Dougherty Valley HS Chemistry - AP
Kinetics – Reference Sheet with Problems

Worksheet #3

Name: **Period:** **Seat#:**

Directions: Show all work in a way that would earn you credit on the AP Test! This is always the rule! Some answers are provided at the end in italics and underlined. If you need more space, use binder paper and staple to your worksheet.

First-Order Reactions: (rate is directly proportional to the concentration)

$$\text{Rate} = -\frac{\Delta[\text{R}]}{\Delta \text{t}} = \text{k}[\text{R}]$$

using calculus, as the Δt approaches 0, the Rate equation becomes

$$\ln\left(\frac{[R]_t}{[R]_0}\right) = kt$$

which can be rearranged into the "y = mx + b" format

$$ln[R]_t = -kt + ln[R]_0$$

so… IF the reaction is first-order with respect to R,

plotting $\ln[R]_t$ versus time results in a straight line with **k = -slope**

SUMMARY

Order	Rate Equation	Integrated Rate Equation	Straight Line Plot	Slope	k Units
0	Rate = $k[R]^0$	$[R]_t - [R]_0 = -kt$	$[R]_t$ vs. t	-k	mol / L∗s
1	Rate = $k[R]^1$	$Ln([R]_t/[R]_0) = -kt$ or see below table	$Ln[R]_t$ vs t	-k	s^{-1}
2	Rate = $k[R]^2$	$(1/[R]_t - (1/[R]_0) = kt$	$1/[R]_t$ vs t	k	L / mol∗s
			Memorize this!!		

Zero-Order Reactions	First-Order Reactions	Second-Order Reactions
$\text{Rate} = -\frac{\Delta[\text{R}]}{\Delta\text{t}} = \text{k}[\text{R}]^0$	$\text{Rate} = -\frac{\Delta[\text{R}]}{\Delta\text{t}} = \text{k}[\text{R}]^1$	$\text{Rate} = -\frac{\Delta[\text{R}]}{\Delta\text{t}} = \text{k}[\text{R}]^2$
$[\text{R}]_\text{t} - [\text{R}]_0 = -\text{kt}$	$Ln[\text{R}]_\text{t} - \text{Ln}[\text{R}]_0 = -\text{kt}$	$\frac{1}{[\text{R}]_\text{t}} - \frac{1}{[\text{R}]_0} = \text{kt}$
$[\text{R}]_\text{t} = -\text{kt} + [\text{R}]_0$	$Ln[\text{R}]_\text{t} = -\text{kt} + \text{Ln}[\text{R}]_0$	$\frac{1}{[\text{R}]_\text{t}} = \text{kt} + \frac{1}{[\text{R}]_0}$

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Practice Problem: Show all work. Complete the following.
Data for the decomposition of N_2O_5 in a particular solvent at 45°C are as follows:

t (min)	**$[N_2O_5]$ mol·L^{-1}**	**Ln$[N_2O_5]$**	$\frac{1}{[N_2O_5]}$
3.07	2.08		
8.77	1.67		
14.45	1.36		
31.28	0.72		

Plot the following:

$[N_2O_5]$,	**ln$[N_2O_5]$,**	$\frac{1}{[N_2O_5]}$
Graph:	*Graph:*	*Graph:*
Equation:	*Equation:*	*Equation:*
R^2 value:	*R^2 value:*	*R^2 value:*

What is the order of the reaction?	What is the rate constant, k, for the reaction?