Higher Order Derivatives

Higher order derivatives refer to the derivatives of a function that are obtained by repeatedly differentiating the original function.

- The **first derivative** of a function, f'(x), represents the rate of change or slope of the function at a point.
- The **second derivative**, f''(x), is the derivative of the first derivative and measures the curvature or concavity of the function.
- The **third derivative**, f'''(x), is the derivative of the second derivative, and so on.

Example 1 Find the first four derivatives for each of the following.

(a) $R(t) = 3t^2 + 8t^{\frac{1}{2}} + e^t$

(b) $y = \cos x$

(c) $f(y) = \sin(3y) + e^{-2y} + \ln(7y)$

Example: Given y(x) = 3x^3 + 12x + 4. Find the value of third derivative at x = 1

Example: Given y = x/(x^2 + 1). Find the value of the second derivative at x = 1

Example 4: Given f(x) = e^x.sin(x). Find the value of f"(x) at x = 0.

Example 5: Given y = 3e^{2x} + 2e^{3x}, prove that $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$