2.2 Basic Differentiation Rules and Rates of Change

- Find the derivative of a function using the Constant Rule.
- Find the derivative of a function using the Power Rule.
- Find the derivative of a function using the Constant Multiple Rule.
- Find the derivative of a function using the Sum and Difference Rules.
- Find the derivatives of the sine function and of the cosine function.
- Use derivatives to find rates of change.

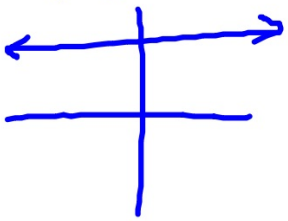
THEOREM 2.2 THE CONSTANT RULE

The derivative of a constant function is 0. That is, if c is a real number, then

$$\frac{d}{dx}[c] = 0.$$

$\frac{d}{dx}[c] = 0$

$f(x) = 3$



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3, 7, 11, 15, ...

Find f '(x)

#1 $f(x) = x^2$

$f'(x) = 2x^1$

#2 $f(x) = x^{-5}$

$f'(x) = -5x^{-6}$

THEOREM 2.3 THE POWER RULE

If n is a rational number, then the function $f(x) = x^n$ is differentiable and

$$\frac{d}{dx}[x^n] = nx^{n-1}.$$

For f to be differentiable at $x = 0$, n must be a number such that x^{n-1} is defined on an interval containing 0.

$$\frac{d}{dx}[x^n] = n \cdot x^{n-1}$$

Find y'. Rewrite the function to make it 'derivative ready' if necessary.

#3

$y = x^{16}$

$y' = 16x^{15}$

#4

$y = \frac{1}{x^8}$

$y = x^{-8}$

$y' = -8x^{-9}$

#5

$g(x) = \sqrt[4]{x}$

$g(x) = x^{1/4}$

$g'(x) = \frac{1}{4}x^{-3/4}$

THEOREM 2.4 THE CONSTANT MULTIPLE RULE

If f is a differentiable function and c is a real number, then cf is also differentiable and $\frac{d}{dx}[cf(x)] = cf'(x)$.

$\frac{d}{dx}[cf(x)] = cf'(x)$

#6

$f(x) = 2x^3 - x^2 + 3x$

$f'(x) = 2 \cdot 3x^2 - 1 \cdot 2x + 3$

$= 6x^2 - 2x + 3$

#7 $g(x) = 7x^3 - \frac{2}{x^4}$

$g(x) = 7x^3 - 2x^{-4}$

$g'(x) = 21x^2 + 8x^{-5}$

#8

$f(t) = 3 - \frac{3}{5t}$

$f(t) = 3 - \frac{3}{5}t^{-1}$

$f'(t) = 0 + \frac{3}{5}t^{-2}$

$= \frac{3}{5t^2}$

#9

Break up fraction

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

$f(x) = x - 6x^{-2}$

$f'(x) = 1 + 12x^{-3}$

#10 $(5-x)^2 = (x-5)^2$

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$f(x) = 3(5 - x)^2$

$f(x) = 3(25 - 10x + x^2)$

$f'(x) = 3(0 - 10 + 2x)$

$= 3(2x - 10)$

THEOREM 2.6 DERIVATIVES OF SINE AND COSINE FUNCTIONS

$$\frac{d}{dx}[\sin x] = \cos x \qquad \frac{d}{dx}[\cos x] = -\sin x$$

Show Geogebra demonstration…

#11

$f(x) = x + 7 - \sin x$

$f'(x) = 1 + 0 - \cos x$

$= 1 - \cos x$

#12

$f(x) = 7x + 3\sin x - 6\cos x$

$f'(x) = 7 + 3\cos x + 6\sin x$

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