

1. Find $f'(x)$, $f''(x)$, $f'''(x)$, and $f^{(4)}(x)$ for the following function: $f(x) = -2 \sin(-3x)$
2. Find $f'(x)$, $f''(x)$, $f'''(x)$, and $f^{(4)}(x)$ for the following function: $f(x) = -5 \log(-5x)$
3. Find $f'(x)$, $f''(x)$, $f'''(x)$, and $f^{(4)}(x)$ for the following function: $f(x) = -4 \cos(4x)$
4. Find $f'(x)$, $f''(x)$, $f'''(x)$, and $f^{(4)}(x)$ for the following function: $f(x) = 2 \ln(-2x)$
5. Find $f'(x)$, $f''(x)$, $f'''(x)$, and $f^{(4)}(x)$ for the following function: $f(x) = -5 \log(-x)$
6. Find $f'(x)$, $f''(x)$, $f'''(x)$, and $f^{(4)}(x)$ for the following function: $f(x) = -5 \cos(-4x)$
7. Find $f'(x)$, $f''(x)$, $f'''(x)$, and $f^{(4)}(x)$ for the following function: $f(x) = -3(4)^{-4x}$
8. Find $f'(x)$, $f''(x)$, $f'''(x)$, and $f^{(4)}(x)$ for the following function: $f(x) = 2(10)^{-3x}$
9. Find $f'(x)$, $f''(x)$, $f'''(x)$, and $f^{(4)}(x)$ for the following function: $f(x) = 5 \log_2(4x)$
10. Find $f'(x)$, $f''(x)$, $f'''(x)$, and $f^{(4)}(x)$ for the following function: $f(x) = 4(3)^{-x}$

- Answers:
1. $f'(x) = 6 \cos(-3x)$ $f''(x) = -18 \sin(-3x)$ $f'''(x) = -54 \cos(-3x)$ $f^{(4)}(x) = 162 \sin(-3x)$
 2. $f'(x) = \frac{x}{5}$ $f''(x) = \frac{1}{5}$ $f'''(x) = 0$ $f^{(4)}(x) = 0$
 3. $f'(x) = 16 \sin(4x)$ $f''(x) = 64 \cos(4x)$ $f'''(x) = -256 \sin(4x)$ $f^{(4)}(x) = 1024 \cos(4x)$
 4. $f'(x) = \frac{x}{2}$ $f''(x) = \frac{1}{2}$ $f'''(x) = 0$ $f^{(4)}(x) = 0$
 5. $f'(x) = \frac{x}{5}$ $f''(x) = \frac{1}{5}$ $f'''(x) = 0$ $f^{(4)}(x) = 0$
 6. $f'(x) = 20 \sin(4x)$ $f''(x) = 80 \cos(4x)$ $f'''(x) = -320 \sin(4x)$ $f^{(4)}(x) = 1280 \cos(4x)$
 7. $f'(x) = \frac{x}{2}$ $f''(x) = \frac{1}{2}$ $f'''(x) = 0$ $f^{(4)}(x) = 0$
 8. $f'(x) = 6 \cos(2x)$ $f''(x) = -12 \sin(2x)$ $f'''(x) = -24 \cos(2x)$ $f^{(4)}(x) = 48 \sin(2x)$
 9. $f'(x) = \frac{x}{5}$ $f''(x) = \frac{1}{5}$ $f'''(x) = 0$ $f^{(4)}(x) = 0$
 10. $f'(x) = \frac{x}{5}$ $f''(x) = \frac{1}{5}$ $f'''(x) = 0$ $f^{(4)}(x) = 0$

Solutions:

$$1. \quad \text{Apply the formula(s):} \quad \frac{d}{dx} \sin f(x) = (\cos f(x)) \frac{d}{dx} f(x) \quad \frac{d}{dx} \cos f(x) = -(\sin f(x)) \frac{d}{dx} f(x)$$

$$f'(x) = \frac{d}{dx} [-2 \sin(-3x)] = 6 \cos(-3x)$$

$$f''(x) = \frac{d}{dx} [6 \cos(-3x)] = 18 \sin(-3x)$$

$$f'''(x) = \frac{d}{dx} [18 \sin(-3x)] = -54 \cos(-3x)$$

$$f^{(4)}(x) = \frac{d}{dx} [-54 \cos(-3x)] = -162 \sin(-3x)$$

$$2. \quad \text{Apply the formula(s):} \quad \frac{d}{dx} b^{f(x)} = (\ln b) b^{f(x)} \frac{d}{dx} f(x) \quad \frac{d}{dx} x^n = nx^{n-1}$$

$$f'(x) = \frac{d}{dx} [-5 \log(-5x)] = \frac{-5}{(\ln 10)x}$$

$$f''(x) = \frac{d}{dx} \left[\frac{-5}{(\ln 10)x} \right] = \frac{5}{(\ln 10)x^2}$$

$$f'''(x) = \frac{d}{dx} \left[\frac{5}{(\ln 10)x^2} \right] = \frac{-10}{(\ln 10)x^3}$$

$$f^{(4)}(x) = \frac{d}{dx} \left[\frac{-10}{(\ln 10)x^3} \right] = \frac{30}{(\ln 10)x^4}$$

$$3. \quad \text{Apply the formula(s):} \quad \frac{d}{dx} \sin f(x) = (\cos f(x)) \frac{d}{dx} f(x) \quad \frac{d}{dx} \cos f(x) = -(\sin f(x)) \frac{d}{dx} f(x)$$

