

1. Find the derivative $\left(f'(x) \text{ or } \frac{dy}{dx}\right)$ of the following functions. Do not simplify your answers.

a. $y = \frac{\sinh(4x)}{1+e^{5x}}$

b. $f(x) = \tan^{-1}(x^3) + \cot^3(x)$

2. Find the derivative $\left(f'(x) \text{ or } \frac{dy}{dx}\right)$ of the following functions. Simplify your answers.

a. $f(x) = \frac{\sin x}{1-\cos x}$

b. $y = (5x) \cdot \sin^{-1}(5x) + \sqrt{1-25x^2}$

3. Find the equation (in *slope-intercept* form) of the tangent line to the curve $y = (x^2 - 8)^x$ at the point where $x = 3$.

4. Given the curve defined by the equation $y = \cos^2 x + (\sqrt{2})\sin x$ with domain $[0, \pi]$, find all points *on the curve* where the tangent line to the curve is horizontal.

5. A table for f and g and their derivatives is given in the table:

x	$f(x)$	$g(x)$	$f'(x)$	$g'(x)$
1	4	7	-4	3
2	-2	5	7	4
3	5	6	4	-6
4	1	-5	2	6
5	3	4	2	-1

Let:

$$u(x) = f(x) \cdot g(x) \qquad v(x) = \frac{f(x)}{g(x)} \qquad w(x) = f(g(x)) \qquad z(x) = g(f(x))$$

Find, if possible (if not possible, write NP and state a reason why it is not possible): show the calculations that you used to get the answer.

a. $u'(1)$

b. $v'(3)$

c. $w'(4)$

d. $z'(5)$

6. Find $\frac{d^2y}{dx^2}$ for the following equation; in part b. express your answer in terms of x and y only.
- a. $f(x) = \sec\left(2x - \frac{\pi}{3}\right)$ b. $y^4 - x^3 = 5y + 7$
7. Cobalt-60 has a half-life of 5.24 years. A sample originally contains 300 mg.
- a. Find a formula for the mass remaining after t years.
b. Find the mass remaining after 12 years. (express your answer to the nearest milligram)
c. Find the number of years required for the mass to be reduced to 30 mg. (You can leave your answer in an exact form, or use a scientific calculator to round your answer to the nearest year).
8. Given that $\cosh x = \frac{e^x + e^{-x}}{2}$, and $\sinh x = \frac{e^x - e^{-x}}{2}$, verify the identity
- $$\cosh(2x) = \cosh^2 x + \sinh^2 x$$
9. A person flying a kite lets the string out at a rate of 12 ft/sec. The kite always stays 100 feet above the ground.
- a. What is the kite's (horizontal) speed when 200 feet of string have been let out?
b. At what rate is the angle between the string and the ground changing at this same time? Use radian measure in your answer, and assume that the string always stays taut (in a straight line).

1. a. $\frac{[4 \cosh(4x)](1+e^{5x}) - \sinh(4x)[5 e^{5x}]}{(1+e^{5x})^2}$ b. $\frac{3x^2}{1+x^6} - 3 \cot^2(x) \csc^2(x)$

2. a. $\frac{1}{\cos x - 1}$ b. $5 \sin^{-1}(5x)$

3. $y = 18x - 53$

4. $\left(\frac{\pi}{4}, \frac{3}{2}\right); \left(\frac{\pi}{2}, \sqrt{2}\right); \left(\frac{3\pi}{4}, \frac{3}{2}\right)$

5. a. -16 b. $\frac{3}{2}$ c. *NP* ($f'(5)$ is not known) d. -12

6. a. $4 \sec\left(2x - \frac{\pi}{3}\right) \left[\tan^2\left(2x - \frac{\pi}{3}\right) + \sec^2\left(2x - \frac{\pi}{3}\right) \right]$
b. $\frac{6x(4y^3-5)^2 - 108x^4y^2}{(4y^3-5)^3}$

7. a. $m = 300 e^{\left(-\frac{\ln 2}{5.24}\right)t}$ b. 61 mg c. $t = \frac{5.24 \ln 10}{\ln 2} \approx 17 \text{ years}$

8. identity

9. a. $8\sqrt{3} \text{ feet/sec} \approx 13.86 \text{ feet/sec}$ b. $-\frac{\sqrt{3}}{50} \text{ rad/sec} \approx -0.0346 \text{ rad/sec}$