

Hyperbolic Function

"تعريف"

$$\sinh x = \frac{e^x - e^{-x}}{2}$$

$$\cosh x = \frac{e^x + e^{-x}}{2}$$

"متطابقات"

$$\cosh^2 x - \sinh^2 x = 1$$

$$1 - \tanh^2 x = \operatorname{sech}^2 x$$

$$\coth^2 x - 1 = \operatorname{csch}^2 x$$

$$\cosh 2x = \cosh^2 x + \sinh^2 x$$

$$\sinh 2x = 2 \sinh x \cosh x$$

$$\cosh x + \sinh x = e^x$$

"مقلوب الدوال"

$$\tanh x = \frac{\sinh x}{\cosh x} = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

$$\coth x = \frac{\cosh x}{\sinh x} = \frac{e^x + e^{-x}}{e^x - e^{-x}}, \quad x \neq 0$$

$$\operatorname{sech} x = \frac{1}{\cosh x} \equiv \frac{2}{e^x + e^{-x}}$$

$$\operatorname{csch} x = \frac{1}{\sinh x} \equiv \frac{2}{e^x - e^{-x}}, \quad x \neq 0$$

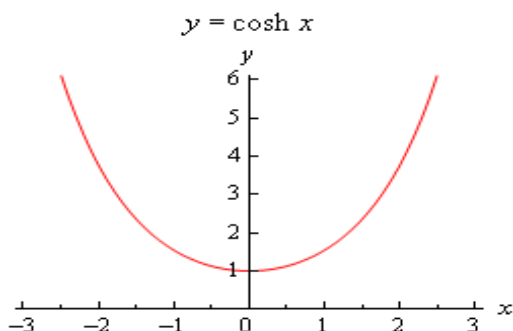
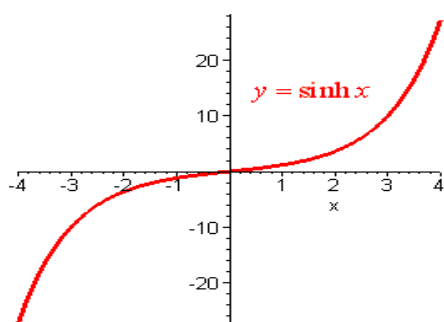
"تعريف الدوال العكسية"

$$\sinh^{-1} x = \ln(x + \sqrt{x^2 + 1})$$

$$\cosh^{-1} x = \ln(x + \sqrt{x^2 - 1}), \quad x \geq 1$$

$$\tanh^{-1} x = \frac{1}{2} \ln \frac{1+x}{1-x}, \quad |x| < 1$$

$$\operatorname{sech}^{-1} x = \ln \frac{1 + \sqrt{1 - x^2}}{x}, \quad 0 < x \leq 1$$



Trigonometric Functions

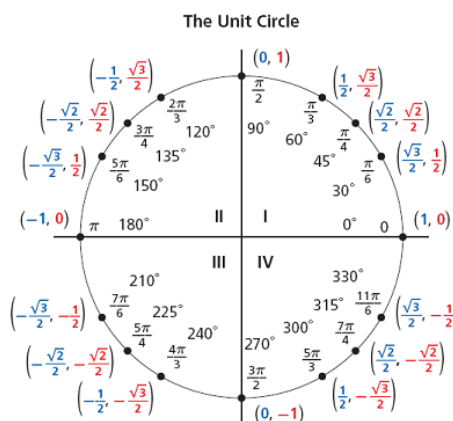
"الدوال المثلثية"

"مقلوب الدوال المثلثية"

$$\sin x = \frac{1}{\csc x}$$

$$\cos x = \frac{1}{\sec x}$$

$$\tan x = \frac{\sin x}{\cos x} = \frac{1}{\cot x}$$



"متطابقات مثلثية"

$$\sin^2 x + \cos^2 x = 1$$

$$\tan^2 x + 1 = \sec^2 x$$

$$1 + \cot^2 x = \csc^2 x$$

$$\sin 2x = 2 \sin x \cos x$$

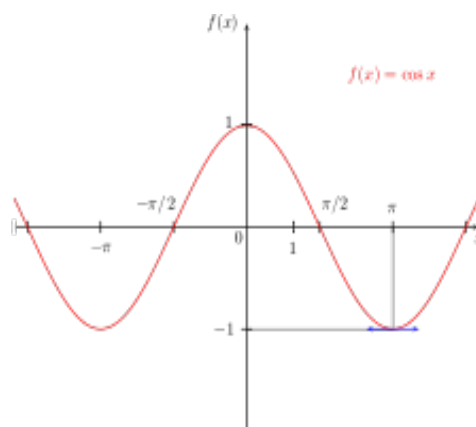
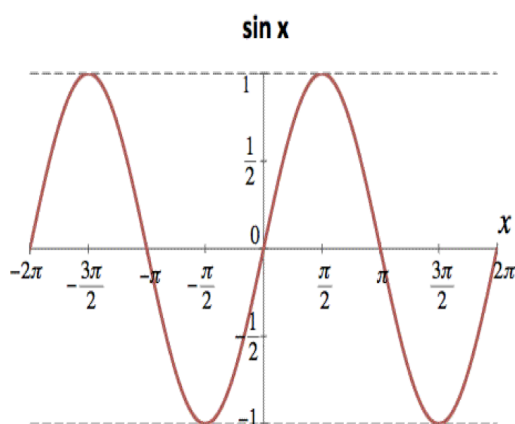
$$\cos 2x = \cos^2 x - \sin^2 x$$

