Mathematics 141: Review for Test 1.

(1) We started out by talking a bit about functions, their domains, ranges, graphs, and composition of functions. As to concrete functions we reviewed at bit about trigonometric functions and exponential and logarithmic functions. Here are some practice problems related to these ideas.
   - Section 1.1, Problems 1, 3, 5, 25.
   - Section 1.2, Problems 1, 5, 7.
   - You should know the values of the basic trigonometric funcions at the standard values. That is $\sin(\theta)$, $\cos(\theta)$, and $\tan(\theta)$ for $\theta = 0, \pi/6, \pi/4, \pi/3, \pi/2$.
   - Section 1.5, Problems 1, 3, 9, 11, 13, 15.
   - Section 1.6, Problems 45, 55, 57.

(2) The next topic we covered was limits. Many of the main ideas for limits are summarized in Section 2.2 of the book, and in particular *limit laws* in Theorem 1 of Section 2.2. I am not so interested in you having these memorized as in being able to use them. The same is true for Theorems 2 and 3 of the same section. Here are some practice problems.
   - Section 2.2, 11–49 odd, 43, 45, 63.

   We also talked some about one sided limits. Related to this discussion was the limit
$$\lim_{\theta \to 0} \frac{\sin \theta}{\theta} = 1.$$
   Know this limit as its statement will be on the test. As will be at least one problem about using it. Some practice problems are
   - Section 2.4, Problems 1, 3, 11, 21–39 odd.

(3) We have talked briefly about when a function f is continuous. The definition is that f is ***continuous*** at the point $x = a$ if and only if
$$\lim_{x \to a} f(x) = f(a).$$
   You should know this definition. The book has several theorems about continuous function, the most important being the *Intermediate Value Theorem*, (Theorem 11). Since we did not talk about it in class, don't worry about it for this test. Some practice problems:
   - Section 2.5, Problems 13, 15, 21, 43.

(4) Section 2.6 is about limits as x approaches infinity and infinite limits. This is mostly a somewhat highbrow of talking about horizontal and vertical asymptotes of the graph of a function. Practice problems:
   - Section 2.6, Problems 9–23 odd, 37–51 odd.

(5) This brings us to Chapter 3 and the derivative. The derivative is one of the main concepts of the course. If $f(x)$ is a real number valued

function of real numbers, then the *derivative* of $f(x)$ at $x = a$ is

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

This definition will be on the test so have it memorized. The number $f'(a)$ has the interpretation of being the slope of the tangent line to the graph $y = f(x)$ at the point $(a, f(a))$. There will be at least one problem where you have to compute the derivative from the definition. Here is an example. Use the definition of the derivative to find $f'(c)$ where $f(x) = 3x^2$.

$$\begin{aligned}
f'(c) &= \lim_{h \to 0} \frac{f(c+h) - f(c)}{h} \\
&= \lim_{h \to 0} \frac{3(c+h)^2 - 3c^2}{h} \\
&= \lim_{h \to 0} \frac{3(c^2 + 2ch + h^2) - 3c^2}{h} \\
&= \lim_{h \to 0} \frac{3c^2 + 6ch + 3h^2 - 3c^2}{h} \\
&= \lim_{h \to 0} \frac{6ch + 3h^2}{h} \\
&= \lim_{h \to 0} \frac{h(6c + 3h)}{h} \\
&= \lim_{h \to 0} (6c + h) \\
&= 6c.
\end{aligned}$$

For many similar functions we have formulas which let us write down the derivative of a function without having to go through all this announce with the derivative. Here is a table of some of these

$f(x)$	$f'(x)$	Comments
c	0	(c is a constant.)
cx	c	(c a constant.)
cx^n	ncx^{n-1}	(n and c constants.)
e^x	e^x	
uv	$u'v + uv'$	
uvw	$u'vw + uv'w + uvw'$	
$\frac{u}{v}$	$\frac{u'v - uv'}{v^2}$	

Quite a few of the questions on the test will be computing derivatives. Some problems to loot at:

- Section 3.1 Problems 1–21 odd (on these you can use the derivative rules rather than the definition to find the derivatives.)

- Section 3.2 Problems 1–9 odd, 13, 15, 23–25 odd. (And again you can use the derivative rules here.)
- Section 3.3 Problems 1–45 odd, 53.