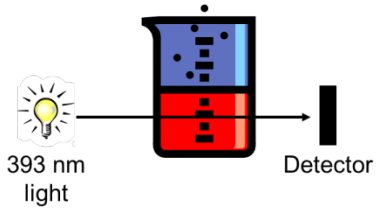
$$\text{Rate of appearance of B} = \frac{\Delta[\text{B}]}{\Delta \text{t}} = \frac{[\text{B}]_f - [B]_i}{\text{t}_f - t_i}$$

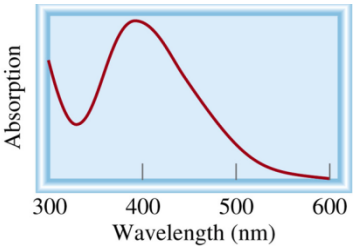
1) Using data from graph, calculate rate of disappearance of A when going from time of 10s to time of 40s.

2) Using data from graph, calculate the rate of appearance of B over the same time period (10 s to 40 s).

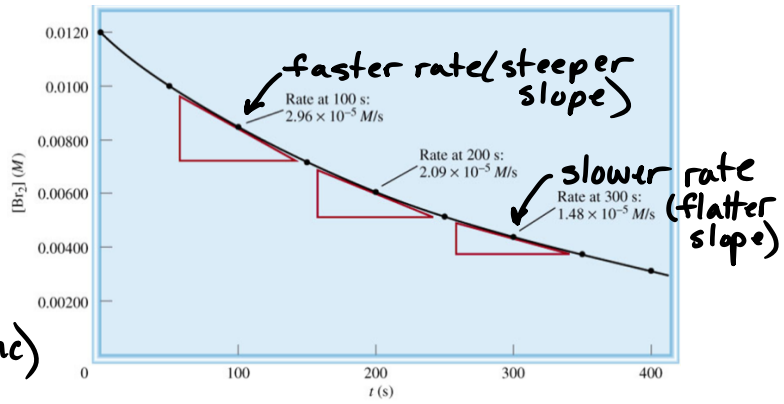
b) Example Rxn: Br_2 (aq) + HCOOH (aq) → 2Br- (aq) + $2H^+$ (aq) + CO_2 (g)







Time (s)	$[Br_2]$ (*M*)
0.0	0.0120 ← red (high conc)
50.0	0.0101
100.0	0.00846
150.0	0.00710
200.0	0.00596
250.0	0.00500
300.0	0.00420
350.0	0.00353
400.0	0.00296 ← colorless (low conc)



One can find an average rate over a specified length of time (or one could take the slope of the tangent line at that point to find the instantaneous rate at a particular time.) **Note: The rate of a reaction often changes as a reaction progresses because the concentrations of reactants change.**

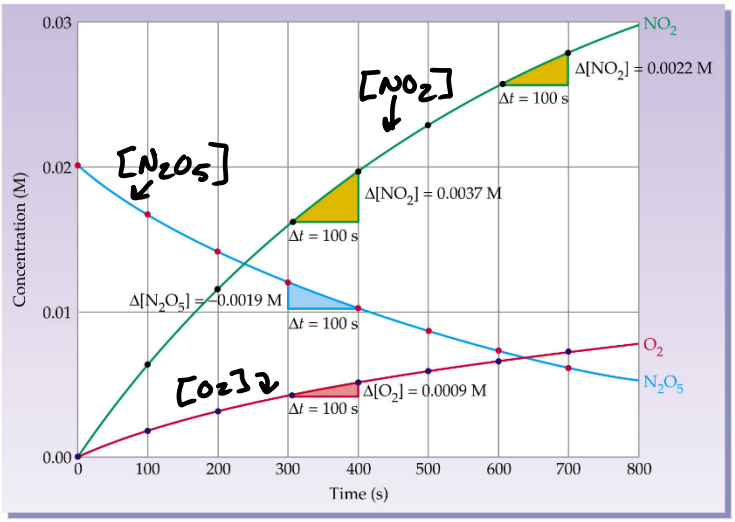
1. What is the average rate of disappearance of Br_2 over the time interval of 50 s to 100s?

2. What is the average rate of appearance of CO_2 over that same interval? *(There is a 1:1 mole ratio!)*

c) **Determining Reaction Rates when stoichiometry is involved**:

Example Rxn: $2\ N_2O_5\ (g) \rightarrow 4\ NO_2\ (g) + \ O_2\ (g)$

1) From the graph, it can be seen that the concentration of N_2O_5 decreases by 0.0019 M in 100 s (When go from time 300s to 400s). What is the rate of disappearance of N_2O_5 over this time period?



2) What must be the rate of appearance for NO_2 over this same time period?

3) What must be the rate of appearance for O_2 over this same time period?

Take Note: *In the book, the following formula is used to make the same stoichiometric calculations that we just did above. I believe the formula is unnecessarily confusing. Thus, I would suggest you disregard it!!*

General rate expression relating the rates of all reactants and products:
In general, for the reaction, $aA + bB \rightarrow cC + dD$

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

There is no reason to use this formula!!
Just use stoichiometry!