1. Find the derivative of each of the following functions.

a. \( y = x^5 - \pi^3 - 4x^2 + 2 \)

b. \( y = \sqrt{x} + \frac{1}{\sqrt{x}} - \frac{3}{\sqrt{x}} + \frac{1}{\sqrt{\pi}} - \frac{5}{\sqrt{x}} \)

c. \( y = (3x^5 + x^4 - \pi^2 + 1)(x^{-1} - x^{-2} + x^{-3}) \)

d. \( y = \frac{1}{x} - \frac{1}{x^2} + \frac{1}{x^3} \)

e. \( y = \frac{x}{5} + \frac{5}{x} + \frac{1}{5x} + 5x \)

2. Find an equation of the tangent line to the curve \( y = \frac{x-1}{x^2+1} \) at \( x = 2 \).

3. Find the derivative of the function \( H(x) = \frac{(f(x)+1)^3}{f(x)-2x} \), where \( f \) is a differentiable function. Do not simplify.

4. Find the point(s) on the graph of \( y = \frac{x}{x-3} \) where the tangent line is perpendicular to the line \( y = 3x - 1 \).

5. A particle moves in a straight line so that its position \( x \) cm from \( 0 \) at time \( t \) seconds is given by \( x(t) = t^3 - 9t^2 + 24t + 2 \).

a. At what times is the particle at rest?

b. When is the particle moving in the positive direction? When is it negative?

c. Find the total distance traveled from \( x = 0 \) to \( x = 6 \).

d. Find the displacement from \( x = 0 \) to \( x = 6 \).

6. Evaluate the following limits:

| a. \( \lim_{\theta \to 0} \frac{\theta}{\sin 3\theta} \) | d. \( \lim_{t \to 0} \frac{(\cos t)-1}{\tan(2t)} \) |
| b. \( \lim_{\theta \to 0} \frac{\sin 5\theta}{\sin 3\theta} \) | e. \( \lim_{x \to 0} \frac{\sin(\cos x)}{\cos x} \) |
| c. \( \lim_{x \to 0} \frac{\sin^2 5x}{3x^2} \) | f. \( \lim_{x \to 3} \frac{\sin(3-x)}{(x^2-9)} \) |
7. Find the derivative of each function:
   
   a. \( f(x) = \frac{x\sin x}{\sec x + \tan x} \)

   b. \( g(x) = \csc x \cot x - xc\cos x \)

   c. \( h(x) = \tan(f(x)), \) where \( f \) is a differentiable function.

   d. \( k(x) = \sin(\sqrt{x^2 + x}) - \sec^2 x + \sqrt{\cos x} \)

   e. \( l(x) = \sin^2 x + \cos^2 x \)

   f. \( s(x) = \sec^2 x - \tan^2 x \)

   g. \( r(x) = \frac{1}{x + \frac{1}{x}} \)

8. Assume that \( y \) is a function of \( x \). Find \( y' = \frac{dy}{dx} \) for \( (x - y)^2 = x + y - 1 \).

9. Assume that \( y \) is a function of \( x \). Find \( y' = \frac{dy}{dx} \) for \( y^4 - x^3 = \sin(3x + 4y) \).

10. Assume that \( y \) is a function of \( x \). Find \( y' = \frac{dy}{dx} \) for \( y - x = x^2 y^3 + x^3 y^2 \).

11. Assume that \( y \) is a function of \( x \). Find \( y' = \frac{dy}{dx} \) for \( \frac{y}{x^3} + \frac{x}{y^3} = x^2 y^4 \).

12. Find points on the curve \( y = \frac{\cos x}{2 + \sin x} \) \( 0 \leq x \leq 2\pi \) where the tangent line is horizontal.