1. When we find $\lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$, we are finding the **Derivative** of f(x).
2. For example, we have found that the derivative of f(x) = sin x, is cos x.
3. We should know that the derivative of a position function is the corresponding velocity function.
4. We should also know that the derivative of a velocity function is the corresponding acceleration function.
5. The position of an object is $s(t) = t^2 + t$.
   a. Find the position at t = 3.
      s(3) = 9 + 3 = 12
   b. Find the position at t = 5.
      s(5) = 25 + 5 = 30
   c. Find the average velocity from t = 3 to t = 5
      $\frac{f(5) - f(3)}{5 - 3} = \frac{30 - 12}{2} = \frac{18}{2} = 9$
   d. Find the instantaneous velocity at t = 3.
      $v(t) = \lim_{h \to 0} \frac{s(t+h) - s(t)}{h}$
      $= \lim_{h \to 0} \frac{(t+h)^2 + (t+h) - (t^2 + t)}{h}$
      $= \lim_{h \to 0} \frac{t^2 + 2th + h^2 + t + h - t^2 - t}{h}$
      $= \lim_{h \to 0} \frac{2th + h^2 + h}{h}$
      $= \lim_{h \to 0} 2t + h + 1$
      $= 2t + 1$
      Therefore v(3) = 6 + 1 = 7
6. Find the derivative of $f(x) = ax^3$, where a is a constant.
   $\lim_{h \to 0} \frac{a(x+h)^3 - ax}{h}$
   $= \lim_{h \to 0} \frac{a(x^3 + 3x^2h + 3xh^2 + h^3) - ax}{h}$
   $= \lim_{h \to 0} \frac{3ax^2h + 3axh^2 + ah^3}{h}$
   $= \lim_{h \to 0} (3ax^2 + 3axh + ah^2)$
   = 3ax
7. $f(x) = ax^n$. The expressions $f'(x)$ or $\frac{d[f(x)]}{dx}$ or $D_x[f(x)]$ all refer to the Derivative of f(x).
8. $f(x) = ax^n$. Find $f'(x)$.
   $f'(x) = \lim_{h \to 0} \frac{a(x+h)^n - ax^n}{h} = \lim_{h \to 0} \frac{a(x^n + nx^{n-1}h + \cdots) - ax^n}{h} = \lim_{h \to 0} \frac{nx^{n-1}h + \cdots}{h} = nx^{n-1}$

9. Notice that in #8, we can now take the exponent on the variable and multiply the constant by it, then reduce the original exponent by one.

10. $f(x) = 3x^4 – 2x^3 + 2x^2 – 3x + 4$. Using the discovery mentioned in #9, find $f'(x)$.

    $\boxed{f'(x) = 12x^3 – 6x^2 + 4x - 3}$. We took the derivative of each term.

11. Find the anti-derivative of $f(x) = 18x^5 – 20x^3 + 7$.
    Answer: $3x^6 – 5x^4 + 7x + C$, where C is any Constant. If you want to check, plug any number in for C, and take the derivative and see is you get the original f(x) back.

12. Since acceleration is the derivative of velocity, and velocity is the derivative of position, then we can now say that velocity is the anti-derivative of acceleration, and position is the anti-derivative of velocity.

13. Given velocity, $v(t) = 3t^2 + 6t – 2$, and position s(t) is 9 when t = 2. Find the position s(3).
    $s(t) = t^3 + 3t^2 – 2t + C$, but we know that $s(2) = 9 = 8 + 12 – 4 + C = 9 \rightarrow C + 16 = 9 \rightarrow C = -7$
    $s(t) = t^3 + 3t^2 – 2t – 7$. Therefore $s(3) = 27 + 27 – 6 – 7 = 41$.

Pre-Calculus 2 Assignment 255 Monday, June 1, 2015 Hour Name ______________________________

1.	An object is moving at a velocity of $v(t) = 21t^2 + 30$ meters per second. Find the Average velocity on the time interval [2, 4].
2.	Using the information given in #1 and our new ways of finding a derivative, find the exact acceleration at time, t = 3 seconds.
3.	An object has position s(t) = sin(t). Find the average velocity on the time interval $\left[0, \frac{\pi}{3}\right]$.
4.	Using the information given in #3, find the exact acceleration at time = $\frac{\pi}{3}$.
5.	An object has acceleration of an object is a(t) = 2t – 4, and v(5) = 12. Find v(2).
6.	$f(x) = 3x^2 - 2x + 1$. Write the point-slope equation of the tangent line to f(x) at x = 3.
7.	$f(x) = \sin x + 6x^2 + x$. Find f '(x).