1. Find an equation of the osculating plane of the curve \( y = t^2 \) at \( t = 1 \). At this point \( z = t^3 \), on the curve, the unit normal vector is parallel to \( \mathbf{a} = \langle 11, 8, -9 \rangle \), the binormal vector is parallel to \( \mathbf{b} = \langle 12, -12, 4 \rangle \) and the unit tangent vector is parallel to \( \mathbf{c} = \langle 1, 2, 3 \rangle \).

2. Given the curve and acceleration vector below, sketch the vectors associated with \( \mathbf{a}_T \) and \( \mathbf{a}_N \) given \( a_T = 4 \) and \( a_N = 11 \).

3. Find and sketch the domain of \( f(x, y) = \sqrt{1-x^2} - \sqrt{1-y^2} \).

4. Given \( f(x, y) = x^2 e^{-4y} \), find \( f_{xy} \).
5. Evaluate the limit or show that it does not exist: \( \lim_{(x,y) \to (0,0)} \frac{e^{-x^2-y^2} - 1}{x^2 + y^2} \).

6. Find the linearization of \( f(x, y) = x\sqrt{y} \) at \((1, 4)\).

7. If \( w = f(x, y, z, t) \) and \( x = x(u, v), \ y = y(u, v), \ z = z(u, v), \ t = t(u, v) \) write out the multivariate chain rule for \( \frac{\partial w}{\partial v} \).
8. Find all points at which the direction of fastest change of
   \[ f(x, y) = x^2 + y^2 - 2x - 4y \text{ is } i + j \]

9. Suppose that (0,0) and (1,0) are critical points of a function \( f \) where
   \[ f_{xx}(0,0) = 2, f_{xx}(1,0) = -3, f_{yy}(0,0) = 2, f_{yy}(1,0) = 5, f_{xy}(0,0) = 0, f_{xy}(1,0) = 7. \]
   Show whether \( f(0,0) \) and \( f(1,0) \) are local max, local min, or saddle points.

10. Find the shortest distance from (2, 1, -1) to \( x + y - z = 1 \).