Today's Plan:

Learning Target (standard): I will find use the definition of derivative to calculate a rate of change. I will explain the definition of derivative in terms of tangent lines and velocity.

Students will: Complete practice problems over previous concepts at the boards, put up homework problems on the board and make neccessary corrections to their own work, take notes over new material and complete practice problems over new concepts.

Teacher will: Provide practice problems over previous concepts, check homework problems for accuarcy and provide students feedback, describe and provide examples of new concepts and assign students assessment problems over new concepts.

Assessment: Board work, homework check and homework assignment

Differentiation: Students will work at the board, go over and correct homework at their seats, actively engage in lecture over new concepts, practice new concepts with the aid of other students and the teacher and complete homework assignment.

Definition of Derivative Worksheet

$1)\, f'(x) = \frac{3}{2\sqrt{3x+5}}$

$2)\, f'(x) = -6x+4$

$3)\, f'(x) = -\frac{2}{(2x+5)^2}$

$4)\, f'(x) = \frac{1}{(x-2)^2}$

$5)\, f'(x) = -10x+5$

$6)\, f'(x) = \frac{1}{2\sqrt{x-4}}$

* QUIZ tomorrow! *

Find the derivative and state 2 interpretations:

$$f(x) = 3x^3 + 2$$

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

$$= \lim_{h\to 0} \frac{[3(x+h)^3+2]-[3x^3+2]}{h}$$

$$= \lim_{h\to 0} \frac{3(x^3+3x^2h+3xh^2+h^3)+2-3x^3-2}{h}$$

$$= \lim_{h\to 0} \frac{\cancel{3x^3}+9x^2h+9xh^2+3h^3+\cancel{2}-\cancel{3x^3}-\cancel{2}}{h}$$

$$= \lim_{h\to 0} \frac{\cancel{h}(9x^2+9xh+3h^2)}{\cancel{h}}$$

$$= \lim_{h\to 0} (9x^2+9xh+3h^2)$$

$$= 9x^2+0+0$$

$$f'(x) = 9x^2$$

$\therefore$ Since $f(x)=3x^3+2$ and $f'(x)=9x^2$, the slope of a tangent line thru the point $(x, f(x))$ to $f(x)=3x^3+2$ is $9x^2$. The velocity of a particle moving along $f(x)=3x^3+2$ @ a time of "x" is $9x^2$.

Find the derivative and state 2 interpretations:

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

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

$$= \lim_{h\to 0} \frac{[\sqrt{3(x+h)+1}]-[\sqrt{3x+1}]}{h}$$

$$= \lim_{h\to 0} \frac{\sqrt{3x+3h+1}-\sqrt{3x+1}}{h} \cdot \frac{\sqrt{3x+3h+1}+\sqrt{3x+1}}{\sqrt{3x+3h+1}+\sqrt{3x+1}}$$

$$= \lim_{h\to 0} \frac{\cancel{3x}+3h\cancel{+1}-\cancel{3x}\cancel{-1}}{h(\sqrt{3x+3h+1}+\sqrt{3x+1})}$$

$$= \lim_{h\to 0} \frac{3\cancel{h}}{\cancel{h}(\sqrt{3x+3h+1}+\sqrt{3x+1})}$$

$$= \lim_{h\to 0} \frac{3}{\sqrt{3x+3h+1}+\sqrt{3x+1}}$$

$$= \frac{3}{\sqrt{3x+0+1}+\sqrt{3x+1}}$$

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

$\therefore$ Since $f(x)=\sqrt{3x+1}$ and $f'(x)=\frac{3}{2\sqrt{3x+1}}$, the slope of the tangent line thru the point $(a, f(a))$ to $f(x)=\sqrt{3x+1}$ is $\frac{3}{2\sqrt{3a+1}}$. The velocity of a particle moving along $f(x)=\sqrt{3x+1}$ @ a time of "a" is $\frac{3}{2\sqrt{3a+1}}$.

