Properties of Logarithms....

Inverse trig functions, special angles...

Limit Laws

Fundamental Laws:

1. $\lim_{x\to a}[f(x)+g(x)] = \lim_{x\to a} f(x) + \lim_{x\to a} g(x)$
2. $\lim_{x\to a}[f(x)-g(x)] = \lim_{x\to a} f(x) - \lim_{x\to a} g(x)$
3. $\lim_{x\to a}[c\,f(x)] = c\lim_{x\to a} f(x)$
4. $\lim_{x\to a}[f(x)\cdot g(x)] = \lim_{x\to a} f(x)\cdot\lim_{x\to a} g(x)$
5. $\lim_{x\to a}\frac{f(x)}{g(x)} = \frac{\lim_{x\to a} f(x)}{\lim_{x\to a} g(x)}$

Derived Laws:

6. $\lim_{x\to a}[f(x)]^n = [\lim_{x\to a} f(x)]^n$ where n is positive integer
7. $\lim_{x\to a} c = c$
8. $\lim_{x\to a} x = a$
9. $\lim_{x\to a} x^n = a^n$ where n is positive integer
10. $\lim_{x\to a}\sqrt[n]{x} = \sqrt[n]{a}$
11. $\lim_{x\to a}\sqrt[n]{f(x)} = \sqrt[n]{\lim_{x\to a} f(x)}$

Squeeze theorem: ....

Limit Continuity:

Continuous if:

1. f(c) is defined
2. The limit exists at the value of x
3. f(c) is = the limit L

Limit continuity theorems:

4. If f and g are continuous at a and c is const, then the following functions are also continuous at a:

   1. $f+g$ 2. $f-g$ 3. cf

   4. fg 5. $\frac{f}{g}$ $if\ g(a)\neq 0$

5. a) Any polynomial is conts everywhere $\mathbb{R} = (-\infty, \infty)$

   b) Any rational function is conts whereveer it is defined (domain).

6. $\lim_{\theta\to 0}\cos\theta = 1$ $\lim_{\theta\to 0}\sin\theta = 0$
7. Types of functions continuous at every number in their domain:
   - Polynomials
   - Rational functions Eg: $\lim_{x\to -2}\frac{x^3+2x^2-1}{5-3x}$
   - Root functions
   - Trig functions
   - Inverse trig functions
   - Exponential functions
   - Log functions
8. Paraphrase: Limit symbol can be moved through a function symbol if the fn is conts and the limit exists. So:

   $\lim_{x\to a} f(g(x)) = f\left(\lim_{x\to a} g(x)\right)$

9. If g is conts at a and f is conts at g(a) then the composite function $f\circ g$ is conts at a
10. **Intermediate value theorem.** If f is conts on the closed interval [a,b] then the conts function takes on every intermediate value between f(a) and f(b)

Derivatives of trig functions

$(\sin x)' = \cos x$ $(\cos x)' = -\sin x$

$(\tan x)' = sec^2 x$ $(\cot x)' = -csc^2 x$

$(sec\,x)' = sec\,x\cdot\tan x$ $(csc^2 x)' = -csc\,x\cdot\cot x$

$(a^x)' = a^x\ln a$ $(e^x)' = e^x$

$(\log_a x)' = \frac{1}{x\ln a}$ $(\ln a)' = \frac{1}{\ln a}$

$(\arcsin x)' = \frac{1}{\sqrt{1-x^2}}$ $(\arccos x)' = -\frac{1}{\sqrt{1-x^2}}$

$(\arctan x)' = \frac{1}{\sqrt{1+x^2}}$ $(\text{arccot}\,x)' = -\frac{1}{\sqrt{1+x^2}}$

$(arcsec\,x)' = \frac{1}{x\sqrt{x^2-1}}$ $(\arccos x)' = -\frac{1}{x\sqrt{x^2-1}}$

Slope of Tangent Line

$y = f(x_1) + f'(x_1)(x-x_1)$

When solving for T.L.'s and points are given instead of slope, let x = a in the T.L. EQ.

Related Rates

Volume of sphere: $V = \frac{4}{3}\pi r^3$

Volume of cone: $V = \frac{1}{3}\pi r^2 h$

Volume of cylinder: $V = \pi r^2 h$

Arc of a circle: $s = r\theta$

Law of Cos: $a^2 = b^2 + c^2 - 2bc\cos\theta$

4.1 Maximum and Minimum Values

Extreme Value Thm: if f is continuous on a closed interval [a,b], then f has an absolute max and min at some values in [a,b].

Fermat's Thm: if f has local max or min at c, and if f '(c) exists then f '(c) = 0.

Find the Critical points: where f '(c) = 0 and where f ' DNE

4.2 Mean Value Theorem

Rolle's Thm:

1. f is continuous on the closed interval [a, b]
2. f is differentiable on the open interval (a, b)
3. f(a) = f(b)

Then there is a number c in (a, b) s.t. $f'(c)=0$

Mean Value Thm:

1. f is continuous on closed interval [a,b]
2. f is differentiable on the open interval (a,b)

Then there is a number c in (a,b) s.t.

$$f'(c) = \frac{f(b)-f(a)}{b-a}$$

4.8 - Newton's Method

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$