Kinetics

So many equations…so many units…

|  |  |  |  |
| --- | --- | --- | --- |
| **Summary of Kinetics Equations** | | | |
| **Order** | **Zero** | **First** | **Second** |
| **Rate Law** *Differential Rate Law -  Comparing rate to concentration* | Rate = k | Rate = k[A] | Rate = k[A]2 |
| **Integrated Rate Law**  *y = mx + b Comparing concentration over time* |  |  |  |
| **Plot needed to give a straight line**  *“Graph C, N, R”* | versus *t* | versus *t* |  |
| **Relationship of rate constant (k) to the slope of the straight line** | Slope = -*k* | Slope = -*k* | Slope = *k* |
| **Units on rate constant (k)** | = |  | = |
| **Half Life Equation**  *Use integrated law when solving other half life related problems* |  |  |  |

**Arrhenius Equation**

k = rate constant

Ea = Activation Energy

T = Temperature

A = Frequency Factor

R = 8.31 J/mol•K

***k = Ae-Ea/RT***

**When Graphing…**

Graph it as ln(k) versus *(y versus x)*

y = m x + b

**R-22**

**Finding Units for k**

Remember:

Rearrange:

Remember:

Substitute in your units and rewrite:

**🡪 🡪 then cancel out units**

|  |  |  |
| --- | --- | --- |
| **Units for k based on overall order of reaction** | | |
| **Overall Order** | **Example of Units Plugged In** | **Final Units for k** |
| 0 |  |  |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| Etc…etc…etc… | | |

*Remember:*

*You may see this substituted into k units.*   
  
*For example: M-1s-1* =

**Using Logarithms**

*There is no way I can show you every version and rearrangement that you may come across during the year. Here are some common ones, some to help jog your memory. Remember that I am a Chemistry teacher, not a Math teacher…maybe Math-Land has better ways to show these! If you have something awesome from a math teacher then share it with me – ha!*

|  |  |  |
| --- | --- | --- |
|  | General | |
|  | Logarithm Form | Exponent Form |
| Equations |  |  |
| Example |  |  |

|  |  |  |
| --- | --- | --- |
|  | Base Ten | |
|  | Logarithm Form | Exponent Form |
| Equations |  |  |
| Example |  |  |

|  |  |  |
| --- | --- | --- |
|  | Natural Logarithms | |
|  | Logarithm Form | Exponent Form |
| Equations |  |  |
| Example | *rounded* | *rounded* |

|  |  |  |
| --- | --- | --- |
|  | Subtracting and Dividing Natural Logarithms | |
|  | Subtraction Form | Division Form |
| Equations |  |  |
| Example |  |  |

|  |  |  |
| --- | --- | --- |
|  | Normal Radioactive Half Life Logarithms | |
|  | Subtraction Form | Division Form |
| Equations |  |  |
| Example |  |  |

**Just \*ONE\* Chemistry Example of Using Natural Logarithms**

*Maybe you want to find out what fraction of a chemical you have after a certain time has passed. Let’s say that you know it is a first order reaction. Remember that Integrated Rate Laws show you Concentration vs. Time. So start there! Remember that the fraction you have left is*

↓

↓

↓

↓

*↓  
Now plug in your value of k (rate constant) and t (time that has passed) and you can find your fraction left! Multiply it by 100 and you would have % left!*

Here is an Excel spreadsheet I made that is programed to automatically graph the various plots for you 😊

<https://tinyurl.com/yr7xzb75>

Qr code

Description automatically generated