1. Sketch the region of integration and evaluate the following integral by switching to polar coordinates.

\[ \int_{1}^{2} \int_{-\sqrt{2y-y^2}}^{0} \frac{y}{x^2+y^2} \, dx \, dy \]

Potentially helpful information: \( \cos^2 x = \frac{1}{2} (1 + \cos 2x) \) \( \sin^2 x = \frac{1}{2} (1 - \cos 2x) \)

2. The density of pollen particles is given by \( \rho(x, y) = 72(x+y)e^{x^2-y^2} \text{ g/cm}^2 \). By making an appropriate change of variables, determine the mass of pollen contained in the rectangle, \( R \), enclosed by the lines \( x-y = 0, x-y = 2, x+y = 3, x+y = 6 \).

3. Consider the region \( W \) below the fourth quadrant and inside the sphere \( x^2 + y^2 + z^2 = 36 \) between the planes \( z = -3 \) and \( z = -3\sqrt{3} \). We want to find \( B = \iiint_{W} xyz \, dV \).

   (a) Set up, but DO NOT EVALUATE the integral(s) necessary to compute \( B \) in rectangular/Cartesian coordinates using the order \( dz \, dy \, dx \).

   (b) Set up, but DO NOT EVALUATE the integral(s) necessary to compute \( B \) in cylindrical coordinates using the order \( dr \, dz \, d\theta \).

   (c) Set up, but DO NOT EVALUATE the integral(s) necessary to compute \( B \) in spherical coordinates using the order \( d\rho \, d\phi \, d\theta \).

4. Evaluate \( \iint_{S} 48\sqrt{3} \, yz \, dS \) where \( S \) is the portion of the surface \( \sqrt{3}x = y + 2z^2 \) with \( -\sqrt{3}/2 \leq y \leq 0, -y \leq z \leq \sqrt{3}/2 \).

5. The electric charge \( q \) at a point \( (x, y, z) \) in space is equal to the square of the distance from the point to the origin. Find the average value of the charge on a wire that lies along the curve \( C = (\sin(\pi t^2), \sqrt{3}\pi t^2, \cos(\pi t^2)) \), \( t > 0 \) between the points \( (0, \sqrt{3}\pi, -1) \) and \( (0, 4\sqrt{3}\pi, 1) \).