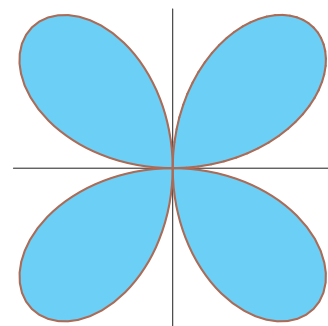
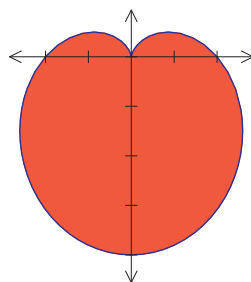


1. Evaluate the following improper integrals.

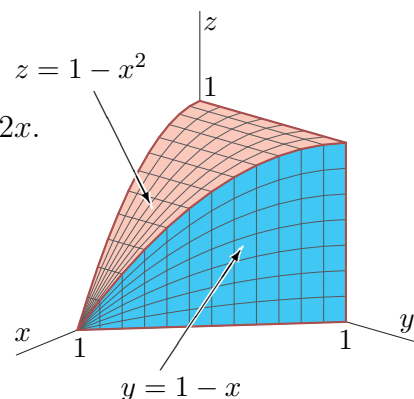
$$(a) \int_{-\infty}^{\infty} x^2 e^{-x^2} dx \quad \text{and} \quad (b) \int_{-\infty}^{\infty} \sqrt{x} e^{-x} dx.$$

2. Electric charge is distributed over the disk $x^2 + y^2 \leq 2$ with charge density $\sigma(x, y) = 1 + x^2 + y^2$. Find the total charge on the disk.
3. A lamina (thin sheet of material) occupies the region inside the circle $x^2 + y^2 = 2y$ but outside the unit circle $x^2 + y^2 = 1$. Find its center of mass if the density at any point is inversely proportional to its distance to the origin.
4. A lamina has shape that part of the disk $x^2 + y^2 \leq 4$ that lies in the first quadrant. Suppose that its mass density is proportional to the square of the distance to the origin, $\rho(x, y) = k(x^2 + y^2)$. Find its center of mass.
5. Suppose that a lamina is in the shape of the rectangle $D = \{(x, y) \mid 0 \leq x \leq 2, 0 \leq y \leq 3\}$ with mass density $\rho(x, y) = \pi y$. Find its center of mass.
6. Find the three moments of inertial I_x , I_y , and I_0 of the lamina from each of the previous two problems.
7. Suppose that a lamina is in the shape of the cardioid $r = 2 - 2\sin(\theta)$ with constant mass density. Find its centroid and three moments of inertial I_x , I_y , and I_0 .
8. Repeat the previous exercise, but for area in the region in the plane enclosed by the four-leaved rose $r = 2\sin(2\theta)$. (Use symmetry to reduce your workload.)
9. Repeat the previous exercise, but for the full area enclosed by the four-leaved rose $r = 2\sin(2\theta)$.



10. Evaluate the iterated integral $\int_0^3 \int_0^{\sqrt{9-x^2}} \int_0^x yz \, dy \, dz \, dx$.
11. Compute $\iiint_E xy \, dV$ where E is the tetrahedron with vertices $(0, 0, 0)$, $(3, 0, 0)$, $(0, 2, 0)$, $(0, 0, 1)$.
12. Compute $\iiint_E xy \, dV$ where E is the solid bounded by the parabolic cylinder $y = x^2$ and the planes $x = z$, $x = y$, and $z = 0$.
13. Express $\iiint_E f(x, y, z) \, dV$ as an iterated integral in six different ways, where E is the solid bounded by $z = 0$, $x = 0$, $y = 2$, and $z = y - 2x$.
14. The figure shows the region of integration for the integral

$$\int_0^1 \int_0^{1-x^2} \int_0^{1-x} f(x, y, z) \, dy \, dz \, dx.$$



Rewrite this as an equivalent iterated integral in the five other ways.