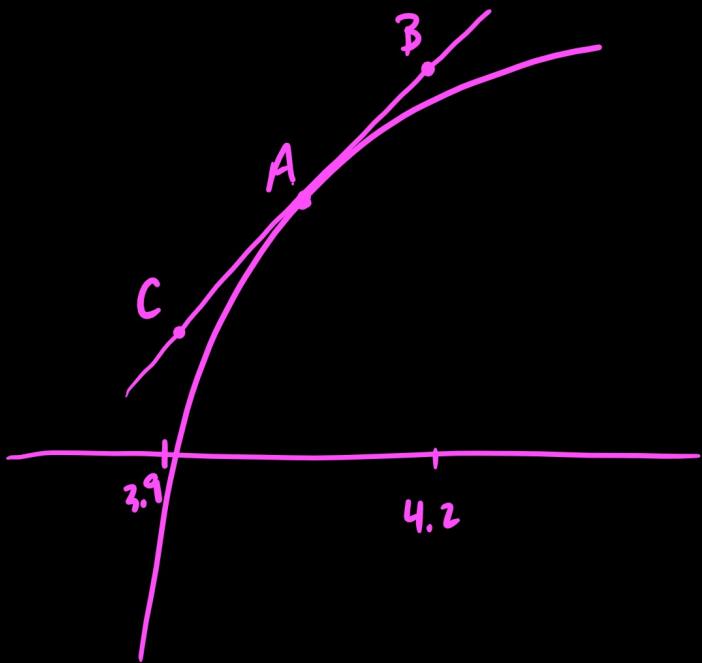


## WARM UP

Calculate  $f'(3)$  if  $f(x) = 2x^2 - 5x + 7$

$$\begin{aligned}
 f'(3) &= \lim_{h \rightarrow 0} \frac{f(3+h) - f(3)}{h} \\
 &= \lim_{h \rightarrow 0} \frac{(2(3+h)^2 - 5(3+h) + 7) - (2 \cdot 3^2 - 5 \cdot 3 + 7)}{h} \\
 &= \lim_{h \rightarrow 0} \frac{2(9+6h+h^2) - 15 - 5h + 7 - (18 - 15 + 7)}{h} \\
 &= \lim_{h \rightarrow 0} \frac{18+12h+2h^2 - 18 - 5h + 7 - 10}{h} = \lim_{h \rightarrow 0} \frac{2h^2 + 7h}{h} \\
 &= \lim_{h \rightarrow 0} 2h + 7 = 2 \cdot 0 + 7 = 7
 \end{aligned}$$

21)



$$f(4) = 25$$

$$f'(4) = 1.5$$

$$m = 1.5$$

$$\text{Point} = (4, 25)$$

$$25 = 1.5 \cdot 4 + b$$

$$25 = 6 + b$$

$$19 = b$$

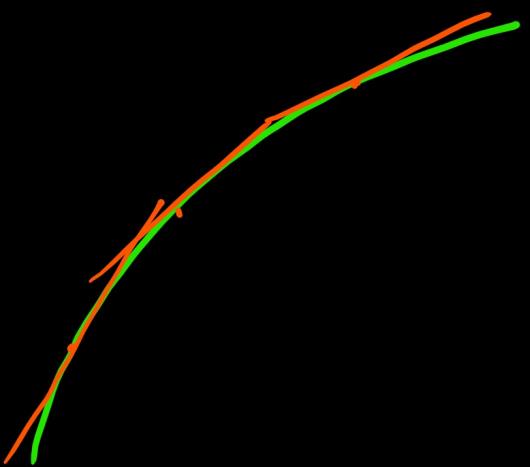
$$y = 1.5x + 19 \quad \leftarrow$$

$$A: (4, 25)$$

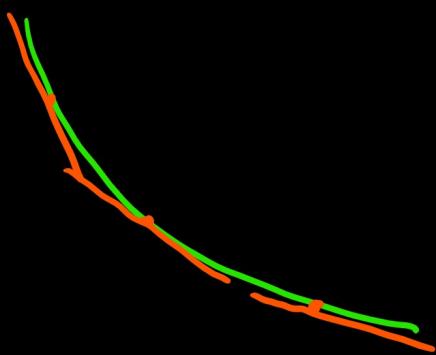
$$\begin{aligned}
 B: \quad y &= 1.5(4.2) + 19 = 25.3 \\
 &(4.2, 25.3)
 \end{aligned}$$

$$\begin{aligned}
 C: \quad y &= 1.5(3.9) + 19 = 24.85 \\
 &(3.9, 24.85)
 \end{aligned}$$