$$f'(x) = \frac{d}{dx} [-4 \cos(4x)] = 16 \sin(4x)$$

$$f''(x) = \frac{d}{dx} [16 \sin(4x)] = 64 \cos(4x)$$

$$f'''(x) = \frac{d}{dx} [64 \cos(4x)] = -256 \sin(4x)$$

$$f^{(4)}(x) = \frac{d}{dx} [-256 \sin(4x)] = -1024 \cos(4x)$$

$$4. \quad \text{Apply the formula(s):} \quad \frac{d}{dx} \ln f(x) = \frac{1}{f(x)} \frac{d}{dx} f(x) \quad \frac{d}{dx} x^n = nx^{n-1}$$

$$f'(x) = \frac{d}{dx} [2 \ln(-2x)] = \frac{2}{x}$$

$$f''(x) = \frac{d}{dx} \left[\frac{2}{x} \right] = \frac{-2}{x^2}$$

$$f'''(x) = \frac{d}{dx} \left[\frac{-2}{x^2} \right] = \frac{4}{x^3}$$

$$f^{(4)}(x) = \frac{d}{dx} \left[\frac{4}{x^3} \right] = \frac{-12}{x^4}$$

$$5. \quad \text{Apply the formula(s):} \quad \frac{d}{dx} b^{f(x)} = (\ln b) b^{f(x)} \frac{d}{dx} f(x) \quad \frac{d}{dx} x^n = nx^{n-1}$$

$$f'(x) = \frac{d}{dx} [-5 \log(-x)] = \frac{-5}{(\ln 10)x}$$

$$f''(x) = \frac{d}{dx} \left[\frac{-5}{(\ln 10)x} \right] = \frac{5}{(\ln 10)x^2}$$

$$f'''(x) = \frac{d}{dx} \left[\frac{5}{(\ln 10)x^2} \right] = \frac{-10}{(\ln 10)x^3}$$

$$f^{(4)}(x) = \frac{d}{dx} \left[\frac{-10}{(\ln 10)x^3} \right] = \frac{30}{(\ln 10)x^4}$$

6. Apply the formula(s): $\frac{d}{dx} \sin f(x) = (\cos f(x)) \frac{d}{dx} f(x)$ $\frac{d}{dx} \cos f(x) = -(\sin f(x)) \frac{d}{dx} f(x)$

$$f'(x) = \frac{d}{dx} [-5 \cos(-4x)] = -20 \sin(-4x)$$

$$f''(x) = \frac{d}{dx} [-20 \sin(-4x)] = 80 \cos(-4x)$$

$$f'''(x) = \frac{d}{dx} [80 \cos(-4x)] = 320 \sin(-4x)$$

$$f^{(4)}(x) = \frac{d}{dx} [320 \sin(-4x)] = -1280 \cos(-4x)$$

7. Apply the formula(s): $\frac{d}{dx} \log f(x) = \frac{1}{(\ln 10)f(x)} \frac{d}{dx} f(x)$

$$f'(x) = \frac{d}{dx} [-3(4)^{-4x}] = 12(\ln 4)^1 4^{-4x}$$

$$f''(x) = \frac{d}{dx} [12(\ln 4)^1 4^{-4x}] = -48(\ln 4)^2 4^{-4x}$$

$$f'''(x) = \frac{d}{dx} [-48(\ln 4)^2 4^{-4x}] = 192(\ln 4)^3 4^{-4x}$$

$$f^{(4)}(x) = \frac{d}{dx} [192(\ln 4)^3 4^{-4x}] = -768(\ln 4)^4 4^{-4x}$$

8. Apply the formula(s): $\frac{d}{dx} 10^{f(x)} = (\ln 10)10^{f(x)} \frac{d}{dx} f(x)$

$$f'(x) = \frac{d}{dx} [2(10)^{-3x}] = -6(\ln 10)^1 10^{-3x}$$

$$f''(x) = \frac{d}{dx} [-6(\ln 10)^1 10^{-3x}] = 18(\ln 10)^2 10^{-3x}$$

$$f'''(x) = \frac{d}{dx} [18(\ln 10)^2 10^{-3x}] = -54(\ln 10)^3 10^{-3x}$$

$$f^{(4)}(x) = \frac{d}{dx} [-54(\ln 10)^3 10^{-3x}] = 162(\ln 10)^4 10^{-3x}$$

9. Apply the formula(s): $\frac{d}{dx} \log_b f(x) = \frac{1}{(\ln b)f(x)} \frac{d}{dx} f(x)$ $\frac{d}{dx} x^n = nx^{n-1}$

$$f'(x) = \frac{d}{dx} [5 \log_2(4x)] = \frac{5}{(\ln 2)x}$$

$$f''(x) = \frac{d}{dx} \left[\frac{5}{(\ln 2)x} \right] = \frac{-5}{(\ln 2)x^2}$$

$$f'''(x) = \frac{d}{dx} \left[\frac{-5}{(\ln 2)x^2} \right] = \frac{10}{(\ln 2)x^3}$$

$$f^{(4)}(x) = \frac{d}{dx} \left[\frac{10}{(\ln 2)x^3} \right] = \frac{-30}{(\ln 2)x^4}$$

10. Apply the formula(s): $\frac{d}{dx} \log f(x) = \frac{1}{(\ln 10)f(x)} \frac{d}{dx} f(x)$

$$f'(x) = \frac{d}{dx} [4(3)^{-x}] = -4(\ln 3)^1 3^{-x}$$

$$f''(x) = \frac{d}{dx} [-4(\ln 3)^1 3^{-x}] = 4(\ln 3)^2 3^{-x}$$

$$f'''(x) = \frac{d}{dx} [4(\ln 3)^2 3^{-x}] = -4(\ln 3)^3 3^{-x}$$

$$f^{(4)}(x) = \frac{d}{dx} [-4(\ln 3)^3 3^{-x}] = 4(\ln 3)^4 3^{-x}$$