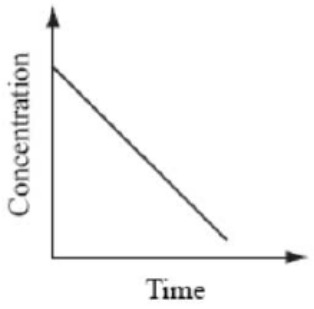
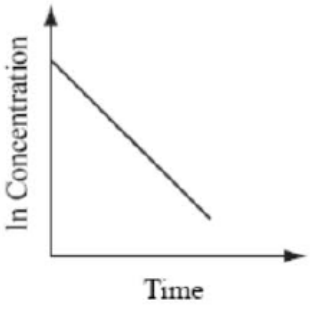
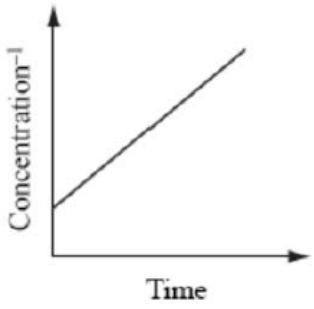
Integrated Rate Laws – use when given concentration and time data



Zero order
k = negative slope



First order
k = negative slope



Second order
k = the slope

	y	=	mx	+	b
zero order	[A]	=	$-kt$	+	$[A_o]$
first order	ln[A]	=	$-kt$	+	$\ln [A_o]$
second order	1/[A]	=	kt	+	$1/[A_o]$

Graphing Calculator Tutorial Set up your calculator so that *time* is always in L1.
Use L2, L3 and L4 to display the *y*-variables. Remember the list for what is placed on the *y*-axis is alphabetical (concentration, natural log of concentration and reciprocal concentration).

L1 = time (*x*-variable throughout!)		
L2 = concentration	[A]	straight line infers zero order
L3 = ln concentration	ln [A]	straight line infers first order
L4 = reciprocal concentration	1/[A]	straight line infers second order

Use this system to set up the data given in the following exercise:

We are going to perform 3 linear regressions to determine the order of the reactant. They will be L1,L2; L1,L3; L1,L4. Next, we will determine which regression has the best *r*-value [linear regression correlation coefficient in big people language!] We will also paste the best regression equation Y=
so that we can easily do other calculations commonly required on AP Chemistry Exam problems.

1. The decomposition of N_2O_5 in the gas phase was studied at constant temperature.

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

The following results were collected:

$[N_2O_5]$	**Time (s)**
0.1000	0
0.0707	50
0.0500	100
0.0250	200
0.0125	300
0.00625	400

a) Determine the rate law and calculate the value of *k*.

b) Calculate the concentration of $N_2O_5(g)$ at 250 s.

c) Calculate the concentration of $N_2O_5(g)$ at 600 s.

d) At what time is the concentration of $N_2O_5(g)$ equal to 0.00150 M?

2. For the reaction of $(CH_3)_3CBr$ with OH^-,

$$(CH_3)_3CBr + OH^- \rightarrow (CH_3)_3COH + Br^-$$

The following data were obtained in the laboratory.

Time (s)	**$[(CH_3)_3CBr]$**
0	0.100
30.0	0.074
60.0	0.055
90.0	0.041

a) Determine the order of this reaction. Sketch an appropriate graph.

b) Calculate the value of the rate constant and include proper units.

c) At what time is the concentration of $(CH_3)_3CBr$ equal to [0.086]?

d) What is the concentration of $(CH_3)_3CBr$ after 2 minutes?