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hyperbolic function definition

$$sinh(x) = \frac{1}{2}(\mathrm{e}^{x} - \mathrm{e}^{-x})$$
$$cosh(x) = \frac{1}{2}(\mathrm{e}^{x} + \mathrm{e}^{-x})$$
$$\tanh(x) = \frac{\sinh(x)}{\cosh(x)}$$
$$\coth(x) = \frac{1}{\tanh(x)}$$
$$\mathrm{sech}(x) = \frac{1}{\cosh(x)}$$
$$\mathrm{cosech}(x) = \frac{1}{\sinh(x)}$$

Limmit rules

$\lim_{x\to a} f(x) = L, \lim_{x\to a} g(x) = M$ and k is a constant then

$$\lim_{x\to a}[f(x) \pm \mathrm{G}(x)] = L \pm M$$
$$\lim_{x\to a}[f(x)\mathrm{G}(x)] = LM$$
$$\lim_{x\to a}[kf(x)] = \mathrm{k}L$$
$$\lim_{x\to a}\left[\frac{f(x)}{g_{(x)}}\right] = \frac{L}{M}, M \neq 0$$

Trig identities

$$\frac{\mathrm{d}}{\mathrm{d}x}\cosh(x) = \sinh(x) \qquad \frac{\mathrm{d}}{\mathrm{d}x}\sinh(x) = \cosh(x)$$
$$\frac{d}{\mathrm{d}x}\tanh(x) = \sec h^2(x) \qquad \frac{d}{\mathrm{d}x}\coth(x) = -cosech^2(x)$$
$$\frac{d}{\mathrm{d}x}\mathrm{sech}(x) = -\mathrm{sech}(x)\tanh(x)$$
$$\frac{d}{\mathrm{d}x}\mathrm{cosech}(x) = -\mathrm{cosech}(x)\coth(x)$$

$$\cosh(-x) = \cosh(x)$$
$$\sinh(-x) = -\sinh(x)$$
$$\sinh(2x) = 2\sinh(x)\cosh(x)$$
$$\cosh(2x) = \cosh^2(x) + \sinh^2(x) = 1 + 2\sinh^2(x) = 2\cosh^2(x) - 1$$
$$\cosh^2(x) - \sinh^2(x) = 1$$
$$\cosh(x+y) = cosh(x)\cosh(y) + sinh(x)\sinh(y)$$
$$\sinh(x+y) = sinh(x)\cosh(y) + cosh(x)\sinh(y)$$

$$(In(y) = x) = (y = \mathrm{e}^{x})$$

$$\mathrm{e}^{(\log_e x)} = x$$
$$\log_a(a^x) = x$$
$$(a+b)(a-b) = (a^2 - b^2)$$

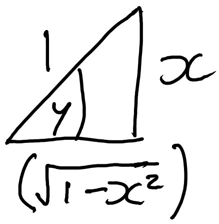
A function continuous if

- f(x) exists
- $\lim_{x\to c} f(x) exists$
- These two quantities are equal

Conditions of continuous functions.

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

$$y = \sin^{-1}(x)$$
$$x = \sin(y)$$
$$\frac{\mathrm{d}}{\mathrm{d}x}(x) = \frac{\mathrm{d}}{\mathrm{d}x}(\sin(y))$$
$$1 = \cos(y)\frac{\mathrm{d}y}{\mathrm{d}x}$$



Continuity

If f(x) and g(x) are continuous then the following are continuous

- f(x) + g(x)
- cf(x)
- f(x)g(x) and
- f(x) / g(x) when g(x) is not equal to 0

The following types of functions are continuous for all points in there domain

- Polynomials
- Trigonometric Functions
- Exponential functions
- Logarithmic functions
- Root functions

Limits tricks

- Squeeze thereom
  - Find a function either side
- L'Hopitals rule (only works when limit is in indeterminate form).
  - 0/0, $\frac{\infty}{\infty}, \frac{-\infty}{\infty}, \frac{\infty}{-\infty}, \frac{-\infty}{-\infty}$
- Factorising and cancelling common factors
- Multiply by conjugate and cancel common factors

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$\frac{\mathrm{d}}{\mathrm{d}x}(cf(x)) = cf'(x)$ c is any constant	$(f(x) \pm g(x))' = f'(x) \pm g'(x)$
$\frac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$	$\frac{\mathrm{d}}{dx}(c) = 0$ c is any constant
$\frac{d}{ax}(fg) = \frac{\mathrm{d}}{dx}(f) \times g + f \times \frac{\mathrm{d}}{dx}(g)$	$\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{f}{g}\right) = \frac{\frac{\mathrm{d}}{\mathrm{d}x}(f) \times g - f \times \frac{\mathrm{d}}{\mathrm{d}x}(g)}{g^2}$
$\frac{\mathrm{d}}{\mathrm{d}x}\Big(f\big(g(x)\big)\Big) = f'\big(g(x)\big) \times g'(x)$	
$\frac{d}{\mathrm{d}x}\left(\mathrm{e}^{g(x)}\right) = g'(x)\mathrm{e}^{g(x)}$	$\frac{\mathrm{d}}{\mathrm{d}x}(\ln g(x)) = \frac{g'(x)}{g(x)}$
$\frac{\mathrm{d}}{\mathrm{d}x}\sin(x) = \cos(x)$	$\frac{\mathrm{d}}{\mathrm{d}x}\cos(x) = -\sin(x)$
$\frac{\mathrm{d}}{\mathrm{d}x}\tan(x) = \sec^2(x)$	
$\frac{\mathrm{d}}{\mathrm{d}x}(a^x) = a^x \ln(a)$	$\frac{\mathrm{d}}{\mathrm{d}x}(\mathrm{e}^x) = \mathrm{e}^x$
$\frac{\mathrm{d}}{\mathrm{d}x}\big(In(x)\big) = \frac{1}{x'} x \neq 0$	$\frac{\mathrm{d}}{\mathrm{d}x}(\ln\lvert x\rvert) = \frac{1}{x}, x > 0$
$\frac{\mathrm{d}}{\mathrm{d}x}(\log_a(x)) = \frac{1}{x \ln a}, x > 0$	

A function is continuous is it is derivable but dose **not** have to be derivable if it is continuous

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

Quadratic equation

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$