Summary of the derivatives and their uses:

Function	Use
$f(x)$	- To find points on the curve/existence of points on the curve - Verify that the graph is continuous (has no breaks) - If the graph is not continuous, can determine these values and said values will be critical numbers
$f'(x)$	- Use typically to show *increasing* and *decreasing*. - If $f'(x)=0$, and is solved for x, these will be some of the critical numbers. - With the critical numbers, can create an interval. With this interval, choose a test value (say c) between the critical numbers to substitute into $f'(x)$. - If $f'(c)>0$ (positive) then the original function, $f(x)$, will be increasing between the critical numbers for which c was picked. - If $f'(c)<0$ (negative) then the original function, $f(x)$, will be increasing between the critical numbers for which c was picked. - **First Derivative Test:** If the original function, $f(x)$, switches from increasing to decreasing at a critical point, then it will be a <u>local max</u>. If the original function, $f(x)$, switches from decreasing to increasing at a critical point, then it will be a <u>local min</u>.
$f''(x)$	- If $f''(x)=0$ and is solved for x, these are *potential* points of inflection (where the concavity changes). To prove that they are indeed points of inflection, we need to look at the intervals of concavity - With the values from the first bullet, we can create intervals and take test values (a) between the potential points of inflection. - If $f''(a)>0$ (positive) then the original function, $f(x)$, will be concave up (CCU) between the potential points of inflection for which a was picked. - If $f''(a)<0$ (negative) then the original function, $f(x)$, will be concave down (CCD) between the potential points of inflection (a) for which a was picked. - If the concavity switches at one of the potential points of inflection, it will indeed be a point of inflection. - **Second Derivative Test:** For a <u>critical number</u> c, if $f''(c)<0$, then there is a local max at $x=c$. If $f''(c)>0$, then there is a local min at $x=c$.