1. Evaluate \( \iint_{R} ye^{-xy} \, dA \) where \( R = [0,2] \times [0,3] \) by hand, then check your answer using mathematica. To enter a double integral using Mathematica, use \( \text{NIntegrate}[f[x], \{x, x_{\text{min}}, x_{\text{max}}\}, \{y, y_{\text{min}}, y_{\text{max}}\}] \). The latter operation would first integrate with respect to \( y \), then \( x \). The range of the outermost integration variable appears first.

2. Graph the solid that lies between the surface \( z = \frac{2xy}{x^2+1} \) and the plane \( z = x + 2y \) and is bounded by the planes \( x = 0, x = 2, y = 0, \) and \( y = 4 \). Then find its volume.

3. Graph the solid that lies between the surfaces \( z = e^{-x^2} \cos(x^2+y^2) \) and \( z = 2 - x^2 - y^2 \) for \( |x| \leq 1, |y| \leq 1 \). Use Mathematica to approximate the volume of this solid correct to 3 decimal places.

4. Use Mathematica to find the exact volume of the solid under the surface \( z = x^2y^4 + xy^2 \) and above the region bounded by the curves \( y = x^3 - x \) and \( y = x^2 + x \) for \( x \geq 0 \). Use \( \text{Integrate}[f[x,y], \{x, x_{1}, x_{2}\}, \{y, y_{1}[x], y_{2}[x]\}] \)

5. Graph the solid bounded by the planet \( x + y + z = 1 \) and the paraboloid \( z = 4 - x^2 - y^2 \) and find its exact volume. HINT: Solve for \( z \) in each equation, set them equal to each other, and derive the curve in \( \mathbb{R}^2 \). The latter is the boundary of the region over which the integration must take place. Be sure to include the 3D plot of the region in question in your final report.

6. Use Mathematica to find the exact area of the surface \( z = 1 + x + y + x^2 \) \( \quad -2 \leq x \leq 1 \quad -1 \leq y \leq 1 \) Illustrate by graphing the surface.

7. Let\( E \) by the solid in the first octant bounded by the cylinder \( x^2 + y^2 = 1 \) and the planes \( y = z, x = 0, \) and \( z = 0 \) with the density function \( \rho(x,y,z) = 1 + x + y + z \). Use Mathematica to find the exact value of the mass, center of mass, and the moment of inertia about the z-axis.