Chain Rule (3.7)

If we have $\frac{2}{5} \cdot \frac{5}{9}$ we simplify by cancelling the five.

Similarly, $\frac{\Delta f}{\Delta g} \cdot \frac{\Delta g}{\Delta x}$ can be simplified by canceling, and this makes us *suspect* the **chain rule** for differentiating a composition of functions. We use "chain" to describe the link made between the two fractions by the Δg factor.

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

Leibniz notation for the chain rule is especially descriptive because it copies $\frac{\Delta f}{\Delta g} \cdot \frac{\Delta g}{\Delta x}$.

$$\frac{d\, f(g(x))}{d\, g(x)} \cdot \frac{d\, g(x)}{d\, x}$$

What are the following?

$\frac{d\, x}{d\, x}$

$\frac{d\, u}{d\, u}$

$\frac{d\, x^2}{d\, x^2}$

$\frac{d^2\, x^2}{d\, x^2}$

Find $\frac{d\, e^{5x}}{d\, x}$.

Find $\dfrac{d\,e^{-x}}{d\,x}$.

Find $\dfrac{d\,(5x+2)^{10}}{d\,x}$.

Find $\dfrac{d\,\sin^4(x)}{d\,x}$.

Find $(f \circ g)'(3)$ if

x	$f(x)$	$g(x)$	$f'(x)$	$g'(x)$
1	7	3	2	7
2	69	2	3	1
3	0	1	5	6
4	-5	4	1	-2

.

Find $\dfrac{d\,(g(x))^n}{d\,x}$.

Find $\dfrac{d\,2^x}{d\,x}$. Compare with $\dfrac{d\,x^2}{d\,x}$, and $\dfrac{d\,2^{4x}}{d\,x}$.

Find the tangent line to the graph of $f(x) = \cos(\tan(x))$ at $x = \dfrac{\pi}{4}$.

Find $\dfrac{d \sin^2(e^{2x} + x^3)}{d\,x}$.

Find $\dfrac{d\,(2x^2 - 4x)^{1/2}}{d\,x}$.

$P = Ri^2$ where P is power (Joules or watts), R is resistance (ohms), i is current (amperes), and t is seconds of elapsed time. Find $\left.\dfrac{dP}{dt}\right|_{t=1/3}$ if $R = 10\cos(20\pi t)$, $i(1/3) = 1$, and $i'(1/3) = 2$.