Name: _____ Date: _____

Learning Goal 3.1	Using all basic derivative rules.

Example Differentiate the following.

a. $y = (4x^2 - 1)^2$

$= (4x^2-1)(4x^2-1)$

$= 16x^4 - 8x^2 + 1$

$= 64x^3 - 16x$

$= 16x(4x^2-1)$

b. $y = (4x^2 - 1)^4$

NO ONE WANTS to EXPAND this!

The Chain Rule

if you have a COMPOSITE FUNCTION $(f \circ g)(x)$ or $f(g(x))$

the DERIVATIVE is $f'(g(x)) \times g'(x)$

* PEEL THE ONION *

~ WORKS WITH MORE FUNCTIONS too - keep PEELING! ~

Example Determine the 'inner' and 'outer' functions, then find the derivative.

a. $y = (2x + 1)^3$

OUTSIDE
$f(x) = x^3$
$f'(x) = 3x^2$

INSIDE
$g(x) = 2x+1$
$g'(x) = 2$

$\frac{dy}{dx} = 3(2x+1)^2 \times 2$

$= 6(2x+1)^2$

b. $f(x) = \sqrt{x^3 - 2x}$

OUTSIDE
$h(x) = \sqrt{x}$
$h'(x) = \frac{1}{2\sqrt{x}}$
$= \frac{\sqrt{x}}{2x}$

INSIDE
$g(x) = x^3 - 2x$
$g'(x) = 3x^2 - 2$

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

$= \frac{\sqrt{x^3-2x}}{2x(x^2-2)} \times (3x^2-2)$

c. $g(x) = \dfrac{1}{(x^2-1)^3}$ ← could use the quotient rule!

$= (x^2-1)^{-3}$

Outside
$f(x) = x^{-3}$
$f'(x) = -3x^{-4}$
$= \dfrac{-3}{x^4}$

Inside
$h(x) = 2x$

$g'(x) = \dfrac{-3}{(x^2-1)^4} \times 2x$

$= \dfrac{-6x}{(x^2-1)^4}$

d. $y = \sqrt{x^3-2x}$

Outside
$f(x) = \sqrt{x}$
$f'(x) = \dfrac{1}{2\sqrt{x}}$
$= \dfrac{\sqrt{x}}{2x}$

Inside
$g(x) = x^3 - 2x$
$g'(x) = 3x^2 - 2$

$\dfrac{dy}{dx} = \dfrac{\sqrt{x^3-2x}}{2(x^3-2x)} \times (3x^2-2)$

it just occurred to me this is exactly the same question 😊

Example Given

$f(2) = -1$	$f(-1) = 3$	$f'(2) = 4$	$f'(-1) = 5$
$g(2) = 2$	$g(-1) = -2$	$g'(-1) = 0$	$g'(2) = 7$

Find the following derivatives, if possible.

a. $(f \circ g)'(2)$

$= \dfrac{d}{dx}[f(g(2))]$

$= f'(g(2)) \times g'(2)$

$= f'(2) \times 7$

$= 4 \times 7$

$= 28$

b. $(f \circ f)'(2)$

$= f'(f(2)) \times f'(2)$

$= f'(-1) \times 4$

$= 5 \times 4$

$= 20$

c. $(g \circ f)'(-1)$

$= g'(f(-1)) \times f'(-1)$

$= g'(3) \times 5$

don't know this value so we can't finish this question!