

## LESSON 2: DIFFERENTIATION RULES

Objective: 1. To learn and practice the rules of differentiation

From Lesson 8: Applications of Limits

<u>Function</u>	<u>Derivative</u>
1. $g(x) = 4x + 3$	$g'(x) =$
2. $s(t) = 2t^2 - 8t$	$s'(t) =$
3. $y = x^2 + 1$	$y' =$
4. $y = -2x^2 + 3x + 1$	$y' =$

### Rules for Differentiation

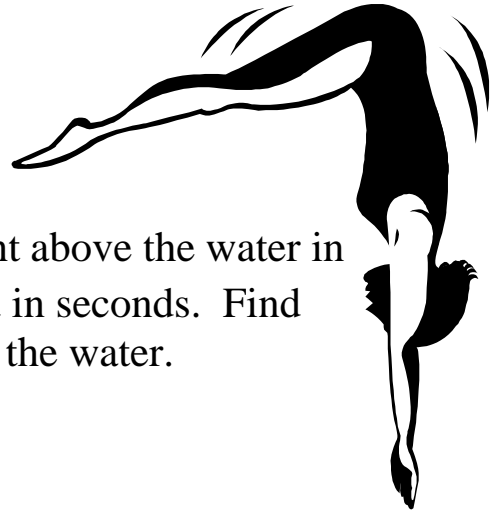
Derivative of a Constant Function	$\frac{d}{dx}(c) = 0$
Power Rule	$\frac{d}{dx}(x^n) = nx^{n-1}$
Constant Multiple Rule	$\frac{d}{dx}(cf(x)) = cf'(x)$
Sum and Difference Rule	$\frac{d}{dx}[f(x) \pm g(x)] = f'(x) \pm g'(x)$
Product Rule	$\frac{d}{dx}[f(x)g(x)] = f(x)g'(x) + g(x)f'(x)$
Product/Assoc.	$\frac{d}{dx}[f \cdot g \cdot h] = f' \cdot g \cdot h + f \cdot g' \cdot h + f \cdot g \cdot h'$
Quotient Rule	$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)f'(x) - f(x)g'(x)}{g^2(x)}$

## Examples for Lesson 2

1. Find  $f'(x)$ , given  $f(x) = x(x^2 + 1)$
2. Find the equation of the line normal to the graph of  $g(x) = -2x^3 + 3x - 5$  when  $x = -2$ .
3. Find the equation of the line tangent to the graph of  $f(x) = \frac{8x + 5}{x^2 + x + 1}$  at  $x = 2$ .

## Problems for Lesson 2

1. Find the equation of the line tangent to  $y = x^2 - 4x + 5$  and parallel to the line  $6x - 3y + 5 = 0$ .
2. When King Kong fell off the World Trade Center in the movie, his height in feet above the ground after  $t$  seconds was given by  $h(t) = 1350 - 16t^2$ . Find King Kong's speed after 1 second, 3 seconds, and 5 seconds. What was his speed when he hit the ground? Convert this speed in ft/sec to mph.
3. Show, using the product rule and associativity, that 
$$\frac{d}{dx}[f \cdot g \cdot h] = f' \cdot g \cdot h + f \cdot g' \cdot h + f \cdot g \cdot h'$$
4. Sketch the graphs of the two equations  $y = x^2$  and  $y = -x^2 + 6x - 5$ , and sketch the two lines that are tangent to both graphs. Find the equation of these lines.



5. If  $s(t) = -16t^2 + 5t + 30$  represents the height above the water in feet of a diver at time  $t$ , where  $t$  is measured in seconds. Find the velocity of the diver when the diver hits the water.

6. Find  $f'(x)$  if  $f(x) = \frac{3 - 2x - x^2}{x^2 - 1}$

7. Find  $g'(x)$ , given  $g(x) = (3x^3 + 4x)(x - 5)(x + 1)$