1. Evaluate the path integral \( \int_C f \, ds \) where \( f = x + xy \) and the path \( C \) is
   (a) a straight line from \((0, 0)\) to \((3, 6)\)
   (b) the curve resulting from the intersection of the cone \( z = 3 \sqrt{x^2 + y^2} \) and the sphere \( x^2 + y^2 + z^2 = 10 \). Assume the curve is oriented anticlockwise.

2. Parameterize the following surfaces. In each case do a simple sketch of the surface.
   (a) A cylinder of radius 4, with axis coinciding with the \( y \) axis, starting at \( y = -2 \) ending at \( y = 2 \). Hint: Use trigonometric parameters.
   (b) The part of a cone \( x = \sqrt{y^2 + z^2} \), starting at \( x = 0 \) ending at \( x = 4 \) and with \( z \geq 0 \).

3. Calculate the area of the surface \( \Phi(\rho, \theta) \) (a “spiral ramp”) parameterised by
   \[
   x = 4 \rho \cos(\theta), \quad y = 4 \rho \sin(\theta), \quad z = \theta
   \]
   for \( 0 \leq \rho \leq 2 \) and \( 0 \leq \theta \leq \pi/2 \).

4. Let \( S \) be the surface of the solid region formed from the intersection of the solid region underneath the cone \( z = 2 - 3 \sqrt{x^2 + y^2} \) and above the region above the plane \( z = 0 \).
   (a) Sketch the surface showing an example of an outward normal on each part of the surface.
   (b) Find the outward normals to the surface \( S \).
   (c) Evaluate the integral
   \[
   \iint_S F \cdot dS
   \]
   where \( F = (x, y, 0) \). Take the normal pointing outwards from \( S \).

Note: Full working must be shown in your solutions. Marks will be deducted for incomplete working.