1. For each curve in \( z \) and \( x \), give the equation and sketch if the curve is rotated about the \( z \)-axis.

a) \( z = x \)  

b) \( z = x^2 \)  

c) \( z^2 = 1 + x^2 \)

If \( x \) is replaced \( \frac{x}{a} \) and \( y \) is replaced \( \frac{y}{b} \), how is the surface changed?

2. Which quadric surface is not the result of rotating a curve about an axis and distorting?

For \( z = x^2 - y^2 \), identify cross sections in the planes \( x=1, y=1, \) and \( z=1. \)

3. Identify each quadric surface by name and identify cross sections parallel to the coordinate planes.

a) \( 4y^2 + 9z^2 + 1 = x \)  

b) \( 4x^2 - 9z^2 + y^2 = 1 \)  

c) \( y^2 = 25x^2 + 36z^2 + 1 \)

d) \( 3x^2 + 3y^2 - 6x - 12y = z \)  

e) \( 3z^2 = x^2 + y^2 \)

4. Find the center and radius of each sphere and sketch it.

a) \( x^2 + y^2 + z^2 + 4x - 6y + 8z = 54 \)  

b) \( x^2 + y^2 + z^2 = 2z \)

5. Identify the quadric surface containing the curve with the given vector function and sketch the curve.

a) \( \vec{r}(t) = t \cos t \vec{i} + t \sin t \vec{j} + t^2 \vec{k} \quad 0 \leq t \leq \pi \)

b) \( \vec{r}(t) = t \sin t \vec{i} + t \cos t \vec{j} + t \vec{k} \quad 0 \leq t \leq \pi \)

c) \( \vec{r}(t) = 3e^t \cos t \vec{i} + 2e^t \sin t \vec{j} + e^{2t} \vec{k} \quad 0 \leq t \leq \pi \)

6. Find parametric equations of the tangent line to the given curve at the given point.

a) \( \vec{r}(t) = \cos(5t) \vec{i} + 3e^{2t} \vec{j} + 4e^{-3t} \vec{k} \quad -\frac{\pi}{2} \leq t \leq \frac{\pi}{2} \) at \( (1,3,4) \)

b) \( x = \sin(\pi t) \quad y = \sqrt{t} \quad z = \cos(\pi t) \quad 0 \leq t \leq 1 \) at \( \left( \frac{\sqrt{2}}{2}, \frac{1}{2}, \frac{\sqrt{2}}{2} \right) \)
7. Find the smaller angle of intersection of the curves with vector equations,

\[ \vec{r}_1(t) = \langle t, 1-t, 3+t^2 \rangle \quad \vec{r}_2(s) = \langle 3-s, s-2, s^2 \rangle \]

8. Find the length of the curve with vector equation:

a) \[ \vec{r}(t) = \left\langle e^t, e^t \sin(2t), e^t \cos(2t) \right\rangle \quad \text{for} \quad 0 \leq t \leq \pi \]

b) \[ \vec{r}(t) = \left\langle t^2, 2t, \ln(t) \right\rangle \]

9. a) For the curve in problem 8a,

find \( T(t) \) and \( N(t) \). Find \( T(0), N(0), B(0) \) and \( \kappa(0) \).

b) For the curve in 8b, find \( T(t) \) and \( N(t) \).

10. Find the velocity, speed and acceleration of a particle traveling along the path with vector equation

\[ \left\langle e^t, 2t, e^{-t} \right\rangle \] cm for \( t \) in seconds.

11. Sketch each region and label as instructed.

a) The region is bounded by \( y + z = 4, z = 0 \) and \( x^2 + y^2 = 1 \). Label 4 points on the intersection.

b) The region is inside the sphere \( x^2 + y^2 + z^2 = 24 \) and inside \( 2z = x^2 + y^2 \). Describe the intersection in words.