THEOREMS OF DIFFERENTIATION

RULE 1:
Derivative of a constant

1. $f(x) = 7$
   $f'(x) = 0$

RULE 2:
Derivative of a power

$f(x) = x^4$ $\quad\quad n = 4$
$\quad = 4x^4-1$
$f'(x) = 4x^4$

RULE 3:
Derivative of a constant times a function.

$f(x) = 5x^3$
$\quad = 5 * x^3$
$\quad = 5x3x\ ^3-1$
$\quad = 5*3x^2$
$f'(x) = 15x^2$

RULE 4:
Derivative of sum and difference

$f(x) = x^3+4x-6$
$\quad = 3x^3-1+4-0$
$\quad = 3x^3-1+4*1x^1-1-0$
$\quad = 3x^2+4*1x^0-0$
$\quad = 3x^2+4-0$
$f'(x) = 3x^2+4$

RULE 5:
Derivative of a Product

$h(x) = x^2*e^x$
$\quad = 2x*e^x + x^2*e^x$
$\quad = 2xe^x + x^2e^x$
$h(x) = e^x(2x+x^2)$

$f(x) = x^2$ $\quad\quad$ **$g(x) = e^x$**
$f'(x) = 2x$ $\quad\quad$ **$g'(x) = e^x$**

RULE 6:
Derivative of a Quotient

$$h(x)=\frac{x^2}{sinx}$$

$$=\frac{2x*sin-x^2*cosx}{(sinx)^2}$$

$$h'(x)=\frac{2xsinx-x^2cosx}{Sin^2x}$$

f(x) = **g(x) =**
f'(x) = **g'(x) =**

RULE 7:
Derivative of a reciprocal

$$f(x)=\frac{1}{x^2}$$

$$f'(x)=\frac{-2}{x^3}$$

$$\frac{1}{x^2} = x^{-2}$$
$$= -2x^{-3}$$

RULE 8:
Derivative of a radical

$$f'(x) = \frac{1}{2}\sqrt{x^3}$$

$$= x^{\frac{3}{2}}$$

$$= \frac{3}{2}\; x^{3/2-1}$$

$$= \frac{3}{2\; x^{1/2}}$$

RULE 9:
Derivative of a function with a radical exponent

h(x) = x^3/4

$$= \frac{3}{4} x^{3/4 - 1}$$

$$= \frac{3}{4} x^{-1/}$$

h'(x) = $\frac{3}{4^4 \sqrt{x}}$

RULE 10:

GENERAL POWER RULE

f(x) = (3x+2) ^5
= 5 (3x+2)^4 *3
f'(x) = 15(3x+2)^4

RULE 11:

CHAIN RULE

h(x) = (sin(2x))
= f'(g(x)) * g'(x)
= cos2x * 2
h'(x) = 2cos2x

f'(x) = cos 2x
g(x) = 2x
g'(x) = 2

IMPLICIT DIFFERENTIATION

1. $x^2 + y^2 - 2x + 3y = 4$

$= 2x^2-1 + 2y^2-1y - 2(1)x^1-1 + 3(1)y^1-1y' = 0$
$= 2x + 2yy' - 2 + 3y' = 0$
$= 2yy' + 3y = -2x + 2$

$$= \frac{y'(2y+3)}{2y+3} = \frac{-2x + 2}{2y + 3}$$

$$y' = \frac{-2x + 2}{2y + 3}$$

$y = f(x)$
$y' = f'(x)$

2. $x^3 - 3x + y^2 = 16$

$= 3x^2 - 3 + 2yy' = 0$

$$= \frac{2yy'}{2y} = \frac{-3x^2 + 3}{2y}$$

* cancelled 2yy'/2y

$$y = \frac{-3x^2 + 3}{2y}$$

3. Y + $(2x - 5)^3 = 3$ (CHAIN RULE)

$= y' + 3(2x-5)^2(2) = 0$
$= y' + 6(2x-5)^2 = 0$
$y' = 6(2x-5)^2$

4. $x^2 + 3x^4y^2 + y^2 = -4x$ (PRODUCT RULE)

$= 2x + 12x^3y^2 + 6x^4yy' + 2yy' = -4$
$= 6x^4yy' + 2yy' = -4 - 2x - 12x^3y^2$

$$= \frac{y'(6x^4 + 2y)}{6x^y+2y} = \frac{-4 - 2x - 12x^3y^2}{6x^4y+2y}$$

*cancelled $\frac{(6x^4 + 2y)}{6x^y+2y}$

$$y' = \frac{-4 - 2x - 12x^3y^2}{6x^4y + 2y}$$