$aA + bB \rightarrow cC + dD$

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

ex: $3O_2(g) \rightarrow 2O_3(g)$ $\quad$ $S_8(s) \rightarrow 4S_2(g)$

$$\text{rate} = -\frac{1}{3}\frac{\Delta[O_2]}{\Delta t} = \frac{1}{2}\frac{\Delta[O_3]}{\Delta t} \qquad \text{rate} = -\frac{\Delta[S_8]}{\Delta t} = \frac{1}{4}\frac{\Delta[S_2]}{\Delta t}$$

if O_2 conc decreases by 0.038M during a 12.0s period, what is:

1) rate of rxn. $= -\frac{1}{3}\frac{\Delta[O_2]}{\Delta t} = -\frac{1}{3}\times\frac{(-0.038M)}{12.0s} = 1.1\times10^{-3}\frac{M}{s}$ (2sf.)

$$M\cdot s^{-1} = \frac{mol/L}{s} = \frac{mol}{L\cdot s} = mol\cdot L^{-1}\cdot s^{-1}$$

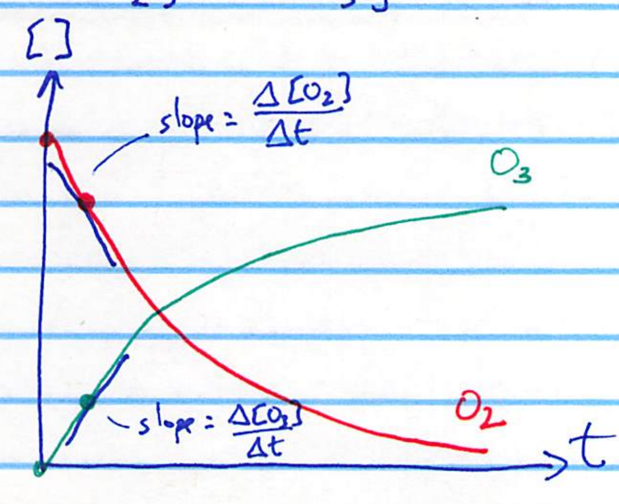
2) $\frac{\Delta[O_3]}{\Delta t}$

$$\text{rate} = \frac{1}{2}\frac{\Delta[O_3]}{\Delta t} \Rightarrow 2\times\text{rate} = \frac{\Delta[O_3]}{\Delta t} = 2\times1.056\times10^{-3}\,M\cdot s^{-1}$$

