

1. Find the derivative $\left(f'(x) \text{ or } \frac{dy}{dx}\right)$ of the following functions. Do not simplify your answers.
 - a. $y = \csc^4(3x - \pi)$
 - b. $f(x) = \cosh(4x) \cdot e^{\sqrt{x}}$

2. Find the derivative $\left(f'(x) \text{ or } \frac{dy}{dx}\right)$ of the following functions. Simplify your answers.
 - a. $f(x) = 2x^2 \cdot \tan^{-1}(x^2) - \ln(x^4 + 1)$
 - b. $y = \frac{\cos x}{1 + \sin x}$

3.
 - a. Find the equation (in *slope-intercept form*) of the line tangent to the curve of the function $f(x) = \sin^{-1}(x)$ at the point where $x = \frac{\sqrt{3}}{2}$.
 - b. Find the point(s) on the graph of $f(x) = \frac{x+3}{x^2+16}$ where the tangent line is horizontal.

4. An object's position s along a line at a time t is given by the equation $s = t^3 - 6t^2 + 9t + 33$, where s is measured in centimeters and t is measured in seconds. Find (show your work below):
 - a. the velocity at time t .
 - b. the acceleration at time t .
 - c. the velocity at 5 seconds (state the units).
 - d. the time(s) when the object is at rest.
 - e. the position of the object when the acceleration is zero.
 - f. the total distance traveled by the object from time $t = 0$ to $t = 6$ seconds.

5. Find $\frac{d^2y}{dx^2}$ for the following equations; in part b. express your answer in terms of x and y only.
 - a. $y = \tan\left(4x - \frac{\pi}{3}\right)$
 - b. $x^2 - y^3 = 6y + 5$

6. Use logarithmic differentiation to find the derivative of the function $y = (\sec x)^{(x^2+1)}$. Express your answer explicitly as a function of x .

7. A radioactive material has a half-life of 3.85 days. A sample originally contains 800 mg.
 - a. Find a formula for the mass remaining after t days.
 - b. Find the mass remaining after 10 days.
 - c. Find the number of days required for the mass to be reduced to 1 mg.

8. A ladder 15 feet long rests against a vertical wall. If the bottom of the ladder is pulled away from the wall at a rate of 2 feet per second, how fast is the top of the ladder sliding down the wall when the bottom of the ladder is 9 feet from the base of the wall? State the units of your answer.

1.
 - a. $-12 \csc^4(3x - \pi) \cot(3x - \pi)$
 - b. $4 \sinh(4x)e^{\sqrt{x}} + \cosh(4x) \frac{e^{\sqrt{x}}}{2\sqrt{x}}$
2.
 - a. $4x \tan^{-1}(x^2)$
 - b. $-\frac{1}{1+\sin x}$
3.
 - a. $y = 2x + \left(\frac{\pi}{3} - \sqrt{3}\right)$
 - b. $\left(2, \frac{1}{4}\right); \left(-8, -\frac{1}{16}\right)$
4.
 - a. $v(t) = 3t^2 - 12t + 9$
 - b. $a(t) = 6t - 12$
 - c. $v(5) = 24 \text{ cm/sec}$
 - d. $v = 0 @ t = 1, t = 3$
 - e. $a = 0 @ t = 2; s(2) = 35$
 - f. $(37 - 33) + |33 - 37| + (87 - 33) = 4 + 4 + 54 = 62 \text{ cm}$
5.
 - a. $\frac{d^2y}{dx^2} = 32 \sec^2\left(4x - \frac{\pi}{3}\right) \tan\left(4x - \frac{\pi}{3}\right)$
 - b. $\frac{d^2y}{dx^2} = \frac{(3y^2+6)^2[2x]-24x^2y}{(3y^2+6)^3}$
6. $\frac{dy}{dx} = (\sec x)^{(x^2+1)}(2x \ln(\sec x) + (x^2 + 1) \tan x)$
7.
 - a. $M = 800 e^{-\frac{\ln 2}{3.85}t} \approx 800 e^{-.18t}$
 - b. $M(10) = 800 e^{-\frac{\ln 2}{3.85}(10)} \approx 132.2 \text{ mg}$
 - c. $t = \frac{3.85 \ln 800}{\ln 2} \approx 37 \text{ days}$
8. The ladder is sliding down the wall at a rate of 1.5 feet/sec $\left(\frac{dy}{dt} = -1.5\right)$