- In previous labs, we have only delt with straight lines with equation $y = mx + b$, where m is the slope and b is the y-intercept
- Unfortunately, in real experiments, the data rarely turns out to be linear
- We will study 2 specific forms of non-linear functions
  - Exponential
  - Power Law

  Since these are so common, they are so common, we have 2 special types of graphs to deal with them, semi-log and log-log graphs.

- Exponential functions
  - Ex. radioactive decay, voltage on a capacitor

$$f(t) = A\mathrm{e}^{wt} \tag{1}$$

  - $A = f(0)$, so it is like "b"
  - w shows how fast the fuction increases/decreases; like slope
  - We can transform an expomemtial function to a linear function by playing some math games

$$\begin{aligned} f(t) &= A\mathrm{e}^{wt} && (2)\\ \ln\left[f(t)\right] &= \ln\left[A\mathrm{e}^{wt}\right] && (3)\\ \ln\left[f(t)\right] &= \ln(A) + wt\ln(\mathrm{e}) && (4)\\ \ln\left[f(t)\right] &= wt + \ln(A) && (5)\\ y &= mx + b && (6) \end{aligned}$$

  - We can calculate the slope and intercept the way we're used to, we just have to drag the ln around
  - Another way to deal with exponentials is semi-log plots
  - The y-axis has a log scale and the x-axis will have a regular axis

  - For a log scale, each major division is a power of 10 greater than the one below it.

  - On a semi-log plot, we don't have to mess with natural logs before we graph, we just have to graph the data, and we can just read the values of w and A from the graphs like you would normally.

- Power law

  - Ex. Period of a pendulum, distance for a falling object

$$\begin{aligned} y &= Ax^n && (7) \\ \log_{10}(y) &= \log_{10}\left(Ax^n\right) && (8) \\ \log_{10}(y) &= \log_{10}(A) + n\log_{10}(x) && (9) \\ y &= b + mx && (10) \end{aligned}$$

  - To turn a power law into a straight line, we use a log-log plot, set both axes to a log scale

- To do a log scale in Excel, make the graph regularly, right click on the axis you want to change, go to the scale tab and click the box next to og scale

Problems for lab 1

Problem	Points
Ex. 1	1
Ex. 2	2
Ex. 3	1
Ex. 4	2
Prob. 1a	1
Prob. 1b	1
Prob. 1c	2
Prob. 1d	2
Prob. 2a	1
Prob. 2b	2
Prob. 2c	3
Prob. 3	2