Calculus Section 2.3 Higher Order Derivatives & Product Rule

Homework: Page 125 #’s 1, 3, 5, 17, 62, 63, 81a, 82a, 91, 93, 97, 115, 132-134.

-Find higher order derivatives of functions.  
-Find an equation for acceleration from a position function.  
-Find the derivative of a function using the product rule.

**Higher Order Derivatives**Oftentimes, more than one derivative can be taken for a differentiable function. These derivatives imply continued continuity (like the first derivative), and can be used to find helpful information about a function. Higher order derivatives can be denoted as follows:



First derivative:   
  
 Second derivative:  
  
 Third derivative:  
  
 Fourth derivative:  
  
 nth derivative:

**Example**  
1) , find  2) , find  3) , find 

**Acceleration**  
Acceleration is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of velocity and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of position.

**Example**The position of a particle is given by the equation x(t) = 4t3 – 3t2 + 5t – 1. Find the acceleration of the particle when t = 3.

**Example**  
The velocity of a particle is given in the table below. Determine the acceleration of the particle when t = 5.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Time (sec) | 0 | 3 | 4 | 6 | 9 |
| Velocity (m/s) | 4 | 7 | 10 | 16 | 17 |

**Product Rule**  
The product of two differentiable functions is differentiable itself. If *f* and *g* are differentiable, then their product *fg* is also differentiable. To find the derivative of a product:



The derivative of a product is: “The derivative of the first function times the second plus the first times the derivative of the second function.”

**Examples)**  
1)  2)  3) 

The product rule can be generalized for any number of products. For example,  


**Example**The position of a particle is given by x(t) = . Find the acceleration of the particle when t = .