



## ICE - Product and Quotient Rules

Calculate formulas for the first derivatives of the functions given in the table below.

Function	First Derivative
$f(x) = \frac{x}{1+x^2}$	
$f(x) = (x + \sqrt{x}) \cdot (1+x^3)$	
$h(t) = (t^2 + 1) \cdot (t-1)^{-1}$	
$l(z) = z \cdot (1+z+z^2)$	
$q(s) = \frac{s^2(1+\frac{1}{s})}{1+s^2}$	
$u(x) = \frac{1+x^2+x^3}{1+9x+2x^2}$	
$v(t) = \frac{\sqrt[3]{t}-t}{1+t^2}$	
$m(z) = z^7 \cdot (3z^{1/4} + z^2)^{-1}$	

**Answers:**

$$(a) \quad f'(x) = \frac{(1+x^2) - 2x^2}{(1+x^2)^2}.$$

$$(b) \quad f'(x) = \left(1 + \frac{1}{2}x^{-1/2}\right) \cdot (1+x^3) + (x + \sqrt{x}) \cdot (3x^2).$$

$$(c) \quad h'(t) = \frac{2t \cdot (t-1) - (t^2+1)}{(t-1)^2}.$$

$$(d) \quad l'(z) = (1+z+z^2) + z \cdot (1+2z).$$

$$(e) \quad q'(s) = \frac{(2s+1) \cdot (1+s^2) - s^2 \cdot \left(1 + \frac{1}{s}\right) \cdot 2s}{(1+s^2)^2}.$$

$$(f) \quad u'(x) = \frac{(2x+3x^2) \cdot (1+9x+2x^2) - (1+x^2+x^3) \cdot (9+4x)}{(1+9x+2x^2)^2}.$$

$$(g) \quad v'(t) = \frac{\left(\frac{1}{3}t^{-2/3} - 1\right) \cdot (1+t^2) - \left(\sqrt[3]{t} - t\right) \cdot (2t)}{(1+t^2)^2}.$$

$$(h) \quad m'(z) = \frac{7z^6 \cdot (3z^{1/4} + z^2) - \left(\frac{3}{4}z^{-3/4} + 2z\right) \cdot (z^7)}{(3z^{1/4} + z^2)^2}.$$