Limits: $\lim_{x\to a} f(x)$ $\lim_{x\to a^-} f(x)$ $\lim_{x\to a^+} f(x)$

Continuity: $\lim_{x\to a^-} f(x) = \lim_{x\to a^+} f(x) = f(a)$

Has a limit if: $\lim_{x\to a^-} f(x) = \lim_{x\to a^+} f(x)$

Derivative: $\lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$

$$f'(c) = \lim_{x\to c} \frac{f(x)-f(c)}{x-c}$$

Definite Integral

$$\int_a^b f(x)\,dx = \lim_{\Delta x\to 0} \sum_n f(c_n)\,\Delta x$$

EVT: on a closed interval, any continuous fcn has an absolute maximum and an absolute minimum

IVT: a continuous fcn: if y_0 is between $f(a)$ and $f(b)$, then there must be an $x=c$ on (a,b) such that $f(c)=y_0$

MVT: differentiable fcn: there is an $x=c$ on (a,b) such that $f'(c)=\frac{f(b)-f(a)}{b-a}$

FTC: if $g(x) = \int_k^x f(t)\,dt$

then $g'(x) = f(x)$

and $g(k) = 0$

chain rule version: if $g(x) = \int_k^{u(x)} f(t)\,dt$

then $g'(x) = f(u(x)) \cdot u'(x)$

Chain Rule for derivatives:

$$[f(g(x))]' = f'(g(x)) \cdot g'(x)$$

$$= \frac{df}{dg} \cdot \frac{dg}{dx}$$

parametric: $\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$

l'Hôpital: if $\lim_{x \to a} \frac{f(x)}{g(x)} = \frac{0}{0}$

then limit $= \lim_{x \to a} \frac{f'(x)}{g'(x)}$

arc length (parametric): $L = \int_a^b \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\,dt$

(Cartesian): $L = \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\,dx$