Unit #10: Applications of Differentiation
Topic: First Derivative Test
Objective: SWBAT identify where a function in increasing/decreasing by using the first derivative.

Warm Up #4:

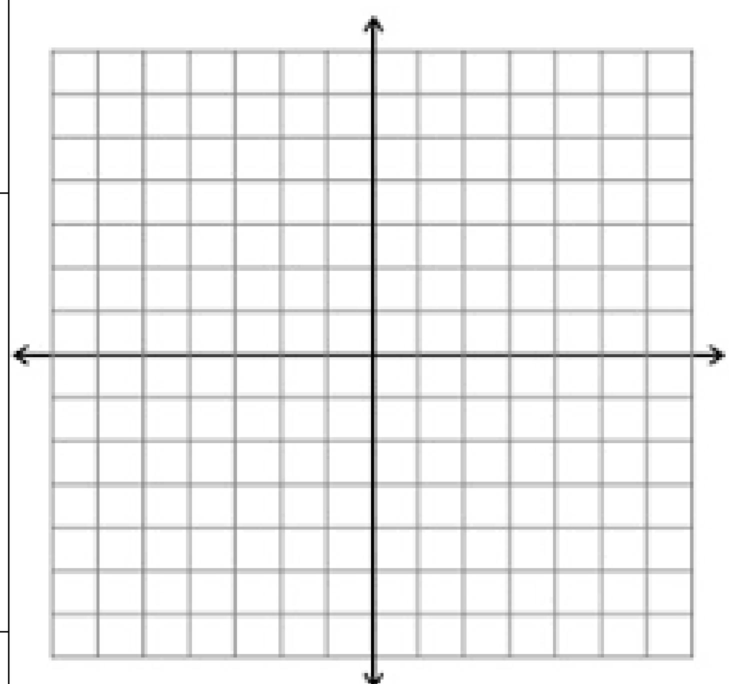
CALCULATOR ALLOWED!
Graph the derivative of $f(x)$ and then use the graph to identify:

(a) Where $f(x)$ is increasing? decreasing? Explain your reasoning.

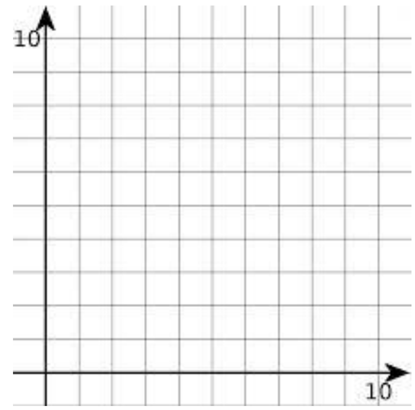
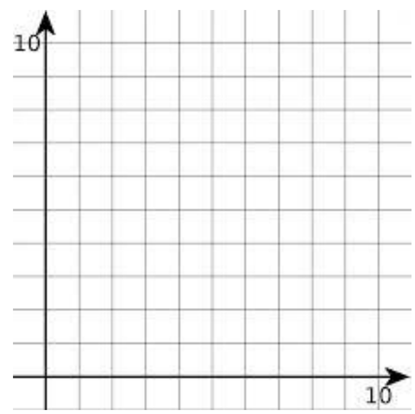
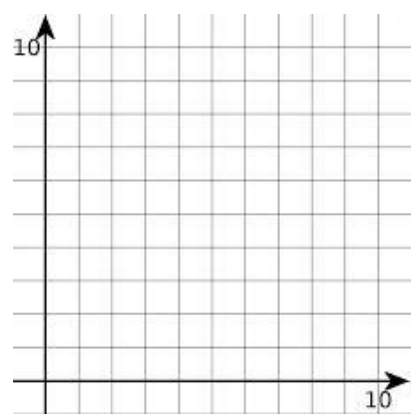
(b) Does $f(x)$ have any horizontal tangent lines? Explain your reasoning.

(c) Does $f(x)$ have any minimum points? maximum points? Justify your answers.

