MAT 1110	NAME: ____________
PROJECT 1.	ASU EMAIL: ____________

Connections Project

The table below summarizes the geometric connections between f, f', and f''.

$f(x)$	$\mid$	$f'(x)$	$\mid$	$f''(x)$
increasing	$\rightarrow$	nonnegative		
max/min	$\rightarrow$	root		
decreasing	$\rightarrow$	nonpositive		
minimum	$\rightarrow$	root	$\rightarrow$	nonnegative
maximum	$\rightarrow$	root	$\rightarrow$	nonpositive
concave up	$\rightarrow$	increasing	$\rightarrow$	positive
inflection pt	$\rightarrow$	max/min	$\rightarrow$	root
concave down	$\rightarrow$	decreasing	$\rightarrow$	negative

Table 1: Ye Charte

Problems

1. Give an example illustrating each row in the table. Show your function, its derivative(s), and appropriately labeled graph(s). (You may use one function's graphs to illustrate a group of rows of the chart.)

2. Where else, other than at a root of the derivative, can extrema occur? (Give sample graph(s).)

3. Suppose that $x = 1$ is a root of the derivative; i.e., $g'(1) = 0$. Does the original function $g(x)$ have to have an *extreme value* (maximum or minimum) at $x = 1$?

4. Suppose that $x = 2$ is a root of the second derivative; i.e., $h''(2) = 0$. Does the original function $h(x)$ have to have an *inflection point* at $x = 2$?

DEFINITION: A zero or root of f at $x = a$ has *multiplicity* n or *order* n if $f(a) = 0$, $f'(a) = 0$, $f''(a) = 0$, up to $f^{(n-1)}(a) = 0$, but $f^{(n)}(a) \neq 0$.

5. Show that $p(x) = x^4 - 7x^3 + 18\,x^2 - 20x + 8$ has a root of order 3 at $x = 2$ and of order 1 at $x = 1$.

6. Replace *root* in the second row of the chart with

   (a) *odd root*. Does this change the implication?

   (b) *even root*. Does this change the implication?

   Odd and *even* denote a root of f of odd or even order n.

7. List your project team members: