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

   a. \( f(x) = \sin^{-1}(x^4) + \sin^4\left(\frac{1}{x}\right) \)
   
   b. \( y = \frac{\sinh(5x-9)}{x^3+3^x} \)

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

   a. \( f(x) = (9x^2 + 1) \cdot \tan^{-1}(3x) - (3x + 5) \)
   
   b. \( y = \ln(\tan(5x) + \sec(5x)) \)

3. Find the equation (in slope-intercept form) of the tangent line to the curve \( y = (2x - 7)^{(x+1)} \) at the point where \( x = 4 \).

4. Given the curve defined by the equation \( y = f(x) = \frac{x+3}{x^2+40} \), find all points on the curve where the tangent line to the curve is horizontal.

5. Given the graph of \( f \) and \( g \) (graph was similar to graph is problem 3.7.86 in text):

   Let: \( u(x) = f(x) \cdot g(x) \quad v(x) = \frac{f(x)}{g(x)} \quad w(x) = f(g(x)) \quad z(x) = g(f(x)) \)

   Find, if possible (if not possible, state a reason why it is not possible). Show any calculations needed to obtain your answers.

   a. \( u'(-4) \)
   
   b. \( v'(0) \)
   
   c. \( w'(4) \)
   
   d. \( z'(2) \)

6. Find \( \frac{d^2y}{dx^2} \) for the following equations; in part b. express your answer in terms of \( x \) and \( y \) only.

   a. \( y = e^{(x^7-4x-9)} \)
   
   b. \( x^3 - y^2 = 5y + 7 \)

7. An object's position \( s \) along a line at a time \( t \) is given by the equation \( s = t^3 - 9t^2 + 15t + 40 \), 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 2 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 \( t = 10 \) (regardless of the direction of travel).
8. The height of a rectangle is decreasing at a rate of 3 cm/sec, and the area of the rectangle is increasing at a rate of 14 cm²/sec. Determine the rate at which the base of the rectangle is changing when the height of the rectangle is 12 cm and the area is 120 cm². Be sure to state clearly whether the base is increasing or decreasing in addition to the magnitude of this change.

9. Use differentials, or the linearization of the square root function to find a rational number written as a fraction of integers that approximates the value of \( \sqrt{48} \). Please state the function \( f(x) \) and the value of \( a \) that you use in your calculations.
1. a. \[
\frac{4x^3}{\sqrt{1-(x^4)^2}} = \frac{4 \sin\left(\frac{1}{x}\right) \cos\left(\frac{1}{x}\right)}{x^2} = \frac{4x^3}{\sqrt{1-x^8}} - \frac{4 \sin^2\left(\frac{1}{x}\right) \cos\left(\frac{1}{x}\right)}{x^2}
\]

b. \[
\frac{[5 \cosh(5x-9)](x^3+3^x) - \sinh(5x-9)[3x^3+3^x \ln 3]}{(x^3+3^x)^2}
\]

2. a. \(18x \tan^{-1}(3x)\)  
b. \(5 \sec(5x)\)

3. when \(x = 4\), \(y = 1\): logarithmic differentiation yields
\[
dy \over dx = y \left(\ln(2x - 7) + \frac{2(x+1)}{2x-7}\right)
\]
\[
\left.\frac{dy}{dx}\right|_{(x,y)=(4,1)} = 10 \quad \text{Tangent line is } y = 10x - 39
\]

4. \((4, \frac{1}{8}); (-10, -\frac{1}{20})\)

5. a. \(-6\)  
b. \(\frac{3}{8}\)  
c. \(6\)  
d. DNE

6. a. \(e^{(x^2-4x-9)}(2 + (2x - 4)^2)\)  
b. \(\frac{6x(2y+5)^2-18x^4}{(2y+5)^3}\)

7. a. \(v(t) = 3t^2 - 18t + 15\)  
b. \(a(t) = 6t - 18\)

c. \(v(2) = -9 \text{ cm/sec}\)  
d. \(t = 1, 5 \text{ seconds}\)

e. \(58 \text{ cm}\)  
f. \(297 \text{ cm}\)

8. Base is increasing at a rate of \(\frac{22}{15} \text{ cm/sec}\).

9. \(f(x) = \sqrt{x} : a = 49 : \sqrt{48} \approx 7 + \frac{1}{14}(48 - 49) = \frac{97}{14}\)