Chain Rule.

1. Theorem:

Let $a \in \mathbb{R}$. Let f, g be functions.

If g is differentiable at a; f is differentiable at $g(a)$.

Then fog is differentiable at a, and $(fog)'(a) = f'(g(a))\, g'(a)$.

2. Proof — using Leibnitz Notation.

$$(f \circ g)'(x) = f'(g(x))\, g'(x)$$

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

$$u = g(x)$$

$$y = f(u) = f(g(x))$$