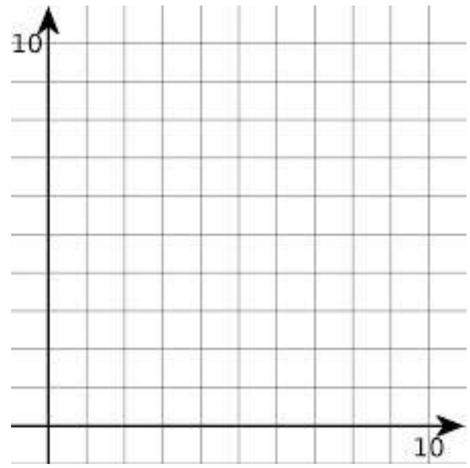
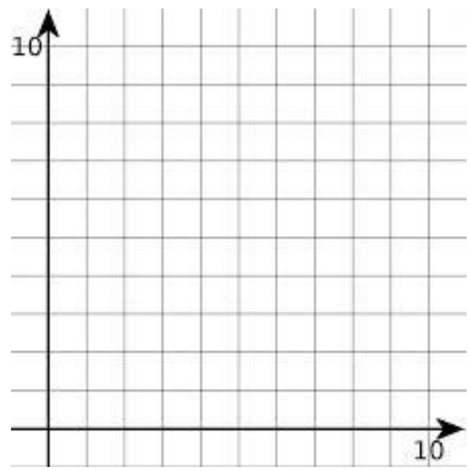
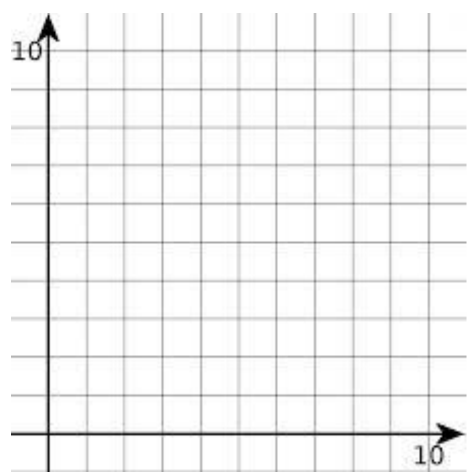
$$f(x) = (x^2 - 3)(x^2 + 2x)\ ;\ \ x \leq 2$$



Increasing, Decreasing, and the 1st Derivative Test

What does it sound like??	*What does it look like??*
If ______________________, then f is _________________________.	
If ______________________, then f is _________________________.	
If ______________________, then f is _________________________.	

At what values of x can the graph of a function change its increasing/decreasing/constant status??

What does it sound like??	*What does it look like??*
If $f'(x)$ changes from ____________________ at $x = c$, then f has a __________________________ at $x = c$.	
If $f'(x)$ changes from ____________________ at $x = c$, then f has a __________________________ at $x = c$.	
If $f'(x)$ ______________________ change signs at $x = c$, then f ________________ have a min/max at $x = c$.	
When using the First Derivative Test, you MUST write a concluding statement that indicates the type of sign change at $x = c$.	

Practice Problems: Use the first derivative test to identify where the function is increasing/decreasing/constant and where the relative extrema are. Justify your answers.

1) $f(x) = x\left(4 + x^2 - \frac{x^4}{5}\right)$ **CALCULATOR ALLOWED!**

2) $y = (x^2 - 4)^{2/3}$

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

4) $h(x) = x\sqrt{8 - x^2}$

5) $f(x) = -2x^3 + 6x^2 - 3$

6) $y = 2x^4 - 4x^2 + 1$

7) $g(x) = x^4 - \frac{2}{3}x^3$
8) $y = 3x^4 - 4x^3 - 12x^2 + 5$

Answer Key:

1) decr: $(-\infty, -2)(2, \infty)$; incr: $(-2,2)$; rel min at $x = -2$; rel max at $x = 2$
2) decr: $(-\infty, -2)(0,2)$; incr: $(-2,0)(2, \infty)$; rel min at $x = \pm 2$; rel max at $x = 0$
3) decr: $\left(-\frac{1}{2}, 0\right)\left(\frac{1}{2}, \infty\right)$; incr: $\left(-\infty, -\frac{1}{2}\right)\left(0, \frac{1}{2}\right)$; rel min at $x = 0$; rel max at $x = \pm\frac{1}{2}$
4) decr: $\left(-\sqrt{8}, -2\right)\left(2, \sqrt{8}\right)$; incr: $(-2,2)$; rel min at $x = -2$; rel max at $x = 2$
5) decr: $(-\infty, 0)(2, \infty)$; incr: $(0,2)$; rel min at $x = 0$; rel max at $x = 2$
6) decr: $(-\infty, -1)(0,1)$; incr: $(-1,0)(1, \infty)$; rel min at $x = \pm 1$; rel max at $x = 0$
7) decr: $\left(0, \frac{1}{2}\right)$; incr: $(\frac{1}{2}, \infty)$; rel min at $x = \frac{1}{2}$
8) decr: $(-\infty, -1)(0,2)$; incr: $(-1,0)(2, \infty)$; rel min at $x = -1$ *and* 2 ; rel max at $x = 0$