

Test 0

Show all your work

Name: _____
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No Calculator allowed. Differentiation practise.

Problem 1: Use the rules of differentiation to find the derivative of each of these functions. Perform any obvious SIMPLIFICATIONS—coefficients, exponents, etc.

a. Find $\frac{d}{dx} \left(\frac{7}{x^5} - e^{3x} + 6^\pi \right)$.

$$\frac{d}{dx} \left(\frac{7}{x^5} - e^{3x} + 6^\pi \right) = \frac{d}{dx} (7x^{-5} - e^{3x} + 6^\pi) = -35x^{-6} - 3e^{3x} + 0$$

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b. Differentiate $f(x) = \ln(x^e - 3\sqrt{x}) - \frac{2}{\sqrt[3]{6-x}} + \frac{7}{x^9 - 5}$.

$$f(x) = \ln(x^e - 3\sqrt{x}) - 2(6-x)^{-1/3} + 7(x^9 - 5)^{-1}, \text{ so}$$

$$\begin{aligned} f'(x) &= \frac{1}{x^e - 3\sqrt{x}} \left(ex^{e-1} - \frac{3}{2\sqrt{x}} \right) + \frac{2}{3}(6-x)^{-4/3}(-1) - 7(x^9 - 5)^{-2}(9x^8) \\ &= \frac{ex^{e-1} - \frac{3}{2\sqrt{x}}}{x^e - 3\sqrt{x}} - \frac{2}{3}(6-x)^{-4/3} - \frac{63x^8}{(x^9 - 5)^2} \end{aligned}$$

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c. Find the derivative of $g(t) = \sin^2(t^3 + 1/t) - \cot^3(\sqrt{1-3t})$

$$\begin{aligned} g'(t) &= 2 \sin(t^3 + 1/t) \cos(t^3 + 1/t)(3t^2 - 1/t^2) \\ &\quad - 3 \cot^2(\sqrt{1-3t}) (-\csc^2(\sqrt{1-3t})) \frac{1}{2\sqrt{1-3t}} \cdot 3 \\ &= 2 \sin(t^3 + 1/t) \cos(t^3 + 1/t)(3t^2 - 1/t^2) + \frac{9 \cot^2(\sqrt{1-3t}) \csc^2(\sqrt{1-3t})}{2\sqrt{1-3t}} \end{aligned}$$

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Problem 2: Determine the following derivatives using differentiation rules. Do NOT simplify.

a. $f(x) = \left(5^{3x^2} + \sqrt[4]{5x-2} \right)^6 (\log(x^3 + \sqrt{ex}))^4$

$$\begin{aligned} f'(x) &= 6 \left(5^{3x^2} + \sqrt[4]{5x-2} \right)^5 \left(5^{3x^2} \ln(5)(6x) + \frac{1}{4}(5x-2)^{-3/4}(5) \right) (\log(x^3 + \sqrt{ex}))^4 \\ &\quad + \left(5^{3x^2} + \sqrt[4]{5x-2} \right)^6 4 (\log(x^3 + \sqrt{ex}))^3 \frac{1}{(x^3 + \sqrt{ex}) \ln(10)} \left(3x^2 + \frac{1}{2\sqrt{ex}}(e) \right) \end{aligned}$$

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b. $y = \frac{(13u^2 + 5 \cos(u^3))^3}{\pi u^e - 4 \sec(u)}$

$$\frac{3 (13u^2 + 5 \cos(u^3))^2 (26u - 5 \sin(u^3)(3u^2)) (\pi u^e - 4 \sec(u)) - (13u^2 + 5 \cos(u^3))^3 (\pi e u^{e-1} - 4 \sec(u) \tan(u))}{(\pi u^e - 4 \sec(u))^2}$$

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