Elementary Tools from Algebra and Geometry

Quadratic Formula: \( ax^2 + bx + c = 0 \implies x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \)

Pythagorean Theorem: If a right triangle has legs \( a, b \) and hypotenuse \( c \), then \( a^2 + b^2 = c^2 \).

Triangle Area = \( \frac{1}{2} \) base \( \times \) height. 
Circle Area = \( \pi r^2 \)
Rectangle Area = base \( \times \) height 
Circle Perimeter = \( 2\pi r \)
Perimeter of a polygon (triangle, rectangle, etc.) = sum of side lengths

Five derivative rules for operations on functions.

Constant Multiple Rule: \( \frac{d}{dx}(cf(x)) = cf'(x) \)

Sum and Difference Rule: \( \frac{d}{dx}(f(x) \pm g(x)) = f'(x) \pm g'(x) \)

Product Rule: \( \frac{d}{dx}(f(x) \cdot g(x)) = f'(x)g(x) + f(x)g'(x) \)

Quotient Rule: \( \frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2} \)

Chain Rule: \( \frac{d}{dx}(f(g(x))) = f'(g(x)) \cdot g'(x) \)

Ten derivative rules for functions

Derivative of a Constant: \( \frac{d}{dx}(c) = 0 \), where \( c \) is a constant.

The Power Rule: \( \frac{d}{dx}(x^a) = nx^{a-1} \)

Exponential Functions: \( \frac{d}{dx}(a^x) = a^x \cdot \ln(a) \) 

Special Case: \( \frac{d}{dx}(e^x) = e^x \)

Three Trigonometric Rules:
\[ \begin{align*}
\frac{d}{dx}(\sin(x)) &= \cos(x) \\
\frac{d}{dx}(\cos(x)) &= -\sin(x) \\
\frac{d}{dx}(\tan(x)) &= \sec^2(x) = \frac{1}{\cos^2(x)}
\end{align*} \]

Three Inverse Function Rules:
\[ \begin{align*}
\frac{d}{dx}(\ln(x)) &= \frac{1}{x} \\
\frac{d}{dx}(\arctan(x)) &= \frac{1}{1 + x^2} \\
\frac{d}{dx}(\arcsin(x)) &= \frac{1}{\sqrt{1-x^2}}
\end{align*} \]

General Antiderivative Rules

If \( k \) is a constant \( \int k \, dx = kx + C \)
\[ \frac{x^n}{n + 1} + C, \text{ when } n \neq -1 \]

\[ \frac{a^x}{\ln(a)} + C \]

\[ e^x + C \]

\[ \cos(x) + C \]

\[ \sin(x) dx = -\cos(x) + C \]
\[ \sec^2(x) dx = \tan(x) + C \]
\[ \frac{1}{x} dx = \ln(|x|) + C \]
\[ \frac{1}{1 + x^2} dx = \arctan(x) + C \]
\[ \frac{1}{\sqrt{1-x^2}} dx = \arcsin(x) + C \]