MATH 171 CALCULUS I
DR. MCLOUGHLIN'S HANDY DANDY GUIDE TO
REMEMBERING THE RULES OF DIFFERENTIATION

The rules of differentiation can be expressed in mathematical symbols or in words. I have found over the years that remembering these rules in words is much more useful and helpful to the student; therefore, here they are in symbols and in words.

The *Basic* Power Rule: $k \in \mathbb{R}$, $n \in \mathbb{R}$, then

$(k \cdot x^n)' = k \cdot n \cdot x^{n-1}$ or stated otherwise $\frac{d}{dx}(k \cdot x^n) = k \cdot n \cdot x^{n-1}$

The derivative of a constant times x to another constant power is bring the power down and multiply by lead constant times x to the one less power.

The Sum/ Difference Rule:

$[f(x) \pm g(x) \pm h(x) \pm ...]' = f'(x) \pm g'(x) \pm h'(x) \pm ...$

The sum of the functions' derivatives is the derivative of the sum
The difference of the the functions' derivatives is the derivative of the difference

The Product Rule:

$[f(x) \cdot g(x)]' = f'(x) \cdot g(x) + g'(x) \cdot f(x)$

The derivative of the product is the derivative of the first function times the second function left alone ***plus*** *the derivative of the second function times the first function left alone*

The Quotient Rule:

$[f(x) \div g(x)]' = \frac{f'(x) \cdot g(x) - g'(x) \cdot f(x)}{(g(x))^2}$

The derivative of the quotient is the derivative of the top function times the bottom function left alone ***minus*** *the derivative of the bottom function times the top function left alone* ***all divided by*** *the bottom function squared.*

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The Power Rule: $k \in \mathbb{R},\ n \in \mathbb{R}, \wedge \lim_{h\to 0}\left(\frac{f(x+h)-f(x)}{h}\right)$ exists for $x \in \mathbb{R}$, then

$$(k\cdot[f(x)]^n) = k\cdot n(f(x))^{n-1}\cdot f'(x)$$

The derivative of the power is power down, leave function alone, take one away from the power, times the derivative of the function.

The Chain Rule:

$$(f\circ g)'(x) = \left(f(g(x))\right)' = f'(g(x))\cdot g'(x)$$

The derivative of the composite of two functions is the derivative of the outside function of leave the inside function alone times the derivative of the inside function.

Also: Special derivaitives need to be recall:

$$f(x)=\sin(x) \quad\Rightarrow\quad f'(x)=\cos(x)$$
$$f(x)=\cos(x) \quad\Rightarrow\quad f'(x)=-\sin(x)$$
$$f(x)=\tan(x) \quad\Rightarrow\quad f'(x)=\sec^2(x)$$
$$f(x)=\cot(x) \quad\Rightarrow\quad f'(x)=-\csc^2(x)$$
$$f(x)=\sec(x) \quad\Rightarrow\quad f'(x)=\sec(x)\cdot\tan(x)$$
$$f(x)=\csc(x) \quad\Rightarrow\quad f'(x)=-\csc(x)\cdot\cot(x)$$

$$f(x)=e^x \quad\Rightarrow\quad f'(x)=e^x$$

Let $a \in \mathbb{R}$ $\quad f(x)=a^x \quad\Rightarrow\quad f'(x)=a^x\cdot\ln(a)$

Let $x \in \mathbb{R} \ni x > 0$ $\quad$ Let $a \in \mathbb{R}$ $\quad f(x)=\ln(x) \quad\Rightarrow\quad f'(x)=\frac{1}{x}$

Let $x \in \mathbb{R} \ni x > 0$ $\quad$ and let $a \in \mathbb{R}$ $\quad f(x)=\log_a(x) \quad\Rightarrow\quad f'(x)=\frac{1}{x\cdot\ln(a)}$

And remember that the symbols can change but mean the same

$$y = f(x) \quad\Rightarrow\quad \frac{dy}{dx} = f'(x) = \frac{d}{dx}(f(x)) = D_y(f(x))$$