Find the derivative and state 2 interpretations:

$$f(x) = 2x^3 - 4x + 1$$

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

$$= \lim_{h \to 0} \frac{\left[2(x+h)^3 - 4(x+h) + 1\right] - \left[2x^3 - 4x + 1\right]}{h}$$

$$= \lim_{h \to 0} \frac{2(x^3 + 3x^2h + 3xh^2 + h^3) - 4x - 4h + 1 - 2x^3 + 4x - 1}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{2x^3} + 6x^2h + 6xh^2 + 2h^3 \cancel{-4x} - 4h \cancel{+1} \cancel{-2x^3} \cancel{+4x} \cancel{-1}}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{h}(6x^2 + 6xh + 2h^2 - 4)}{\cancel{h}}$$

$$= \lim_{h \to 0} (6x^2 + 6xh + 2h^2 - 4)$$

$$= 6x^2 + 0 + 0 - 4$$

$$f'(x) = 6x^2 - 4$$

$\therefore$ Since $f(x) = 2x^3 - 4x + 1$ and $f'(x) = 6x^2 - 4$, the slope of a tangent line thru the point $(x, f(x))$ to $f(x) = 2x^3 - 4x + 1$ is $6x^2 - 4$. The velocity of a particle moving along $f(x) = 2x^3 - 4x + 1$ @ a time of "x" is $6x^2 - 4$.

$$f(x) = 4x^2 + x$$

$$f'(x) =$$

$$m_{\tan(1,5)} =$$

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

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

$$= \lim_{h \to 0} \frac{4(x^2 + 2xh + h^2) + x + h - 4x^2 - x}{h}$$

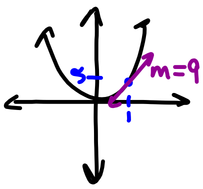
$$= \lim_{h \to 0} \frac{\cancel{4x^2} + 8xh + 4h^2 \cancel{+x} + h \cancel{-4x^2} \cancel{-x}}{h}$$

$$= \lim_{h \to 0} \frac{\cancel{h}(8x + 4h + 1)}{\cancel{h}}$$

$$= \lim_{h \to 0} (8x + 4h + 1)$$

$$= 8x + 0 + 1$$

$$f'(x) = 8x + 1$$



$$m_{\tan(1,5)} = 8(1) + 1$$

$$m_{\tan(1,5)} = 9$$

$f(t) = 3t^2 - 2t$

$v(a) =$

$v(2) =$

$v(7) =$

$$V(a) = \lim_{h\to 0} \frac{f(a+h) - f(a)}{h}$$

$$= \lim_{h\to 0} \frac{\left[3(a+h)^2 - 2(a+h)\right] - \left[3a^2 - 2a\right]}{h}$$

$$= \lim_{h\to 0} \frac{\cancel{3a^2} + 6ah + 3h^2 - \cancel{2a} - 2h - \cancel{3a^2} + \cancel{2a}}{h}$$

$$= \lim_{h\to 0} \frac{h(6a + 3h - 2)}{h}$$

$$= \lim_{h\to 0} (6a + 3h - 2)$$

$$V(a) = 6a - 2$$

$V(2) = 6(2) - 2$

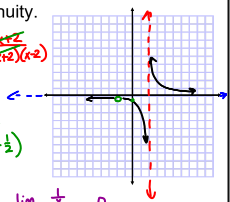
$V(2) = 10$

$V(7) = 6(7) - 2$

$V(7) = 40$

Discuss the continuity.

$$f(x) = \frac{x+2}{x^2-4} = \frac{\cancel{x+2}}{\cancel{(x+2)}(x-2)}$$



$f(x) = \frac{1}{x-2}$

D: $\{x \mid x \neq -2, 2\}$ Ix: —

Holes: $(-2, -\frac{1}{4})$ Iy: $(0, -\frac{1}{2})$

End Behavior:

$$\lim_{x\to\infty} \frac{1}{x-2} = \lim_{x\to\infty} \frac{\frac{1}{x}}{\frac{x}{x} - \frac{2}{x}} = \lim_{x\to\infty} \frac{\frac{1}{x}}{1 - \frac{2}{x}} = \frac{0}{1-0} = 0$$

$$\lim_{x\to -\infty} \frac{\frac{1}{x}}{1 - \frac{2}{x}} = \frac{0}{1-0} = 0$$

$\therefore$ HA: $y = 0$

intersects?

