GN_Rules of Differentiation Calculus AB Name_____

RECALL: *If* $y = f(x)$ *, then the derivative* $y' = f'(x) = \frac{dy}{dx} = \frac{d}{dx}\big(f(x)\big) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$

RULES:

I. The derivative of a constant is 0: $\frac{d}{dx}(c) = 0$

Ex. $y = 3$, $y' =$ ****Think of the SLOPE of a horizontal line!****

II. Power Rule: $\frac{d}{dx}(x^n) = nx^{n-1}$, n *is a constant*

Ex 1. $y = x^2$ Ex 2. $y = x^7$ Ex. $y = x$

$y' =$ $y' =$ $y' =$

III. Constant Multiplication Rule: $\frac{d}{dx}(cu) = c\frac{d}{dx}(u)$, u *is a function of* x *and* $c =$ *constant*

Ex 1. $y = 3x^4$ Ex 2. $y = 2x^9$

IV. Sum or Difference Rule: $\frac{d}{dx}(u \pm v) = \frac{d}{dx}(u) \pm \frac{d}{dx}(v)$, *where* u *and* v *are functions of* x

This rule can be extended to any number of terms.

Ex 1. $y = 9x^2 - 14x + 7$ Ex 2. $y = 6x^7 + 4x^5 - x$

V. Product Rule: $\frac{d}{dx}(uv) = u\frac{d}{dx}(v) + v\frac{d}{dx}(u)$, *where* u *and* v *are functions of* x

****The product rule song**** Tune of Mary Had a Little Lamb	Ex 1. $y = (x^2 + 1)(x^3 + 3)$
u d(v) plus v d(u) Product Rule! Product Rule! u d(v) plus v d(u) The product rule is cool!	Ex 2. $y = (3x^2 - 2x)(2x^3 + x)$

VI. Quotient Rule: $\frac{d}{dx}\left(\frac{u}{v}\right)=\frac{v\frac{d}{dx}(u)-u\frac{d}{dx}(v)}{v^2}$ ***OR*** $\left(\frac{u}{v}\right)'=\frac{lo\ d\ hi-hi\ d\ lo}{lo\ lo}$, ***u and v are functions of x***

****Quotient Rule Song**** Tune of Camptown Races
lo d (hi) less hi d (lo) lo lo , lo lo The quotient rule's the way to go To show how much we know!

Ex 1. $y=\frac{x^2+1}{x^2-1}$

Ex 2. $y=\frac{x^3}{2x-5}$

Ex 3. $y=\frac{2}{x^2}$
(Hint: Rewrite as negative exponent)

Ex 4. $y=\frac{(2x+4)(x^3-x)}{x^2}$ (Hint: Multiply out the numerator first)

*** ***If f is even, the f′is odd. If f is odd, then f′is even.*** ***

Second, third, and higher order derivatives	**Derivatives in Terms of Other Variables**
$y=x^4-3x^3+4x^2+9$ $y'=f'(x)=\frac{dy}{dx}=$ $y''=f''(x)=\frac{d^2y}{dx^2}=$ $y'''=f'''(x)=\frac{d^3y}{dx^3}=$ $y^{iv}=f^4(x)=\frac{d^4y}{dx^4}=$ $y^v=f^5(x)=\frac{d^5y}{dx^5}=$ ****All successive derivatives are equal to 0.****	$A=\pi r^2$ The derivative of A with respect to r. $\frac{dA}{dr}=$ $V=\frac{4}{3}\pi r^3$ The derivative of V with respect to r. $\frac{dV}{dr}=$