Exercise 1 Find a vector-valued function representing the intersection of the cylinder \( x^2 + y^2 = 1 \) and the plane \( y + z = 2 \).

Exercise 2 Find the derivative of \( r(t) = (1 + t^3)\vec{i} + te^{-t}\vec{j} + \sin 2t\vec{k} \). Find the unit tangent vector at the point of parameter \( t = 0 \).

Exercise 3 Show that the curve with parametric equations \( x = t \cos t, y = t \sin t, z = t \) lies on the cone \( x^2 + y^2 = z^2 \).

Exercise 4 Two particles travel along the space curves
\[
r(t) = (t, t^2, t^3) \quad s(t) = (1 + 2t, 1 + 6t, 1 + 14t).
\]
Do the particles collide? Do their paths intersect?

Exercise 5 Reparametrize the curve \( r(t) = (\cos t, \sin t, t^2) \) with respect to arc length. Same question with the curve \( (e^t, e^t \sin t, e^t \cos t) \).

Exercise 6 Find the point of intersection of the curves \( (\cos t, \sin t, t) \) and \( (1 + t, t^2, t^3) \) and compute the angle of intersection.

Exercise 7 Let \( \gamma : I \to \mathbb{R}^3 \) be the parametrization of a space curve \( \Gamma := \gamma(I) \). We say that \( x \in \Gamma \) is a double point when there exists \( t_1 \neq t_2 \) such that \( \gamma(t_1) = \gamma(t_2) = x \) (but \( x \) has no other pre-image, otherwise it would be a triple, quadruple, \( k \)-uple... point).

1. If \( \Gamma \) admits a double point, does it imply that the tangent vector must be zero somewhere?

2. Define a curve which has an infinite number of double points.

3. If the tangent lines are not colinear, the double point is said to be ordinary. Find an example of an ordinary double point, and of a not-ordinary one.

4. Find an example of an ordinary \( k \)-uple point.

5. (***) If \( \gamma \) is continuous, show that there are at most a countable number of double points.