<u>Chapter 13 Kinetics Math Summary</u>

- Handling "ln y = x" on calculator:
  1. When you know "y" but want to solve for "x", enter "y" and hit your "ln" button. (On some calculators, you will instead hit "ln" button first, then enter "y")
  2. When you know "x" but want to solve for "y", enter "x", then hit your e^x button

- Determining the "Order" of a Particular Reactant in a Rate Law

  Use two different concentrations (A_1 and A_2), and then measure the rates (r_1 and r_2). Set the rate ratio (r_2/r_1) equal to the concentration ratio (A_2/A_1) to the "x" power. "x" is the "Order" for reactant A. Usually "x" will be a small whole number [0, 1, 2, occasionally 3].

  $$\mathbf{r_2/r_1 = ([A]_2/[A]_1)^x}$$

  - In general, for $y = m^x$, what does the "x" mean? It's the number of times you would have to multiply "m" x "m" to equal "y". Examples: $2 = 2^x$ then x = 1; $4 = 2^x$ then x = 2, since 2 x 2 = 4. For $8 = 2^x$ then x = 3, since 2 x 2 x 2 = 8. And for $16 = 2^x$ then x = 4, since 2 x 2 x 2 x 2= 16.
  - In general for $y = m^x$ then x = (ln y)/(ln m).

- Rate Constants, Quantities and Half-Lives for First-Order Reactions

  $$\mathbf{kt_{1/2} = .693}$$

  - Given k, can find $t_{1/2}$
  - Given $t_{1/2}$ can find k.

  $$kt = \ln([A]_o/[A]_t)$$

  - $[A]_o$ is the amount of material at time zero
  - $[A]_t$ is the amount of stuff at time "t"
  - when dealing with problems involving "percents", the original percent is 100%

- Graphical Form for Determination of the Rate Law "k" for First-Order Reactions. (Won't use for tests.)

  $\ln[A]_t = -kt + \ln[A]_o$ [y = mx + b form: when ln[A] is plotted versus time, the slope of the line equals (-k)]

- The Arrhenius Equation (won't be test-responsible)

  $$k = Ae^{(-E_a/RT)}$$

  - R = constant = 0.00831
  - T in Kelvin
  - E_a is the activation energy in kJ/mol
  - A is a constant for each reaction

- Solving for E_a (activation energy) given known rate constants at two temperatures (won't be test responsible, but used for laboratory)

  $$E_a = [0.00831\ln(k_2/k_1)] / (1/T_1 - 1/T_2)$$ Answer in kJ/mol