1. Consider the line \( L \) in the plane given by the equation \( 2x + 5y + 10 = 0 \). Find a base \( \{U, V\} \) with \( U \) parallel to \( L \), and \( V \) counterclockwise to \( U \). Find the equation of the line in coordinates \( \{u, v\} \) relative to the base \( \{U, V\} \).

2. An ellipse has center at the point \((2,1)\), and its major axis is the line \( x + y = 3 \). Its major radius is 3 and its minor radius is 1. What is the equation of the ellipse?

3. Show that the intersection of a plane with a sphere is a circle.

4. Consider the set of all points \( P \) in space such that the vector from \( O \) to \( P \) has length 2 and makes an angle of 45 degrees with \( I + J \).
   a) What kind of geometric object is this set?
   b) Give equations in cartesian coordinates for this set.

5. Write down the equations of the paraboloid of revolution \( z = x^2 + y^2 \) in cylindrical and spherical coordinates.

6. a) Draw some typical level curves in the \((x,y)\)-plane for the function \( f(x,y) = (1 + x^2 + y^2)^{-1} \).
   b) Sketch the surface \( z = f(x,y) \).

7. Let \( L \) be the line \( x = 1, \ z = 3y \). If we rotate the line about the \( z \)-axis, it describes a surface. Find the equation of that surface.

8. Consider the helix \( \mathbf{X}(t) = \cos t \mathbf{I} + \sin t \mathbf{J} + t \mathbf{K} \). For each \( t \), let \( L_t \) be the line perpendicular to the \( z \)-axis intersecting the helix at \( \mathbf{X}(t) \). Find the equation of the surface swept out by the lines \( L_t \). What are its level sets?

9. Sketch or describe the surface given by the equation \( \frac{y^2}{4} - \frac{z^2}{9} = x^2 \).

10. Sketch or describe the surface given by the equation \( \frac{x^2}{9} + \frac{z^2}{4} = y \).