1. Given \( \mathbf{r}(t) = \langle 2 \sin t, 5t, 2 \cos t \rangle \), find the unit tangent vector \( T(t) \)

2. Given a particle whose acceleration, initial velocity and initial position are 
\( \mathbf{a}(t) = i + 2j \), \( \mathbf{v}(0) = k \) and \( \mathbf{r}(0) = i \), respectively, find the position vector of the particle.

3. 
   a. Find and sketch the domain of \( f(x, y) = \sqrt{x} + \sqrt{25 - x^2 - y^2} \)
   
   b. Draw a contour map of \( f(x, y) = x^3 - y \) showing four level curves.
4. Evaluate \( \lim_{(x,y) \to (0,1)} \frac{x^4 - y^4}{x^2 + y^2} \)

5. Compute \( f_x \) and \( f_y \) for the following functions:

a. \( f(x, y) = \tan(xy) \)

b. \( f(x, y) = \sqrt{x} \ln y \)

6. Find an equation of the tangent plane to \( f(x, y) = y \cos(x - y) \) at \( (2, 2, 2) \)
7. Given $z = e^{x+2y}$, where $x = \frac{s}{t}$, $y = \frac{t}{s}$, use the Chain Rule to find:

a. $\frac{\partial z}{\partial s}$

b. $\frac{\partial z}{\partial t}$

8. Given $f(x, y) = \ln(x^2 + y^2)$:

a. Find the gradient of this function at (2,1)

b. Find the rate of change of this function at (2, 1) in the direction of $v = \langle -1, 2 \rangle$
9. Find three positive numbers whose sum is 100 and whose product is a maximum. DO NOT USE THE METHOD OF LAGRANGE MULTIPLIERS.
10. Use the Method of Lagrange Multipliers to find the maximum and minimum values of $f(x, y) = 4x + 6y$ subject to the constraint $x^2 + y^2 = 13$