



Calculus AB, sect. 3.5 – Higher Derivatives

Example 1

Find $f''(x)$ and $f'''(x)$ for $f(x) = x^4 + 2x - 9x^{-2}$ and evaluate

$$f''(-1). \quad f'(x) = 4x^3 + 2 + 18x^{-3}$$

$$f''(x) = 12x^2 - 54x^{-4}$$

$$f'''(x) = 24x + 216x^{-5}$$

$$f'''(-1) = -240$$

Example 2

Calculate the first four derivatives of $y = x^{-1}$. Then find the pattern and determine a general formula for the n th derivative $y^{(n)}$.

$$y' = -x^{-2}$$

$$y'' = 2x^{-3}$$

$$y''' = -6x^{-4}$$

$$y^{(4)} = 24x^{-5}$$

$$y^{(n)}(x) = (-1)^n n! x^{-n-1}$$

$$y^{(100)}(x) = 100! x^{-101}$$

$$165: 5, 11, 17, 19,$$

?? ??

$$y^{(4)} = 24x^{-5}$$

$$160, 2, 1, 1, 1, 1 \\ 23, 33$$

Example 3

Calculate $f'''(x)$ for $f(x) = xe^x$

Example 4 – Acceleration due to Gravity

$$s(t) = s_0 + v_0 t - \frac{1}{2} g t^2$$

Calculate the acceleration $a(t)$ of a ball tossed vertically in the air from ground level with an initial velocity of 40 ft/s. How does $a(t)$ describe the change in the ball's velocity as it rises and falls?

$$g = 32$$
$$v_0 = 40$$

$$s(t) = 40t - 16t^2$$

$$v(t) = 40 - 32t$$

$$a(t) = -32$$

$$v(0) = 40$$

$$v(1) = 8$$

$$v(2) = -24$$