

# Top 10 Theorems of Calculus

10. The Intermediate Value Theorem	If $f$ is continuous on the closed interval $[a,b]$ and $d$ is any value between $f(a)$ and $f(b)$ , then there exists some $c$ in the open interval $(a,b)$ such that $f(c)=d$ .
9. The Extreme Value Theorem	If $f$ is continuous on the closed interval $[a,b]$ , then $f$ has both a maximum and a minimum on the interval.
8. Relative Extrema only occur at critical points	If $f$ has a relative minimum or a relative maximum at $x = c$ , then $c$ is a critical number of $f$ .
7. The Second Derivative Test for Relative Extrema	<p>Given <math>c</math> is a critical number</p> <p>If <math>f''(c) &lt; 0</math>, then <math>(c, f(c))</math> is a relative max</p> <p>If <math>f''(c) &gt; 0</math>, then <math>(c, f(c))</math> is a relative min</p> <p>If <math>f''(c) = 0</math>, then the test fails.</p>
6. The First Derivative Test for Relative extrema	If $c$ is a critical number of the function $f$ that is continuous on an open interval containing $c$ and differentiable on the open interval (except possibly at $c$ ) then $(c, f(c))$ is a relative max if $f'(c)$ changes from positive to negative at $c$ and $(c, f(c))$ is a relative min if $f'(c)$ changes from negative to positive at $c$
5. Rolle's Theorem	If $f$ is continuous on the closed interval $[a,b]$ and differentiable on the open interval $(a,b)$ , and $f(a) = f(b)$ then there exists some $c$ in the open interval such that $f'(c) = 0$
4. The Mean Value Theorem (Derivatives)	<p>If <math>f</math> is continuous on the closed interval <math>[a,b]</math> and differentiable on the open interval <math>(a,b)</math>, then there exists some <math>c</math> in the open interval such that</p> $f'(c) = \frac{f(b) - f(a)}{b - a}$
3. The Mean Value Theorem (Integrals)	<p>If <math>f</math> is continuous on the closed interval <math>[a,b]</math>, then there exists a number <math>c</math> in the open interval such that</p> $\int_a^b f(x)dx = f(c)(b - a)$
2. The Second Fundamental Theorem of Calculus	$\frac{d}{dx} \int_a^x f(t)dt = f(x)$
1. The Fundamental Theorem of Calculus	$\int_a^b f'(x)dx = f(b) - f(a)$