"معكوس الدوال المثلثية"

$$y = \sin^{-1} x \Leftrightarrow x = \sin y, \quad -1 \leq x \leq 1, \quad -\frac{\pi}{2} \leq y \leq \frac{\pi}{2}$$

$$y = \cos^{-1} x \Leftrightarrow x = \cos y, \quad -1 \leq x \leq 1, \quad 0 \leq y \leq \pi$$

$$y = \tan^{-1} x \Leftrightarrow x = \tan y, \quad x \in \mathbb{R}, \quad -\frac{\pi}{2} < y < \frac{\pi}{2}$$



List of integrals

$$1. \int x^r dx = \frac{x^{r+1}}{r+1} + c, \text{ for } r \neq -1$$

For example: $\int x^3 dx = \frac{x^{3+1}}{3+1} + c = \frac{x^4}{4} + c$

$$2. \int \sin x \, dx = -\cos x + c$$

$$3. \int \cos x \, dx = \sin x + c$$

$$4. \int \sec^2 x \, dx = \tan x + c$$

$$5. \int \csc^2 x \, dx = -\cot x + c$$

$$6. \int \sec x \tan x \, dx = \sec x + c$$

$$7. \int \csc x \cot x \, dx = -\csc x + c$$

$$8. \int e^x \, dx = e^x + c$$

$$9. \int e^{-x} \, dx = -e^{-x} + c$$

$$10. \int \frac{1}{x} \, dx = \ln|x| + c, \quad x \neq 0$$

$$11. \int \frac{1}{1+x^2} dx = \tan^{-1}x + c$$

$$12. \int \frac{1}{\sqrt{1-x^2}} dx = \sin^{-1}x + c$$

$$13. \int \frac{1}{|x|\sqrt{x^2-1}} dx = \sec^{-1}x + c$$

$$14. \int \sinh u \, du = \cosh u + c$$

$$15. \int \cosh u \, du = \sinh u + c$$

$$16. \int \operatorname{sech}^2 u \, du = \tanh u + c$$

$$17. \int \operatorname{csch}^2 u \, du = -\coth u + c$$

$$18. \int \operatorname{sech} u \tanh u \, du = -\operatorname{sech} u + c$$

$$19. \int \operatorname{csch} u \coth u \, du = -\operatorname{csch} u + c$$

$$20. \int \frac{1}{\sqrt{a^2+u^2}} du = \sinh^{-1} \frac{u}{a} + c, \quad a > 0$$

$$21. \int \frac{1}{\sqrt{u^2-a^2}} du = \cosh^{-1} \frac{u}{a} + c, \quad 0 < a < u$$

$$22. \int \frac{1}{a^2-u^2} du = \frac{1}{a} \tanh^{-1} \frac{u}{a} + c, \quad |u| < a$$

$$23. \int \frac{1}{u\sqrt{a^2-u^2}} du = -\frac{1}{a} \operatorname{sech}^{-1} \frac{|u|}{a} + c, 0 < |u| < a$$

$$24. \int \frac{f'(x)}{f(x)} dx = \ln|f(x)| + c$$

$$25. \int \sec ax \, dx = \frac{1}{a} \ln |\sec ax + \tan ax| + C$$

$$26. \int \tan x \, dx = -\ln|\cos x| + c$$

$$27. \int \sec^n ax \, dx = \frac{\sec^{n-2} ax \tan ax}{a(n-1)} + \frac{n-2}{n-1} \int \sec^{n-2} ax \, dx \quad (\text{for } n \neq 1)$$

$$28. \int \cos^n ax \, dx = \frac{\cos^{n-1} ax \sin ax}{na} + \frac{n-1}{n} \int \cos^{n-2} ax \, dx \quad (\text{for } n > 0)$$

$$29. \int \sin^n ax \, dx = -\frac{\sin^{n-1} ax \cos ax}{na} + \frac{n-1}{n} \int \sin^{n-2} ax \, dx \quad (\text{for } n > 0)$$

