

Instructions: You must show all work to receive full credit for the problems below. You may check your work with a calculator, but answers without work will receive minimal credit. Use exact answers unless the problem starts with decimals or you are specifically asked to round.

1. Find the derivatives of the following functions. You do not need to simplify.

a. $g(x) = \frac{4x^4 - 1}{3x^2 + 5}$

$$g'(x) = \frac{16x^3(3x^2 + 5) - (6x)(4x^4 - 1)}{(3x^2 + 5)^2}$$

b. $h(x) = (3t^7 - t^4 + 3)\left(t^2 - \frac{9}{t} - 11\right)$ (use the product rule, do not FOIL)

$$h'(x) = (21t^6 - 4t^3)\left(t^2 - \frac{9}{t} - 11\right) + (3t^7 - t^4 + 3)\left(2t + \frac{9}{t^2}\right)$$

c. $F(x) = \sqrt[3]{x^5 + 8x} = (x^5 + 8x)^{1/3}$

$$F'(x) = \frac{1}{3}(x^5 + 8x)^{-2/3} \cdot (5x^4 + 8)$$

d. $f(x) = x^5 \ln(e^{-3x} - x)$

$$f'(x) = 5x^4 \ln(e^{-3x} - x) + \frac{x^5}{e^{-3x} - x} \cdot (-3e^{-3x} - 1)$$

e. $G(x) = 5^{-x} - \frac{7x}{e^{9x} + 1}$

$$G(x) = -(\ln 5)5^{-x} - \frac{7(e^{9x} + 1) - (9e^{9x}) \cdot 7x}{(e^{9x} + 1)^2}$$

2. Find the third derivative of $f(x) = 2x^5 + 3x^4 - 4x^3 + 5x^2 - 8x + 6$.

$$f'(x) = 10x^4 + 12x^3 - 12x^2 + 10x - 8$$

$$f''(x) = 40x^3 + 36x^2 - 24x + 10$$

$$f'''(x) = 120x^2 + 72x - 24$$