1. Find the (first) derivative \[ f'(x) \text{ or } \frac{dy}{dx} \] : simplify your results.

   a. \[ f(x) = \frac{\sin x}{1 - \cos x} \]
   b. \[ y = \ln \left( x + \sqrt{x^2 - 16} \right) \]
   c. \[ y = 3x \cdot \sin^{-1}(3x) + \sqrt{1 - 9x^2} \]

2. Find the second derivative of the following functions:

   a. \[ f(x) = \tan^3(4x) \]
   b. \[ y = \tan^{-1}(x^3) \]

3. Given the equation \[ x^3 + x^2 y + y^2 = 29 \] :

   a. Find the point on the graph of this equation in the first quadrant whose \( x \)-coordinate is 2.
   b. Find the formula for \( \frac{dy}{dx} \) (in terms of both \( x \) and \( y \)).
   c. Find the equation, in slope-intercept form, of the line tangent to the graph of this equation at the point from part a.

4. Find the derivative of \( y = (\sec x)^x \). Write your answer explicitly in terms of \( x \).

5. Given the function \( f(x) = x^{3/2} \):

   a. Compute the Taylor polynomial of degree 3 about \( x = 9 \) for \( f(x) \).
   b. Use the Taylor polynomial in part a. to find a single fraction (of integers) that is an estimate for \( (11)^{3/2} \).
6. Find the critical numbers for the function \( f(x) = \sqrt{x^2 - 8x - 20} \).

7. Find the absolute maximum and minimum values of the function \( f(x) = 2x^3 - 9x^2 - 24x + 35 \) on the interval \([-2, 7]\) state the value(s) of \( x \) where each of these extremes occur. Justify your answers using calculus.

8. Given the function \( f(x) = x^4 - 12x^2 + 32 \), find:
   
a. the coordinates of all intercepts.
   
b. the open interval(s) where the graph of the function is increasing.
   
c. the open interval(s) where the graph of the function is concave down.

9. Evaluate the following limits, if they exist (if not, write DNE). Justify your answers.
   
a. \( \lim_{x \to -8} \frac{\sqrt{3x+1}-5}{2x-16} \)
   
b. \( \lim_{x \to 0} \frac{\cos(5x)-\cos(2x)}{x^2} \)
   
c. \( \lim_{x \to 0} (1 - 4x)^{\frac{1}{2}} \)

10. A rectangular storage container with an open top is to have a volume of 6 \( \text{m}^3 \). The length of its base is twice the width. Material for the base costs $12 per square meter, and material for the sides costs $9 per square meter. Find the dimensions of the container that can be constructed for the least amount of money. What is the cost?
1. a. \( f'(x) = \frac{1}{\cos x - 1} \)
   b. \( \frac{dy}{dx} = \frac{1}{\sqrt{x^2 - 16}} \)
   c. \( \frac{dy}{dx} = 3 \sin^{-1}(3x) \)

2. a. \( f''(x) = 96 \tan(4x) \sec(4x)(\sec^2(4x) + \tan^2(4x)) \)
   b. \( \frac{d^2y}{dx^2} = \frac{6x-12x^7}{(1+x^6)^2} \)

3. a. \((2, 3)\)
   b. \( \frac{dy}{dx} = \frac{-3x^2 - 2xy}{x^2 + 2y} \)
   c. \( y = -\frac{12}{5}x + \frac{39}{5} \)

4. \( \frac{dy}{dx} = (\sec x)^2(2x \ln(\sec x) + x^2 \tan x) \)

5. a. \( T_3(x) = 27 + \frac{9}{2}(x - 9) + \frac{1}{8}(x - 9)^2 - \frac{1}{432}(x - 9)^3 \)
   b. \( (11)^{3/2} \approx \frac{1970}{54} = \frac{985}{27} \)

6. critical numbers are \(-2, 4,\) and \(10\)

7. \( f_{\max}(x) = 112 \quad @ \ x = 7 \quad f_{\min}(x) = -77 \quad @ \ x = 4 \)

8. a. intercepts at: \((0, 32); \ (\pm \sqrt{8}, 0); \ (\pm 2, 0)\)
   b. \( f(x) \) is increasing on: \((-\sqrt{6}, 0)\) and \((\sqrt{6}, \infty)\)
   c. \( f(x) \) is concave down on: \((-\sqrt{2}, \sqrt{2})\)

9. a. \( \frac{3}{20} \)
   b. \( -\frac{21}{2} \)
   c. \( e^{-4} \)

10. dimensions are: length \(3m \times \) width \(\frac{3}{2}m \times \) height \(\frac{4}{3}m\)
    
    minimum cost is \$162