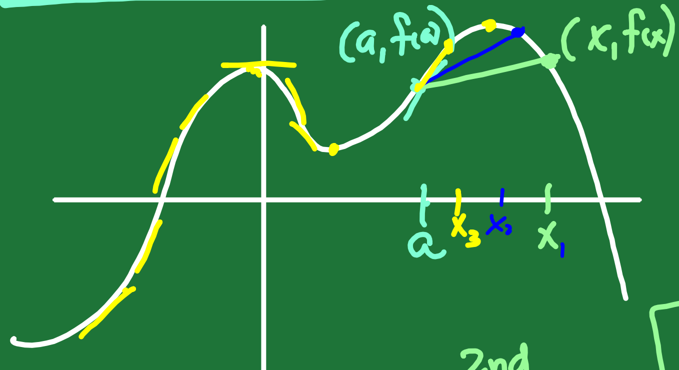
DERIVATIVES

$f(x) = x^4 - 3x^2 + 7x + 4$

x	$f(x)$
0	4
1	



the slope of a line tangent to a curve at a given pt.

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

1st Def. of Deriv.

func.	Deriv.	2nd deriv
$f(x)$	$f'(x)$	$f''(x)$
$y=$	$y'=$	$y''=$
$y=$	$\frac{dy}{dx} = \frac{\Delta y}{\Delta x}$	$\frac{d^2y}{dx^2}$
$y=$	$D_x y$	$D^2_x y$

$$\frac{d^2}{dx^2} y$$

$f(x) = x^3 - 2x^2 + 4x - 7$ $\qquad$ $f'(a) = \lim\limits_{x \to a} \dfrac{f(x) - f(a)}{x - a}$

Find $f'(a)$.

$$\lim_{x \to a} \frac{x^3 - 2x^2 + 4x - \cancel{7} + (-a^3 + 2a^2 - 4a + \cancel{7})}{x - a} = \frac{0}{0}$$

$$\lim_{x \to a} \frac{(x^3 - a^3)(-2x^2 + 2a^2)(+4x - 4a)}{x - a}$$

$$\lim_{x \to a} \frac{\cancel{(x-a)}(x^2 + ax + a^2) - 2\overset{(x+a)\cancel{(x-a)}}{\cancel{(x^2 - a^2)}} + 4\cancel{(x-a)}}{\cancel{x - a}}$$

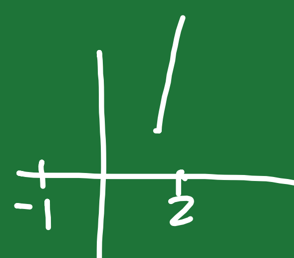
$$\lim_{x \to a} x^2 + ax + a^2 - 2x - 2a + 4$$

$$= a^2 + a^2 + a^2 - 2a - 2a + 4$$

$$\boxed{f'(a) = 3a^2 - 4a + 4}$$

$a = 2 \qquad 3(2)^2 - 4(2) + 4 = 8$

$a = -1 \qquad 3(-1)^2 - 4(-1) + 4 = 11$



$$\lim_{x \to a} \frac{\sqrt{x} - \sqrt{a}}{x - a} \cdot \frac{(\sqrt{x} + \sqrt{a})}{(\sqrt{x} + \sqrt{a})}$$

$$\lim_{x \to a} \frac{\frac{a \cdot 1}{a \cdot x} - \frac{1 \cdot x}{a \cdot x}}{x - a} = \frac{\qquad}{xa}$$

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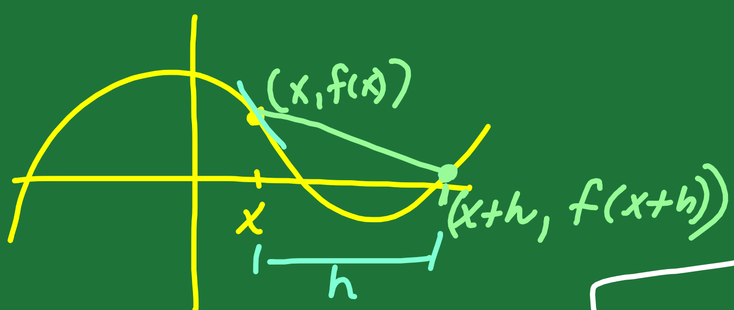

$$f(x) = \sin x$$

$$\lim_{x \to a} \frac{\sin x - \sin a}{x - a}$$

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

$$\boxed{\begin{array}{c}\underline{\text{2nd Def. of Deriv}} \\ \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}\end{array}}$$

$f(x) = 8\sin x$ $\qquad \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$

$$\lim_{h\to 0} \frac{8\sin(x+h) - 8\sin x}{h}$$

$\sin(A+B)$

$$8\lim_{h\to 0} \frac{\sin(x+h) - \sin x}{h}$$

$$8\lim_{h\to 0} \frac{\sin x\cos h + \cos x\sin h - \sin x}{h}$$

$$8\lim_{h\to 0} \frac{\sin x\cos h - \sin x}{h} + \frac{\cos x\sin h}{h}$$

$$8\lim_{h\to 0} \sin x \underbrace{\frac{(\cos h - 1)}{h}}_{0} + \cos x \cdot \underbrace{\frac{\sin h}{h}}_{1}$$

$$8\left[\cancel{\sin x \cdot 0} + \cos x \cdot 1\right]$$

$$= 8\cos x$$

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$$\frac{d}{dx}\sin x = \cos x$$

$$\frac{d}{dx}\cos x = -\sin x$$

$$\frac{d}{dx}\tan x = \sec^2 x$$

$$\frac{d}{dx}\cot x = -\csc^2 x$$

$$\frac{d}{dx}\sec x = \sec x \tan x$$

$$\frac{d}{dx}\csc x = -\csc x \cot x$$

$$f(x) = 4\tan x + 3\csc x$$

$$f'(x) = 4\sec^2 x - 3\csc x \cot x$$

Power Rule

$f(x)$	$f'(x)$
$x^3 - 2x^2 + 4x^1 - 7x^0$	$3x^2 - 4x + 4$

$$\frac{d}{dx}x^n = n \cdot x^{n-1}$$

$$f(x) = 3x^8 - \frac{2}{3x^5} - 7x^{10} + 6\sqrt[3]{x^2} - 89$$

$$= 3x^8 - \frac{2}{3}x^{-5} - 7x^{10} + 6x^{2/3} - 89$$

$$f'(x) = 24x^7 + \frac{10}{3}x^{-6} - 70x^9 + 4x^{-1/3}$$

$$= 24x^7 + \frac{10}{3x^6} - 70x^9 + \frac{4}{\sqrt[3]{x}}$$

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(c)