b. This law is already in the form of $y = mx + b$ if first order 1/20

i. Slope gives average of all data

4. How did we get integrated rate law?

a. Rate $= -\frac{\Delta[A]}{\Delta t} = -\frac{d[A]}{dt} = k[A]$

b. $\frac{d[A]}{[A]} = -k\,dt$

c. $\int_{A_0}^{A_t} \frac{dA}{[A]} = \int_0^t -k\,dt$, solve $\rightarrow \ln[A_t] - \ln[A_0] = -kt$

d. $\ln[A_t] = -kt + \ln[A_0]$

5. Using Integrated Rate Law

a. $SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$, $k = .17/h$ → Time for Cl_2 to decrease

i. $\ln(0.31 \cdot 10^{-3}\,m / 1.25 \cdot 10^{-3}\,m) = (-.17/h)t$

b. $Ce(IV) + Fe(II) \rightleftharpoons Fe(III) + Ce(III)$, 'a clock reaction'

yellow red blue clear

iii. Second Order Reactions

1. Differential Rate Law

a. $Rate = k[NO_2]^2$

b. Differential $= \dfrac{d[NO_2]}{dt}$

c. Integrated $= \dfrac{1}{[NO_2]_t} = \overset{\text{slope}}{kt} + \dfrac{1}{[NO_2]_0}$ ← intercept

i. Straight positive line is diagnostic for Second Order

d. Example: $2HI \rightarrow H_2(g) + I_2(g)$; $k = 30\,m^{-1}min^{-1}$ → Concentration after 10 min.

i. $1/[A]_t = (30\,m^{-1}\,min^{-1} \cdot 10\,min) + 1/.01\,m = 2.5 \cdot 10^{-3}\,m$

iv. Zero Order Reactions

1. $2N_2O(g) \rightarrow 2N_2(g) + O_2(g)$ w/ platinum catalyst

a. $Rate = k$ (m/s)

i. Concentration doesn't effect rate!

ii. Often zero order due to saturation effect

b. Rate is constant over time

c. Differential $= \dfrac{-\Delta[N_2O]}{\Delta t} = k$

d. Integrated $= [N_2O]_t = \overset{\text{slope}}{-kt} + [N_2O]_0$ ← intercept

i. Straight line is diagnostic for zero order

v. Units of k

1. Ø Order: rate $= k$ → Units: $\dfrac{m}{sec}$

2. 1st Order: rate $= k[A]$ → Units: sec^{-1}

3. 2^{nd} Order: Rate $= k[A]^2 \rightarrow$ Units: $\frac{1}{M \cdot sec} \equiv M^{-1}s^{-1}$