$0 = \frac{1}{x-2}$

$0 \neq 1$ DNI

VA: $x = 2$

$\lim_{x\to 2^-} f(x) = -\infty$

$\lim_{x\to 2^+} f(x) = \infty$

Continuity:

1) D: $\{x \mid x \neq -2, 2\}$

2) continuous on $(-\infty, -2) \cup (-2, 2) \cup (2, \infty)$

3) removeable discontinuity @ $x = -2$

infinite/essential discontinuity @ $x = 2$

4) a. $f(-2) = $ und

b. $\lim_{x\to -2^-} f(x) = -\frac{1}{4}$

$\lim_{x\to -2^+} f(x) = -\frac{1}{4}$ $\therefore \lim_{x\to -2} f(x) = \frac{1}{4}$

c. $f(-2) \neq \lim_{x\to -2} f(x)$

$\therefore$ Since the function is undefined @ the x-value of -2 and the left-hand and right-hand limits as x approaches -2 are both equal to $-\frac{1}{4}$, the function has a removable discontinuity @ the x-value of -2.

a. $f(2) = $ und

b. $\lim_{x\to 2^-} f(x) = -\infty$

$\lim_{x\to 2^+} f(x) = \infty$ $\therefore \lim_{x\to 2} f(x) = $ DNE

c. $f(2) \neq \lim_{x\to 2} f(x)$

$\therefore$ Since the function is undefined @ the x-value of 2 and the one-sided limits are infinite and not equal to one another, the function has an infinite/essential discontinuity @ the x-value of 2.

Assignment: #1-5, find f ' (x).

1) $f(x) = 7x^3 - 3x^2 + 2x + 1$

$m_{\tan(1,7)} =$

$v(1) =$

2) $f(x) = -\frac{5}{x} - 2x + 3$

$m_{\tan(1,-4)} =$

$v(2) =$

3) $f(x) = 4\sqrt{x} - 1$

$m_{\tan(4,7)} =$

$v(1) =$

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

$m_{\tan(1,-3)} =$

$v(-1) =$

5) $f(x) = \frac{x^2 + 3x - 4}{x + 4}$

$m_{\tan(0,-1)} =$

$v(2) =$

6) Discuss the continuity:

$$f(x) = \begin{cases} \frac{x^2 - 2x - 3}{x - 3}, & x < 4 \\ 4 - x, & x \geq 4 \end{cases}$$

7)

If an object is thrown upwards with an initial velocity of 48 ft/sec, then its distance above the ground at *t* seconds is given by $f(t) = 48t - 16t^2$. Find the velocity when *t* = 1, *t* = 2. When does it reach its maximum height? Its minimum height?

Assignment:

1) $f(x) = 7x^3 - 3x^2 + 2x + 1$

$m_{\tan(1,7)} = 17$

$v(1) = 17$

$\boxed{f'(x) = 21x^2 - 6x + 2}$

2) $f(x) = -\frac{5}{x} - 2x + 3$

$m_{\tan(1,-4)} = 3$

$v(2) = -{}^3/_4$

$\boxed{f'(x) = \frac{5}{x^2} - 2}$

3) $f(x) = 4\sqrt{x} - 1$

$m_{\tan(4,7)} = 1$

$v(1) = 2$

$\boxed{f'(x) = \frac{2}{\sqrt{x}}}$

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

$m_{\tan(1,-3)} = 5$

$v(-1) = -3$

$\boxed{f'(x) = 4x + 1}$

5) $f(x) = \frac{x^2 + 3x - 4}{x + 4}$

$m_{\tan(0,-1)} = 1$

$v(2) = 1$

$\boxed{f'(x) = 1}$

6) Discuss the continuity:

$$f(x) = \begin{cases} \frac{x^2 - 2x - 3}{x - 3}, & x < 4 \\ 4 - x, & x \geq 4 \end{cases}$$

Removeable at x = 3
Jump at x = 4

7) If an object is thrown upwards with an initial velocity of 48 ft/sec, then its distance above the ground at *t* seconds is given by $f(t) = 48t - 16t^2$. Find the velocity when *t* = 1, *t* = 2. When does it reach its maximum height? Its minimum height?

$$\boxed{\begin{aligned} v(a) &= 48 - 32a \frac{ft}{\sec} \\ v(1) &= 16 \frac{ft}{\sec} \\ v(2) &= -16 \frac{ft}{\sec} \end{aligned}}$$

max height at ${}^3/_2$ seconds

min height at 3 seconds