STEM Center (BLRC 200)
Academic Success Center
HCC Brandon Campus
https://hccfl.mywconline.net

Integrated Rate Law

$A \rightarrow B$	Zero Order	First Order	Second Order
Rate Law	Rate = k	Rate = $k[A]^1$	Rate = $k[A]^2$
Units of k	M^1t^{-1}	M^0t^{-1} or t^{-1}	$M^{-1}t^{-1}$
Half-life ($t_{1/2}$)	$\frac{[A]_0}{2k}$	$\frac{Ln2}{k}$	$\frac{1}{k[A]_0}$
Integrated Rate Law y=mx+b	$A_F = -kt + [A]_0$ Slope: m= -k	$\ln[A_F] = -kt + \ln[A_0]$ Slope: m= -k	$1/[A_F] = kt + 1/[A_0]$ Slope: m= +k
Plot	[A] vs t	Ln[A] vs t	1/[A] vs t

❖ Note: k = rate constant, $[A]_0$ = initial concentration, $[A]_F$ = final concentration

- The higher the order, the more effective the reaction is.
- Unit of k for any order: $M^{1-n} . t^{-1}$
    - Where n is the number of order. For example, if it is second order, n=2.
- The half-life of first order doesn't depend on initial concentration while zero and second order do. Also, as K increases, A_0 decreases and vice versa for all cases.

Example:

- The initial concentration of a reactant in a zero order reaction is 0.75 M. The rate constant k is 0.015 M/min. What will be the concentration of the reaction in 15 minutes? How long it will take the concentration to be reduced to 0.06 M?

Because this reaction is in zero order, we are going to use this equation:

$$A_F = -kt + [A]_0$$

- For the first question, we have to plug the value for t to the equation to solve for A_F. We have: A_F = -0.015 M/min . 15 min + 0.75 M = 0.525 M
- For the second question, we instead have the value for A_F, and is asked to solve for t. Using the same equation, we have: 0.06M = -0.015 M/min . t + 0.75 M. To solve for t, we have: t = (0.06M – 0.75M)/ (-0.015 M/min) = 46 minutes.