AP Calculus-AB — Derivatives (1) Day 1

Notes: Formal Definition of Derivative

Terminology and Notation:

The *derivative* of f at $x = a$ is the instantaneous rate of change of f at $x = a$. The following notations are used for the derivative of f at $x = a$:

$$f'(a) \qquad \left.\frac{df}{dx}\right|_{x=a}$$

Derivative: $f'(x)$	Derivative at a point: $f'(a)$ where a is some number	
$\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$	$\lim_{h\to 0}\frac{f(a+h)-f(a)}{h}$	$\lim_{x\to a}\frac{f(x)-f(a)}{x-a}$

Example(s) 1:

A.) Find $\frac{dy}{dx}$ for $f(x) = x^2 + 1$

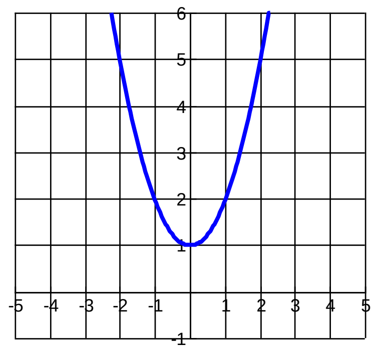
B.) Find $\left.\frac{dy}{dx}\right|_{x=-1}$

C.) Find $\left.\frac{dy}{dx}\right|_{x=0}$

D.) Find $\left.\frac{dy}{dx}\right|_{x=1}$

E.) Find $\left.\frac{dy}{dx}\right|_{x=2}$

What does this mean graphically?



Example 2:

Find $f'(x)$ for $f(x) = \sqrt{x-2}$

Example 3:

Remember: $f'(x)$ is the same as instant rate of change.

Find $f'(x)$ for $f(x) = x^3 - 2x$

Example 4:

Find the instant rate of change of the function at $x = 2$

$f(t) = 6 + \sqrt{t}$

Tangent Lines: You will always need two things for a tangent line:

1. Point
2. Slope

There are three forms of a line:

1. Slope /Intercept 2. Point/Slope 3. General

Example 5:

Find the equation for the tangent line to $g(x) = \frac{8}{x}$ at $x = 4$.

Example 6:

Find the equation for the tangent line to $g(x) = 2x - 3$ at $x = 2$.

Memorize each of these!!!

Derivative: $f'(x)$	Derivative at a point: $f'(a)$ where a is some number	
$\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$	$\lim_{h\to 0}\frac{f(a+h)-f(a)}{h}$	$\lim_{x\to a}\frac{f(x)-f(a)}{x-a}$

Example(s) 7:

What is $f(x)$ in each of the following? What is each question asking you to answer?

$\lim_{h\to 0}\frac{\sqrt{x+h}-\sqrt{x}}{h}$	$\lim_{h\to 0}\frac{\sqrt{4+h}-\sqrt{4}}{h}$ or $\lim_{h\to 0}\frac{\sqrt{4+h}-2}{h}$	$\lim_{x\to 4}\frac{\sqrt{x}-\sqrt{4}}{x-4}$ or $\lim_{x\to 4}\frac{\sqrt{x}-2}{x-4}$
$\lim_{h\to 0}\frac{(x+h)^5-x^5}{h}$	$\lim_{h\to 0}\frac{(2+h)^5-32}{h}$	$\lim_{x\to 2}\frac{x^5-32}{x-2}$
$\lim_{h\to 0}\frac{\cos(x+h)-\cos x}{h}$	$\lim_{h\to 0}\frac{\cos(\pi+h)-(-1)}{h}$	$\lim_{x\to \pi}\frac{\cos(x)-(-1)}{x-\pi}$
$\lim_{x\to -1}\frac{(x^2+2)-(3)}{x+1}$	$\lim_{h\to 0}\frac{(x+h)^2+2-(x^2+2)}{h}$	$\lim_{h\to 0}\frac{(-1+h)^2+2-(3)}{h}$
$\lim_{h\to 0}\frac{\frac{1}{2+h}-\frac{1}{2}}{h}$	$\lim_{x\to 2}\frac{\frac{1}{x}-\frac{1}{2}}{x-2}$	$\lim_{h\to 0}\frac{\frac{1}{x+h}-\frac{1}{x}}{h}$
$\lim_{h\to 0}\frac{\left[(x+h)^3-2\right]-(x^3-2)}{h}$	$\lim_{x\to \frac{\pi}{4}}\frac{\tan x-1}{x-\frac{\pi}{4}}$	$\lim_{h\to 0}\frac{\ln(5+h)-\ln 5}{h}$
$\lim_{x\to \frac{\pi}{2}}\frac{\sec x-1}{x-\frac{\pi}{2}}$	$\lim_{h\to 0}\frac{e^{2+h}-e^2}{h}$	$\lim_{h\to 0}\frac{\left[\lvert x+h\rvert-1\right]-(\lvert x\rvert-1)}{h}$