# Derivative Rules

By now you know that a derivative can be a formula that gives you the slope of some function at any point you care about. Using the 'definition of derivative' to get that formula is a bit tedious and there are not many people in this world who enjoy that method. The set of rules and procedures below are shortcuts that allow you to circumvent the definition of derivative. Imagine how happy you will be after you've memorized and mastered these rules.

**Power Rule**

1. $y = 5x^3 - 3x^{-4}$

$y' = 15x^2 + 12x^{-5}$

2. $y = 6\sqrt{x} \rightarrow y = 6x^{\frac{1}{2}}$

$\frac{dy}{dx} = 3x^{-\frac{1}{2}}$ or $\frac{3}{\sqrt{x}}$

3. $w = \frac{1}{\sqrt{a}} \rightarrow w = a^{-\frac{1}{2}}$

$\frac{dw}{da} = -\frac{1}{2}a^{-\frac{3}{2}} = \frac{-1}{a^{3/2}}$

$= \frac{-1}{\sqrt{a^3}}$

4. $f(x) = \frac{3}{x^4} - \frac{1}{3}x^2 + 7x$

$f(x) = 3x^{-4} - \frac{1}{3}x^2 + 7x$

$f'(x) = -12x^{-5} - \frac{2}{3}x + 7$

$f''(x) = 60x^{-6} - \frac{2}{3}$

Find the equation of the line tangent to $f(x) = x^{3/2} - \frac{1}{4}x^2$ at $x = 4$.

$f'(x) = \frac{3}{2}x^{\frac{1}{2}} - \frac{1}{2}x$

$f'(x) = \frac{3\sqrt{x}}{2} - \frac{1}{2}x$

SLOPE: $f'(4) = 1$

POINT: $f(4) = 4$ or $(4, 4)$

$y - y = m(x - x)$

$y - 4 = 1(x - 4)$

$y = x - 4 + 4$

$\boxed{y = x}$ or $\boxed{y = 1x + 0}$

Locate the x-coordinates of all horizontal tangents of $f(x) = \frac{1}{2}x^4 - 9x^2 + 7$.

horiz asymptote ... $f'(x) = 0$ !

$f'(x) = 2x^3 - 18x = 0$

$2x(x^2 - 9) = 0$

$2x(x+3)(x-3) = 0$

$x = 0$, $x = -3$, $x = 3$ } Location of horizontal tangents