List of Derivatives

التعريف العام للإشتقاق

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

مثال	المشتقة	الدالة
$\frac{dy}{dx} 3 = 0$	$\frac{d}{dx} a = 0, a \text{ is constant}$	تفاضل الدالة الثابتة
$\frac{d}{dx} \sqrt{x} = \frac{d}{dx} x^{\frac{1}{2}} = \frac{1}{2} x^{\frac{1}{2}-1} = \frac{1}{2\sqrt{x}}$	$\frac{d}{dx} x^n = nx^{n-1}$	تفاضل الدالة المرفوعة لقوى (x^n)
$\frac{d}{dx} (2x^2 + 1)(3x) = (4x)(3x) + (2x^2 + 1)(3)$	$(f \cdot g)' = f'g + fg'$	إشتقاق ضرب دالتين $(f \cdot g)'$:
$\frac{d}{dx} \left(\frac{x}{x+1} \right) = \frac{(x+1)(1) - (x)(1)}{(x+1)^2}$	$\left(\frac{f}{g} \right)' = \frac{f'g - fg'}{(g)^2}$	إشتقاق قسمة دالتين $\left(\frac{f}{g} \right)'$
$\frac{d}{dx} (2x-1)^3 = 3(2x-1)^2 \cdot 2$	$(f \circ g)' = \frac{d}{dx} (f \circ g)(x) = [f(g(x))]' = f'(g(x)) \cdot g'(x)$	قاعدة السلسلة (مشتقة التحصيل) "the chain rule"
	$\frac{d}{dx} (\sin x) = \cos x$ $\frac{d}{dx} (\cos x) = -\sin x$ $\frac{d}{dx} (\tan x) = \sec^2 x$ $\frac{d}{dx} (\sec x) = \sec x \cdot \tan x$ $\frac{d}{dx} (\csc x) = -\csc x \cdot \cot x$	مشتقة الدوال المثلثية

	$\frac{d}{dx}(\cot x) = -\csc^2 x$	
	$\frac{d}{dx}(\sin^{-1}x) = \frac{1}{\sqrt{1-x^2}}$ $\frac{d}{dx}(\cos^{-1}x) = \frac{-1}{\sqrt{1-x^2}}$ $\frac{d}{dx}(\tan^{-1}x) = \frac{1}{1+x^2}$	مشتقة الدوال المثلثية العكسية:
	<p>الصورة العامة للدالة اللوغاريتمية</p> $f(x) = \log_a(x)$ <p>مشتقة ما بداخل ال \log</p> $f'(x) = \frac{\log}{(\log \text{ ما بداخل }) \cdot \ln a}$ $= \frac{1}{x \cdot \ln a}$ <p>لو كان الأساس $a=e$</p> $\log_a(x) = \log_e(x) = \ln x$	مشتقة الدالة اللوغاريتمية
$\frac{d}{dx} \ln(x^2) = \frac{2x}{x^2} = \frac{2}{x}$	$\frac{d}{dx} \ln f(x) = \frac{f'(x)}{f(x)}$	إشتقاق ال \ln
$\frac{d}{dx} 3^{x^2} = (\ln 3) 3^{x^2} (2x)$	<p>الصورة العامة للدالة الأسية</p> <p>$y = b^x$ حيث أن $b > 0$</p> <p>قانون إشتقاق الدالة الأسية</p> $\frac{d}{dx} b^x = (\ln b) b^x$ <p>لو كان الأساس دالة</p> $\frac{d}{dx} b^{g(x)} = \ln b \cdot (g'(x)) \cdot b^{g(x)}$	إشتقاق الدالة الأسية
	$\frac{d}{dx}(\sinh u) = \cosh u \frac{du}{dx}$	Hyperpolic function

	$\frac{d}{dx}(\cosh u) = \sinh u \frac{du}{dx}$ $\frac{d}{dx}(\tanh u) = \operatorname{sech}^2 u \frac{du}{dx}$ $\frac{d}{dx}(\coth u) = -\operatorname{csch}^2 u \frac{du}{dx}$ $\frac{d}{dx}(\operatorname{sech} u) = -\operatorname{sech} u \tanh u \frac{du}{dx}$ $\frac{d}{dx}(\operatorname{csch} u) = -\operatorname{csch} u \coth u \frac{du}{dx}$	
	$\frac{d}{dx}(\sinh^{-1} u) = \frac{1}{\sqrt{u^2 + 1}} \frac{du}{dx}$ $\frac{d}{dx}(\cosh^{-1} u) = \frac{1}{\sqrt{u^2 - 1}} \frac{du}{dx}, u > 1$ $\frac{d}{dx}(\tanh^{-1} u) = \frac{1}{1-u^2} \frac{du}{dx}, u < 1$ $\frac{d}{dx}(\operatorname{sech}^{-1} u) = \frac{-1}{u\sqrt{1-u^2}} \frac{du}{dx}, 0 < u < 1$	<p><i>Inverse hyperbolic function</i></p>

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