The Chain Rule

Section 3.4

(Students often find this the toughest one!!
Do as many practice questions as you can
from the textbook to master it!)

Chain Rule

Prime Notation

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

"derivative of the outer function evaluated at the inner function times the derivative of the inner function"

Example:
Differentiate the following.

(a) $f(x) = (4x^3 + 1)^{10}$

(b) $g(x) = \dfrac{1}{\sqrt{x^2 + 1}}$

Chain Rule

In Leibniz notation, if *y=f(u)* and *u=g(x)* are both differentiable functions, then

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

Example:
Differentiate the following.

(a) $y = \sqrt{2 - e^x}$

(b) $y = \sin^4 x$

Chain Rule

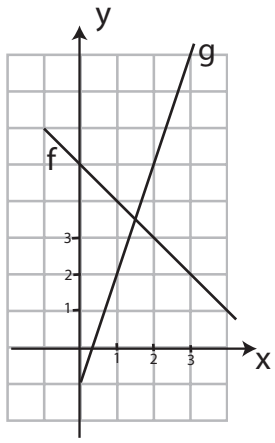
More Examples:

Differentiate the following.

(a) $f(x) = e^{-2x}\cos 4x$

(b) $g(x) = (x^2+1)^3(x^2+2)^6$

(c) Given the graphs of f and g, determine $(f \circ g)'(1)$.



Derivative of a General Exponential Function

$$\frac{d}{dx}\left(a^x\right) = a^x \ln a$$

Example:

Differentiate the following.

(a) $f(x) = x^2 + 2^x$

(b) $g(x) = 10^{x^2 - 3x}$