## Section 2.4 The Derivative Function

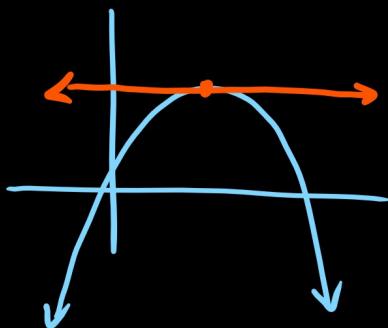


If  $f(x)$  is increasing on an interval, then  
 $f'(x) > 0$

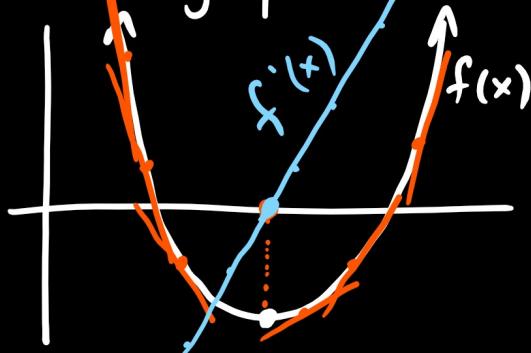


If  $f(x)$  is decreasing on an interval, then  
 $f'(x) < 0$

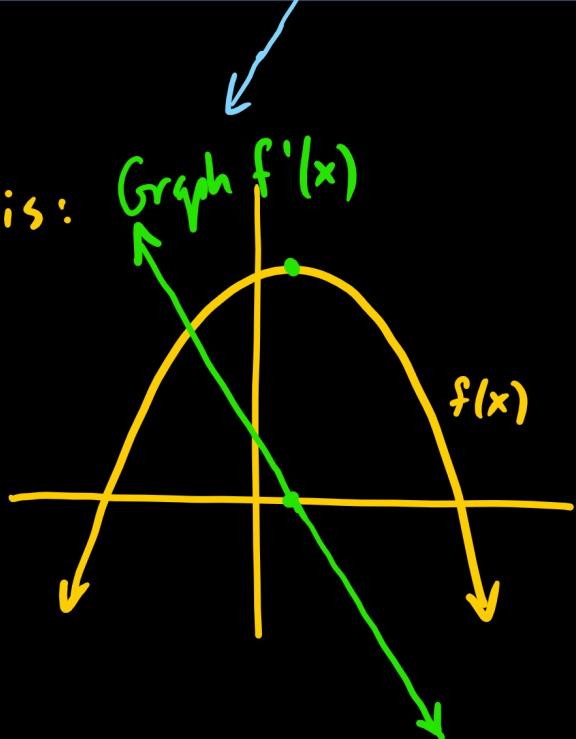
If  $f(x)$  has a horizontal tangent at a point  
then  $f'(x) = 0$  at that point.



Ex: Given the graph of  $f(x)$  graph  $f'(x)$



Try this: Graph  $f'(x)$



ex: Given  $f(x) = 7x^2 + 10x$ , find  $f'(x)$

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

$$= \lim_{h \rightarrow 0} \frac{[7(x+h)^2 + 10(x+h)] - [7x^2 + 10x]}{h}$$

$$= \lim_{h \rightarrow 0} \frac{7(x^2 + 2xh + h^2) + 10x + 10h - 7x^2 - 10x}{h}$$

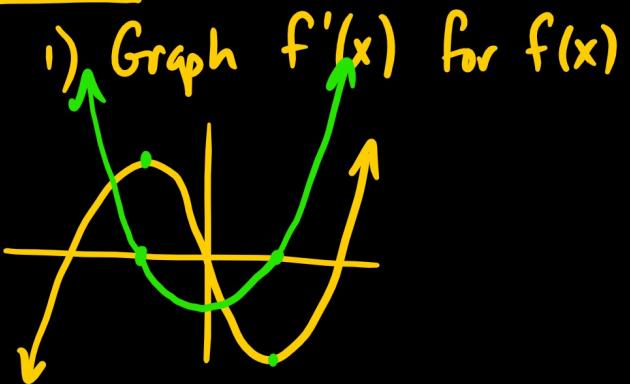
$$= \lim_{h \rightarrow 0} \frac{7x^2 + 14xh + 7h^2 + 10x + 10h - 7x^2 - 10x}{h}$$

$$= \lim_{h \rightarrow 0} \frac{h(14x + 7h + 10)}{h}$$

$$= 14x + 7 \cdot 0 + 10$$

$$= 14x + 10$$

## Assignment



2) Calculate  $f'(x)$

using  

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

for A)  $f(x) = 4x^2 - 7x$

B)  $f(x) = 3\sqrt{x}$

C)  $f(x) = \frac{5}{x}$

2B) 
$$\lim_{h \rightarrow 0} \frac{(3\sqrt{x+h} - 3\sqrt{x})}{h} \quad \frac{(3\sqrt{x+h} + 3\sqrt{x})}{(3\sqrt{x+h} + 3\sqrt{x})}$$

$$\lim_{h \rightarrow 0} \frac{9(x+h) - 9x}{h(3\sqrt{x+h} + 3\sqrt{x})} = \lim_{h \rightarrow 0} \frac{9x + 9h - 9x}{h(3\sqrt{x+h} + 3\sqrt{x})}$$

$$= \lim_{h \rightarrow 0} \frac{9}{3\sqrt{x+h} + 3\sqrt{x}} = \frac{9}{3\sqrt{x} + 3\sqrt{x}} = \frac{9}{6\sqrt{x}} = \frac{3}{2\sqrt{x}}$$

2c) 
$$\lim_{h \rightarrow 0} \frac{\cancel{5}}{x+h} \frac{\cancel{5}}{h} \frac{5}{x}$$

$$= \lim_{h \rightarrow 0} \frac{5x - 5(x+h)}{h(x+h)x}$$

$$= \lim_{h \rightarrow 0} \frac{5x - 5x - 5h}{h(x+h)x}$$

$$= \frac{-5}{(x+0)x} = -\frac{5}{x^2}$$

$$\text{Find } f'(x) \text{ if } f(x) = \frac{8}{\sqrt{x}}$$