1. Let \( \mathbf{r}(t) = \langle \cos(2t), \sin(2t), t \rangle \) represent the position of a particle.
   
   a) Find the velocity, speed and acceleration functions for the particle.
   
   b) Find the unit tangent vector \( \mathbf{T}(t) \).

2. Find the length of this curve:
   
   \( \mathbf{r}(t) = 4t^{3/2} \mathbf{i} + t^2 \mathbf{j} + 9t \mathbf{k} \), \( 0 \leq t \leq 1 \).

3. For the function \( f(x, y) = \sqrt{9 - 9y^2} \), do the following:
   
   a) State and sketch the domain of \( f \).
   
   b) Sketch (and describe, if you think it will help) the graph of \( f \).

4. A particle starts at the origin with initial velocity vector \( \langle 3, -1, 1 \rangle \). Its acceleration is \( \mathbf{a}(t) = \langle 4t, -24t^2, -8t \rangle \).

   Find this particle’s position function.

5. Find all first order partial derivatives of the function \( f(x, y, z) = xyz \sin(y) \).

6. Sketch the plane curve represented by the vector-valued function \( \mathbf{r}(t) = 2 \cos(t) \mathbf{i} - 3 \sin(t) \mathbf{j} \).

Mark the curve with an arrow indicating the direction of increasing \( t \).

7. Given the following relations, use the chain rule to find expressions for \( \frac{\partial w}{\partial r} \) and \( \frac{\partial w}{\partial \theta} \).

\[
 w = xy + yz, \quad x = r \cos(\theta), \quad y = r \sin(\theta), \quad z = \theta.
\]

You may leave a mixture of \( x \)'s, \( y \)'s, \( z \)'s, \( r \)'s and \( \theta \)'s in your answer.

8. For the function/surface \( z = f(x, y) = \sqrt{4x^2 + y^2} \), draw a contour map of \( f \), showing level curves for \( z \)-levels of 0, 1, 2, 3, 4. Label each contour with its \( z \)-level.

9. For the function \( f(x, y) = \frac{x + y}{x - y} \), do the following:
   
   a) Find the linearization of \( f \) at the point \( (2,1) \).
   
   b) Find the equation of the plane that is tangent to the graph of \( f \) at the point where \( (x, y) = (1,2) \).

10. For the multivariable function \( f(x, y, z) = \frac{1}{x^2 + y^2 + z^2 - 1} \), do the following:
    
    a) Compute \( f(1,2,3) \).
    
    b) Describe the domain of \( f \).
    
    c) Describe the level surfaces of \( f \).

11. Show that \( \lim_{(x,y) \to (0,0)} \frac{2xy}{x^2 + 2y^2} \) does not exist.

12. Find the value of \( \lim_{(x,y) \to (2,2)} \frac{x^2 - y^2}{x - y} \), and discuss the continuity of the function \( f(x, y) = \frac{x^2 - y^2}{x - y} \).