Math 1A - Graphing

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There is a systematic method with which you can graph a function without using your calculator, called the **'DISAIC'**-method, which is outlined below! Here are my two favorite mnemonics to remember that method: 'Downloading Illegal Songs Always Infringes Copyright (laws)' and 'Dunkin (donuts) Is Serving Amazing Iced Coffee' :)

1. **D**omain: First find the **domain** of your function (section 1.1)
2. **I**ntercepts: To find the $y-$ **intercept**, calculate $f(0)$, to find the $x-$**intercept**, solve for $f(x) = 0$ (section 1.1)
3. **S**ymmetry: There are 3 types of symmetries a function can have (section 1.1):
   - If $f(-x) = f(x)$, then f is an **even** function, and its graph is symmetric about the y-axis. This saves you half of your work, because all you need to know is what the graph looks like for $x \geq 0$, and you can deduce what the graph looks like for $x \leq 0$ just by reflecting your graph about the $y-$axis
   - If $f(-x) = -f(x)$, then f is an **odd** function, and its graph is symmetric about the origin. This also saves you half of your work.
   - If $f(x + K) = f(x)$ for all x, then f is **periodic** of period K. This saves you a lot of work, because you only need to know what your graph looks like on $[0, K]$, the rest of the graph is just a repetition of that portion! **Trigonometric functions will always be periodic**
4. **A**symptotes: There are 3 types of asymptotes:
   - **Horizontal Asymptotes** (section 2.6): Calculate $\lim_{x\to\infty} f(x)$ and $\lim_{x\to-\infty} f(x)$. If either of those limits is **finite**, then you have a H.A. at ∞ or $-\infty$.
   - **Vertical Asymptotes** (section 2.6): For every point a where f is not defined, calculate $\lim_{x\to a^+} f(x)$ and $\lim_{x\to a^-} f(x)$. If either of those limits is **infinite**, then you have a V.A. at a.

- **Slant Asymptotes** (section 4.5): Check out the 'slant asymptotes'-handout for more info! If $y = ax + b$ is a S.A. at ∞, then $a = \lim_{x\to\infty} \frac{f(x)}{x}$ and $b = \lim_{x\to\infty} f(x) - ax$, and similarly for $-\infty$.
  Also, **periodic functions don't have S.A.**, and if you already have a H.A. at ∞, then you **cannot** also have a S.A. at ∞ (and similarly for $-\infty$)

5. **I**ncreasing/Decreasing: Just use the **I/D test** (section 4.3). Calculate $f'(x)$, solve for $f'(x) = 0$, and then draw a sign table. Also, determine **local maxima and minima** of f.

6. **C**oncavity: Use the **concavity test** (section 4.3). Calculate $f''(x)$, solve for $f''(x) = 0$, and then draw a sign table. Also, find the **inflection points**!

And finally, to draw your graph, first label the intercepts, then the asymptotes, and then the local maxima/minima and inflection points. Then using your sign tables and intuition, draw your graph!