

Name: ANSWERS

Instructions: No calculators! Answer all problems in the space provided! Do your rough work on scrap paper.

1. Let $f(x)$, $g(x)$ and u be differentiable functions of x , c a constant. Complete the following formulas. (You may use f' , g' and u' as shorthand):

(a) $\frac{d}{dx}(cf(x)) = \underline{c \cdot \frac{d}{dx}f(x)}$ (b) $\frac{d}{dx}(f(x) \cdot g(x)) = \underline{f'g + fg'}$ (c) $\frac{d}{dx}e^u = \underline{u'e^u}$
 (d) $\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \underline{\frac{f'g - fg'}{g^2}}$ (e) $\frac{d}{dx}\ln u = \underline{\frac{u'}{u}}$ (f) $\frac{d}{dx}f(g(x)) = \underline{f'(g(x)) \cdot g'(x)}$

2. Suppose $e - x^3 + xy = 3y^2$, then $y' = \underline{\frac{y-3x^2}{6y-x}}$

3. For problem 2 above, find the equation of the tangent line at $(\sqrt[3]{e}, 0)$: $y = 3e^{1/3}(x - e^{1/3})$

4. Find the following derivatives:

(a) $\frac{d}{dx}\left(\frac{xe^x}{2}\right) = \underline{\frac{1}{2}(e^x + xe^x)}$ (b) $\frac{d}{dx}\sqrt[3]{x^3 + x + 1} = \underline{\frac{1}{3}(x^3 + x + 1)^{-2/3}(3x^2 + 1)}$ ← parentheses important!
 (c) $\frac{d}{dx}e^{e^x} = \underline{e^x e^{e^x} \text{ or } e^{e^x+x}}$ (d) $\frac{d}{dx}\frac{4x^4 - 3x^2 + 2x + 3}{2x^2} = \underline{4x - x^{-2} - 3x^{-3}}$
 (e) $\frac{d}{dx}\ln(x^3 + 1) = \underline{\frac{3x^2}{x^3 + 1}}$ (f) $\frac{d}{dx}\ln\sqrt{e^\pi} = \underline{0}$
 (g) $\frac{d}{dx}\pi^{x^2 + e^x} = \underline{(2x + e^x)\pi^{x^2 + e^x} \ln \pi}$

5. Complete the table:

Function (assume all are continuous everywhere)	The behavior it tells us about	How?
$f(x)$	Points on the graph	Plug in x into $f(x)$, find corresponding y -value to get (x, y)
$f'(x)$	The function is increasing (Also, decreasing/max/min)	$f'(x) > 0$
$f''(x)$	The function is Concave down	$f'' < 0$
$f'(x)$	The function is decreasing	$f' < 0$
$f'(x)$	There is a minimum point at x	$f'(x) = 0$ or undefined and $f' < 0$ on left, $f' > 0$ on right of x

→ We will later see how to use f'' to determine this.

Bonus:

1. If $c(x) = 3 + \frac{2}{x}$ is a cost function, what is the marginal cost function?: $C'(x) = -2x^{-2}$

2. $\frac{d}{dx}x^x = \underline{x^x(\ln x + 1)}$