AP CALC AB FORMULA STUDY GUIDE

Properties of Limits

$\lim_{x \to c}[f(x) + g(x)] = \lim_{x \to c} f(x) + \lim_{x \to c} g(x)$

$\lim_{x \to c}[f(x) - g(x)] = \lim_{x \to c} f(x) - \lim_{x \to c} g(x)$

$\lim_{x \to c}[cf(x)] = c \lim_{x \to c} f(x)$

$\lim_{x \to c}[f(x)g(x)] = \lim_{x \to c} f(x) \cdot \lim_{x \to c} g(x)$

$\lim_{x \to c} \frac{f(x)}{g(x)} = \frac{\lim_{x \to c} f(x)}{\lim_{x \to c} g(x)}$ if $\lim_{x \to c} g(x) \neq 0$

$\lim_{x \to c}[f(x)]^n = \left[\lim_{x \to c} f(x)\right]^n$

$\lim_{x \to c} \sqrt[n]{f(x)} = \sqrt[n]{\lim_{x \to c} f(x)}$

Direct Substitution Property

If f is a polynomial or a rational function and a is in the domain of f, then $\lim_{x \to a} f(x) = f(a)$.

Theorems

$\lim_{x \to 0} \frac{\sin x}{x} = 1$ $\qquad$ $\lim_{x \to 0} \frac{\cos x - 1}{x} = 0$

$\lim_{x \to c} f[g(x)] = f\left[\lim_{x \to c} g(x)\right]$

The Squeeze Theorem

Given $f(x) \leq g(x) \leq h(x)$ for values of x near c, except possibly at c. If $\lim_{x \to c} f(x) = \lim_{x \to c} h(x) = L$, then $\lim_{x \to c} g(x) = L$.

Continuity

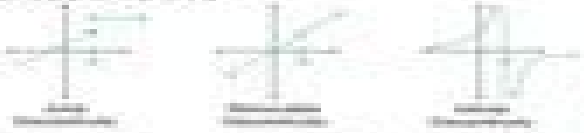
f is continuous at a number $x = a$ if

(1) $f(a)$ is defined

(2) $\lim_{x \to a} f(x)$ exists

(3) $\lim_{x \to a} f(x) = f(a)$

Discontinuities



Vertical Asymptote(s) of f

The line $x = a$ is a vertical asymptote of $y = f(x)$ if at least one of the following statements is true:

$\lim_{x \to a^-} f(x) = \infty$ $\qquad$ $\lim_{x \to a^+} f(x) = \infty$

$\lim_{x \to a^-} f(x) = -\infty$ $\qquad$ $\lim_{x \to a^+} f(x) = \infty$

$\lim_{x \to a^-} f(x) = \infty$ $\qquad$ $\lim_{x \to a^+} f(x) = -\infty$

Infinite Limits

$\lim_{x \to a} \frac{f(x)}{g(x)}$

- If $f(x)$ is a great factor, the limit $= \infty$.
- If $g(x)$ is a great factor, the limit $= 0$.
- If $f(x)$ & $g(x)$ are polynomials with the same degree, the limit equals the ratio of their leading coefficients.

Horizontal Asymptote(s) of f

$y = \lim_{x \to -\infty} f(x)$ or $y = \lim_{x \to \infty} f(x)$

Intermediate Value Theorem

If f is continuous on $[a,b]$ and M is any number between $f(a)$ and $f(b)$, then there is at least one number c in $[a,b]$ such that $f(c) = M$.

Average Rate of Change

The function $f(x)$ over the closed interval $[a,b]$ is $\frac{f(b) - f(a)}{b - a}$.

Definition of a Derivative

$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$

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

Non-Differentiable

Differentiation Rules

$\frac{d}{dx}(c) = 0$

$\frac{d}{dx}[cf(x)] = c\frac{d}{dx}[f(x)]$

$\frac{d}{dx}[f(x) + g(x)] = \frac{d}{dx}f(x) + \frac{d}{dx}g(x)$

$\frac{d}{dx}[f(x) - g(x)] = \frac{d}{dx}f(x) - \frac{d}{dx}g(x)$

Derivatives

$\frac{d}{dx}(x^n) = nx^{n-1}$ $\qquad$ $\frac{d}{dx}(\sin x) = \cos x$

$\frac{d}{dx}(e^x) = e^x$ $\qquad$ $\frac{d}{dx}(\cos x) = -\sin x$

$\frac{d}{dx}(a^x) = a^x \ln a$ $\qquad$ $\frac{d}{dx}(\tan x) = \sec^2 x$

$\frac{d}{dx}(\ln x) = \frac{1}{x}$

Derivatives of Inverses

$\frac{d}{dx}(\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}}$

$\frac{d}{dx}(\cos^{-1} x) = -\frac{1}{\sqrt{1-x^2}}$

$\frac{d}{dx}(\tan^{-1} x) = \frac{1}{1+x^2}$

$\frac{d}{dx}[f^{-1}(x)] = \frac{1}{f'(f^{-1}(x))}$

Product Rule

$\frac{d}{dx}[f(x) \cdot g(x)] = f(x)g'(x) + g(x)f'(x)$

Quotient Rule

$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$

Chain Rule

$\frac{d}{dx}f[g(x)] = f'[g(x)]g'(x)$

Linear Approximation / Tangent Line

Linear approximation of f at $x = a$ is $L(x) = f(a) + f'(a)(x - a)$.

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Ap Calculus Ab Preparation Guide

Wolfgang Guggemos

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