$$= 2.1\times10^{-3}\,M\cdot s^{-1} \text{ (2s.f.)}$$

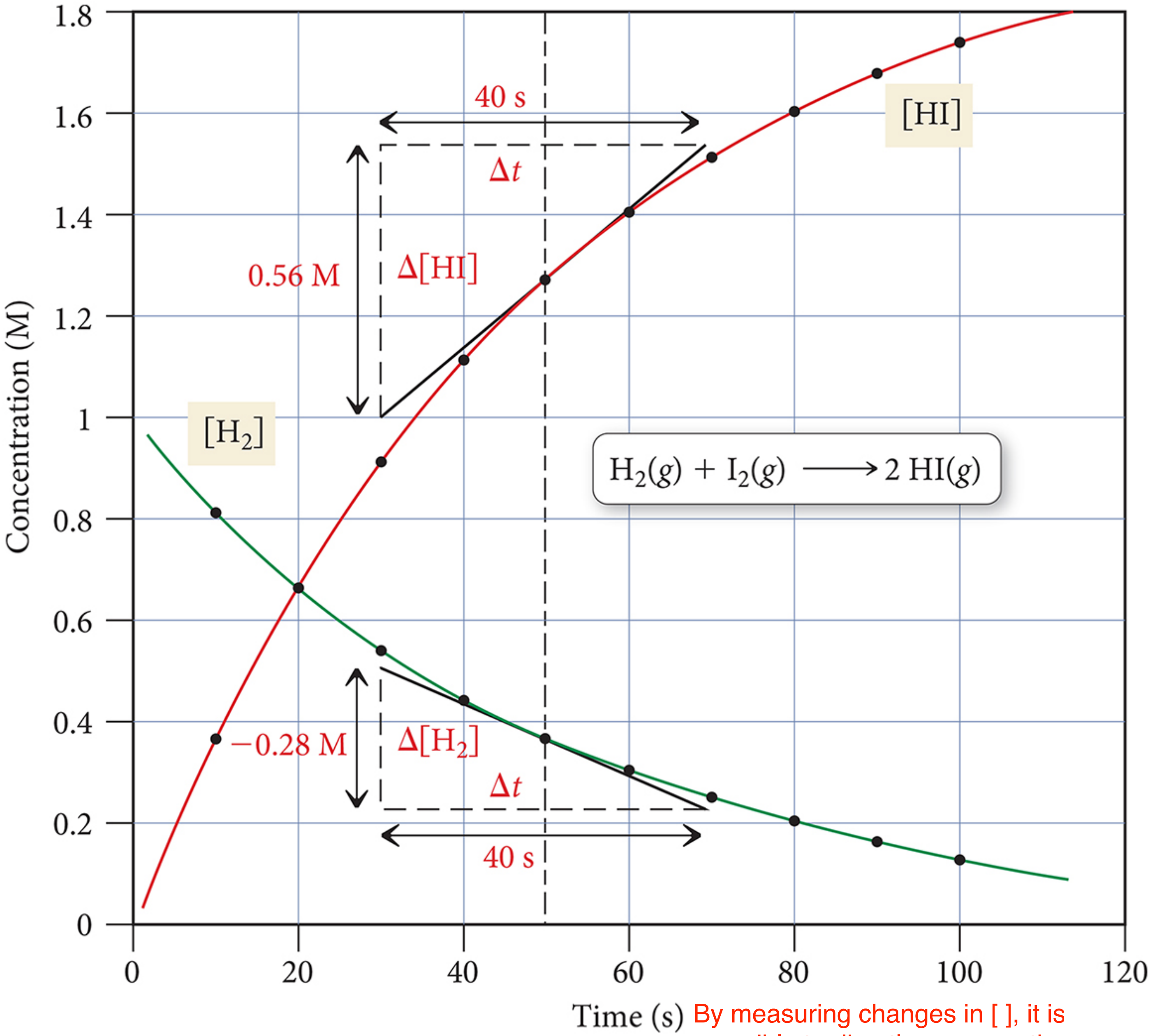
rates are ~ slopes of [ ] vs. t

$3O_2(g) \rightarrow 2O_3(g)$



$$\text{rate} = -\frac{1}{3}\frac{\Delta[O_2]}{\Delta t}$$

$$= +\frac{1}{2}\frac{\Delta[O_3]}{\Delta t}$$



By measuring changes in [ ], it is possible to directly measure the reaction rate!

Note: rate = $-\Delta[H_2]/\Delta t = +\frac{1}{2}\ \Delta[HI]/\Delta t$

$= -\ [-0.28\ M]\ /\ 40s = +\frac{1}{2}\ [0.56\ M]\ /\ 40s$
$= 0.070\ M/s$

How do we measure rates?

- just need a way to measure [ ] vs. t

ex: if we have gases, we can measure P + relate to conc!
ex: if reactant/product is colored, we can monitor changes in absorption of light

The rate law: effect of conc on rate

rate law ~ allows us to predict rate if we know reactant concs.

ex: A ⟶ Products

RATE LAW

$$\text{rate} = K \cdot [A]^n$$

n ← reaction order; K ← rate constant

$n = 0$, zero order
1, 1st order
2, 2nd order
(commonly integers, but can be fractional)

ex: $aA + bB \longrightarrow cC + dD$

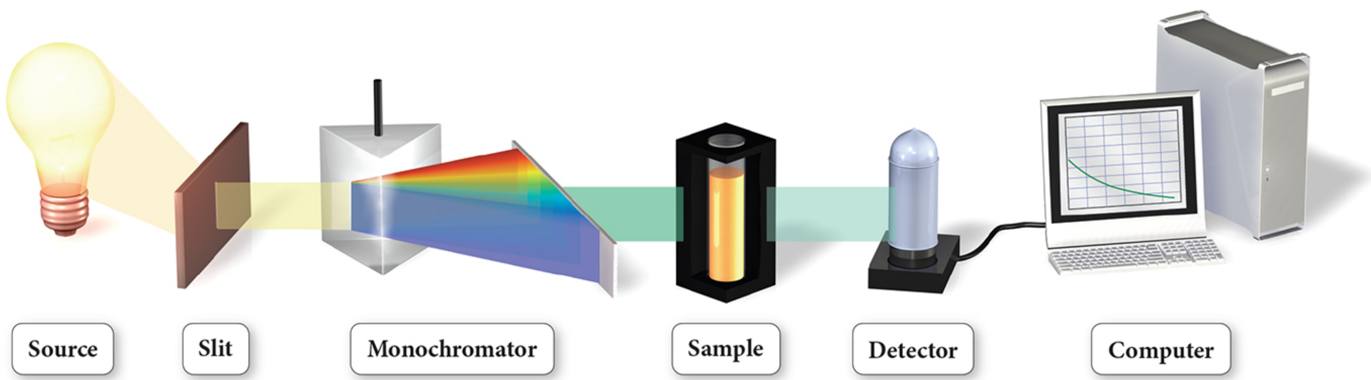
Rate law

$$\text{rate} = K[A]^m[B]^n$$

K ← rate constant

m = order wrt A
n = order wrt B
$m+n$ = overall order

Rxn orders (m,n) have nothing to do w/ stoich coeffs (a,b)



Absorbtion of light can be used as a direct measure of concentration—which is very handy when we are running a reaction with colored reactants or products!

ex: $2H_2(g) + 2NO(g) \longrightarrow N_2(g) + 2H_2O(g)$

rate law: $\text{rate} = k[H_2]^m[NO]^n$

if we want to know m, n ⇝ XPTs

$\text{rate} = k[H_2]^1[NO]^2$ overall order 1+2=3