Lesson 105 Objective: SWBAT determine the derivative of a function using the alternate definition.

Kickoff: Determine the normal line for the function:

f(x) = 2x^2 -4x +5 at the point x = -1

$$f'(x) = \lim_{h\to 0} \frac{[2(x+h)^2 - 4(x+h)+5] - [2x^2 - 4x + 5]}{h}$$

$$\frac{\cancel{2x^2} + 4xh + 2h^2 \cancel{-4x} - 4h \cancel{+5} \cancel{-2x^2} \cancel{+4x} \cancel{-5}}{h}$$

$$\frac{4x\cancel{h} + 2h^2 - 4\cancel{h}}{\cancel{h}}$$

$$\lim_{h\to 0} 4x + \cancel{2h} - 4 = 4x - 4 = f'(x)$$

$x = -1$

$f'(-1) = 4(-1) - 4 = -8$ Tangent Slope

Normal $m = \frac{1}{8}$

$y - 11 = \frac{1}{8}(x+1)$

$f(-1) = 11$

$f(-1) = 2(-1)^2 - 4(-1) + 5$

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Homework

⑦ T: $y - 2 = \frac{2\sqrt{15}}{15i}(x+3)$

N: $y - 2 = \frac{-\sqrt{15}i}{2}(x+3)$

⑦ $\lim_{h\to 0} \frac{\sqrt{4(x+h)-3} - \sqrt{4x-3}}{h}$

$\frac{\sqrt{4x+4h-3} - \sqrt{4x-3}}{h}$ $(\sqrt{4x+4h-3} + \sqrt{4x-3})$

$\frac{(\cancel{4x} + 4h \cancel{-3}) - \cancel{(4x-3)}}{h(\sqrt{4x+4h-3} + \sqrt{4x-3})}$

$\lim_{h\to 0} \frac{4\cancel{h}}{\cancel{h}(\sqrt{\ } + \sqrt{\ })}$

$\frac{4}{\sqrt{4x+\cancel{4h}-3} + \sqrt{4x-3}} = \frac{4}{\sqrt{4x-3} + \sqrt{4x-3}} = \frac{\cancel{4}2}{\cancel{2}\sqrt{4x-3}}$

$x = -3$

$\frac{2}{\sqrt{4(-3)-3}} = \frac{2}{\sqrt{-15}} = \frac{2\sqrt{15}}{\sqrt{15}i\sqrt{15}}$ $\frac{2}{\sqrt{4x-3}}$

T: $y - 2 = \frac{2\sqrt{15}}{15i}(x+3)$ N: $y - 2 = \frac{-\sqrt{15}i}{2}(x+3)$

⑧ $f(x) = \frac{x}{2x+5}$

$\lim_{h\to 0} \frac{\frac{(x+h)}{2(x+h)+5} - \left(\frac{x}{2x+5}\right)}{h}$

$\frac{(2x+5)\frac{x+h}{2x+2h+5} - \frac{x}{2x+5}(2x+2h+5)}{h}$

$\frac{\cancel{2x^2} + \cancel{2xh} + 5x + 5h \cancel{-2x^2} \cancel{-2xh} \cancel{-5x}}{(2x+2h+5)(2x+5)}$

h

$\frac{5h}{(2x+2h+5)(2x+5)} \cdot \frac{1}{h} = \frac{5}{(2x+2h+5)(2x+5)}$

$\frac{5}{(2x+5)(2x+5)} = \frac{5}{(2x+5)^2}$

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Things you need to know:

Test is THURSDAY

Extra Help is WEDNESDAY

Final is Friday June 8th & Monday June 11th

Bring your textbooks starting THURSDAY

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Alternate Definition of a Derivative

*Can only use for a specific point! The derivative of the function f at the point $x = \boxed{a}$ is: ← is a #!

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

Find the derivative of the given function at the given value of a using the alternate derivative.

Example 1: $f(x) = x^2 - 3$, $\boxed{a = 1}$

$f(a) = f(1) = 1^2 - 3 = -2$

$$\lim_{x\to a} \frac{f(x) - f(a)}{x - a} = \frac{[x^2 - 3] - [-2]}{x - 1}$$

$$\frac{x^2 - 1}{x - 1} = \frac{(x - \cancel{1})(x+1)}{\cancel{x-1}} = x + 1$$

$$\lim_{x\to a} x + 1 = a + 1 = 1 + 1 = \boxed{2}$$

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Example 2: $f(x) = x^2 + 4, a = 1$

$f(a) = f(1) = 1^2 + 4 = 5$

$$\lim_{x\to a} \frac{[x^2 + 4] - [5]}{x - 1} = \frac{x^2 + 4 - 5}{x - 1} = \frac{x^2 - 1}{x - 1}$$

$$\frac{(x+1)(x-\cancel{1})}{\cancel{x-1}} = x + 1 =$$

$a + 1 = 1 + 1$

$\boxed{2}$

Example 3: $f(x) = 2x + 3, a = 2$

$$\lim_{x\to a} \frac{[2x+3] - [7]}{x - 2}$$

$$\frac{2x + 3 - 7}{x - 2} = \frac{2x - 4}{x - 2} = \frac{2(x - \cancel{2})}{\cancel{x-2}} = 2$$

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Example 4: $f(x) = \sqrt{x+1}, a = 3$

$f(3) = \sqrt{3+1} = 2$

$$\lim_{x\to a} \frac{\sqrt{x+1} - 2}{x - 3} \cdot \frac{(\sqrt{x+1} + 2)}{(\sqrt{x+1} + 2)}$$

$$\frac{\cancel{x-3}}{\cancel{(x-3)}(\sqrt{x+1} + 2)} = \frac{1}{\sqrt{x+1} + 2} = \frac{1}{\sqrt{a+1} + 2}$$

$$\frac{1}{\sqrt{3+1} + 2}$$

$$\frac{1}{2+2} = \boxed{\frac{1}{4}}$$

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Example 5: $f(x) = \frac{1}{x}, a = 2$

$$\lim_{x \to a} \frac{\frac{(2)}{(2)}\frac{1}{x} - \frac{1}{2}\frac{(x)}{(x)}}{x-2} \qquad \frac{\frac{2-x}{2x}}{x-2}$$

$$\frac{\cancel{2-x}^{\,-1}}{2x} \cdot \frac{1}{\cancel{x-2}} = \frac{-1}{2x} = \frac{-1}{2a}$$

$$\frac{-1}{2(2)} = \frac{-1}{4}$$

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Calculator Steps!!

We can use our calculator to find the derivative at a specific value, the steps are:

1. Put function in y=
2. math
3. #8 nDeriv( )

$$\frac{dy}{d\,\square}\left(\square\right)\Big|_{x=\square}$$

x

alpha trace enter

a or x value

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