2C: Product and Quotient Rule

So, we have *specific rules* for the differentiation of power functions and some trig. functions. We also have *general rules* for the derivatives of constant multiples of functions and the sum or difference of some functions. Now we need to investigate the case where we have a product or quotient of two functions.

# Product Rule

First, we need to figure out how to find the derivative of functions like .

**Let’s make a Rule!**

Ok, let’s write our derivative as

Now let’s look at the derivative for functions and .

Now, I wish this fraction said or so we could write it as and . Let’s get creative…

**General Rule 4: Product Rule**

If and are differentiable functions, then is a differentiable function and

That is, the derivative of a product is equal to

**Examples** Find the derivative of the function.







# Quotient Rule

If multiplication gets its own rule, division should get one too. Let’s find a rule for division quotients.

So, we start with two differentiable functions and .

**General Rule 5: Quotient Rule**

If and are differential functions, so is , and   
That is, the derivative of a quotient is equal to

**Examples** Use the quotient rule to find these derivatives.



# Putting it all together… Combo time!

Now we have two very useful tools, let’s put them together to find the derivative of some more complex functions.

**Try it!** Find the derivative of the following functions.

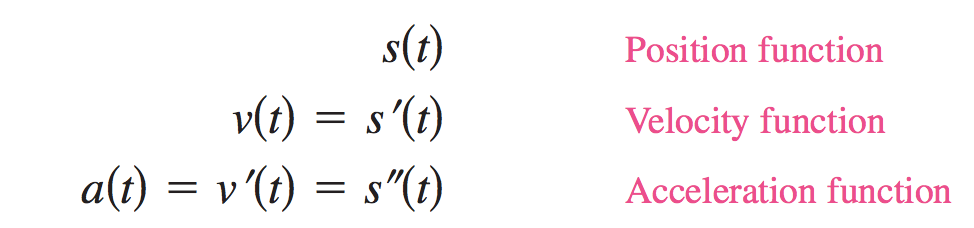
|  |  |
| --- | --- |
|  |  |
| How about some more trig. functions… |  |
|  |  |
|  |  |

**Here’s how the AP test will use these rules**:

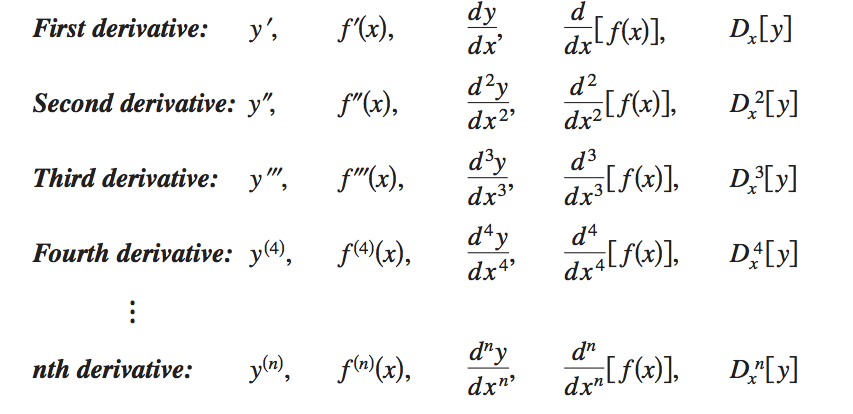
# Higher Derivatives

Now that we have more ways to find derivatives, we can start to find **higher derivatives.** This just means we will take the derivative of the derivative.

**Example** Find the second derivative of which is the position function for a falling object on the moon.



When working with physics applications, we have a very important relationship that we will work more with later:



In General, this table gives us the notation for higher derivatives: