1. Find the angle between the diagonal of a cube and one of the edges.

2. Consider the following two straight lines:
   
   \( l \) : passes through the point \((1, 1, 0)\) and has direction vector \( \vec{d} = 3\vec{k} \).
   
   \( L \) : passes through the origin and has direction vector \( \vec{D} = \vec{i} + \vec{j} + 6\vec{k} \).
   
   (a) Find the point where they intersect.

   Let \( P \) denote the plane that contains both \( l \) and \( L \).
   
   (b) Find a normal vector for \( P \).
   
   (c) Find an equation for \( P \).
   
   (d) Find \( \cos \theta \) where \( \theta \) is the angle between \( l \) and \( L \). (Don’t worry about whether \( \theta \) is acute or not).

3. (a) Find \( \vec{r}(t) \), given that \( \vec{r}'(t) = \vec{a} + t\vec{b}, \vec{r}'(0) = \vec{c} \), and \( \vec{r}(0) = \vec{d} \).

   (b) Given that \( \vec{r}(t) = (t + 1)\vec{i} + (t^2 + 1)\vec{j} + (t^3 + 1)\vec{k} \), find the tangent vector \( \vec{r}'(t) \) at the point \((1, 1, 1)\) and parametrize the tangent line through this point.

4. A particle travels along a curve parameterized by \( \vec{r}(t) = t\vec{i} + \cos(t)\vec{j} + \sin(t)\vec{k} \). Compute the following:
   
   (a) the velocity of the particle
   
   (b) the acceleration of the particle
   
   (c) the speed of the particle
   
   (d) the unit tangent vector \( \vec{T}(t) \)
   
   (e) the principle unit normal vector \( \vec{N}(t) \)
   
   (f) the length of the curve from \((0, 1, 0)\) to \((2\pi, 1, 0)\)

5. The following two surfaces intersect in a space curve \( C \). Determine the projection of \( C \) onto the \( xy \) plane.
   
   The cone \( x^2 + y^2 = z^2 \) the plane \( y + 2z = 2 \).

6. (a) Consider a real valued function \( f(x, y) \). State the definition of the partial derivative of \( f \) with respect to \( y \).

   (b) Use the above definition to compute \( f_y(x, y) \) when \( f(x, y) = x^2 + 2xy + 3y^2 \).

   (c) Calculate all the first partial derivatives of \( g \) where \( g(u, v, w) = ln(u^2 + vw - w^2) \).