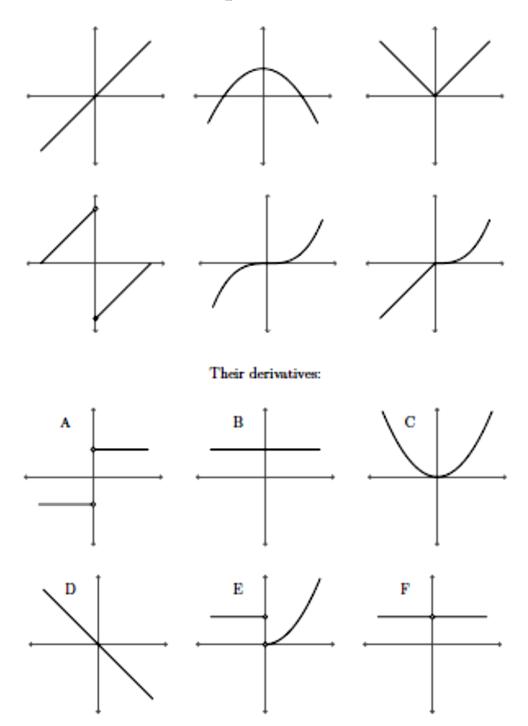*Unit #10:* Applications of Differentiation
Topic: Extreme Values
Objective: SWBAT identify the extrema of a function on an interval by using the derivative.

Warm Up #3:

Six graphs of functions are below, along with six graphs of derivatives. Match the graph of each function with the graph of its derivative.

Original Functions:

Their derivatives:

Now that we know how to find derivatives, we will use them to analyze the graphs of functions.

Example #1: Given the function $f(x) = x^5 - \frac{5}{3}x^3 - 1$ on the interval $[-2,2]$.

(a) Find all the critical values of $f(x)$.

(b) Determine whether each critical value found in part (a) is a relative minimum, maximum, or neither. Explain your reasoning.

(c) Does $f(x)$ have an absolute maximum or minimum point? Show the work that justifies your answer.

Example #2: Given $g(x) = \sqrt[3]{x^2 - x - 2}$ on the interval $[-3, 6]$.

(a) Find all the critical values of $f(x)$. (HINT: Be Verrrrrrry Observant!!)

(b) Determine whether each critical value found in part (a) is a relative minimum, maximum, or neither. Explain your reasoning.

(c) Does $f(x)$ have an absolute maximum or minimum point? Show the work that justifies your answer.

Problem Set #3: Find all absolute and relative extrema of the following functions. Show al necessary steps. **NO CALCULATOR!!**

1) $f(t) = 5t^{2/3} + t^{5/3}$; $[-1, 8]$	2) $y = xe^{2x}$; $[-1, 2]$
3) $g(t) = \sqrt{t}\,(1 - t)$; $t \geq 0$	4) $f(x) = \sqrt[3]{x^2 - x}$; $(-\infty, \infty)$

5) $y = 2x^3 - 3x^2 - 12x + 1;\ [-2,3]$

6) $f(x) = (x^2 - 1)^3;\ [-1,2]$

7) $f(x) = 3x^{2/3} - 2x\ ;\ [-1,2]$

8) $g(x) = \dfrac{2x}{x^2 + 1}\ ;\ [-2,2]$

Answer Key

1) $x = 0$ *rel min*
  abs min is 0 *at* $x = 0$
  abs max is 52 *at* $x = 8$
	2) $x = -\frac{1}{2}$ *rel min*
	  abs min is $-\frac{1}{e^2}$ *at* $x = -1$
	  abs max is $2e^4$ *at* $x = 2$

3) $x = \frac{1}{3}$ *rel max*
  abs min is 0 *at* $x = 0$
  no abs max
	4) $x = \frac{1}{2}$ *rel min*, $x = 0$ *and* 1 *neither*
	  no abs min
	  no abs max

5) $x = 2$ *rel* min *and* $x = -1$ *rel max*
  abs min is -19 *at* $x = 2$
  abs max is 8 *at* $x = -1$
	6) $x = 0$ *rel* min *and* $x = 1$ *neither*
	  abs min is -1 *at* $x = 0$
	  abs max is 27 *at* $x = 2$

7) $x = 0$ *rel* min *and* $x = 1$ *rel max*
  abs min at $x = 2$
  abs max is at $x = -1$
	8) $x = -1$ *rel* min *and* $x = 1$ *rel max*
	  abs min is -2 *at* $x = -1$
	  abs max is 2 *at* $x = 1$