

Differentiation Rules: math test, College – download the PDF

Suggested time: 45 minutes. Out of 20 points. Calculator allowed only when the problem says so.

1 Product and quotient rules

/ 4 pts

Differentiate. (a) $f(x) = (3x - 1)(x^2 + 4)$. (b) $g(x) = \frac{2x + 1}{x - 3}$, for $x \neq 3$.

2 Chain rule

/ 3 pts

Differentiate. (a) $y = (x^3 + 2)^6$. (b) $y = e^{-3x} \cos(2x)$.

3 A logarithmic quotient

/ 3 pts

Let $y = \frac{\ln x}{x^2}$ for $x > 0$. (a) Find y' . (b) Find the exact x -value where the tangent line is horizontal.

4 Implicit differentiation

/ 3 pts

The point $(3, 3)$ lies on the curve $x^3 + y^3 = 6xy$. Find $\frac{dy}{dx}$ in terms of x and y , then the equation of the tangent line at $(3, 3)$.

5 Logarithmic differentiation

/ 4 pts

(a) For $x > 0$, differentiate $y = x^{3x}$ and compute $y'(1)$. (b) For $y = \frac{(x+1)^4 \sqrt{x-2}}{(3x-1)^2}$ with $x > 2$, write $\frac{y'}{y}$ and evaluate it at $x = 3$.

6 Higher derivatives and concavity

/ 3 pts

Let $f(x) = x e^{-x}$. (a) Find f' . (b) Find f'' . (c) Find where $f'' = 0$ and decide where the graph bends upward.



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