1. Find the volume of each region or type of solid.

(a) the region bounded by the paraboloid \( z = x^2 + y^2 \) and the cone \( z = 2 - \sqrt{x^2 + y^2} \)
(b) the region below the surface \( z = xy + 10 \) and above the annular region \( R = \{(x, y) : 4 \leq x^2 + y^2 \leq 16\} \)
(c) the region inside both the cone \( \varphi = \frac{\pi}{6} \) and the sphere \( \rho = 4 \)
(d) a spherical cap of radius \( R \) and height \( H \)
(e) the solid obtained from a sphere centered at the origin with radius 2 after a cylindrical hole of radius 1 is drilled through the center of the sphere perpendicular to its base
(f) the solid bounded by the cylinder \( x^2 + y^2 = 1 \), the \( xy \)-plane, and the plane \( z = x + y \)

2. Let \( D_1 \) be the disk in the \( xy \)-plane centered at the origin with radius 2. Let \( D_2 \) be the disk in the \( xy \)-plane centered at \((2,0)\) with radius 2. Suppose \( g(x, y) \) is continuous for all \( x \) and \( y \). Write an iterated integral in polar coordinates for \( \iint_{R} g(x, y) \, dA \), where \( R \) is...

(a) ...the region outside \( D_1 \) and inside \( D_2 \).
(b) ...the region inside both \( D_1 \) and \( D_2 \).

3. Calculate \( \int_{0}^{3} \int_{0}^{y} x \, dx \, dy \) by changing to polar coordinates.

4. Calculate \( \int_{0}^{3} \int_{-\sqrt{9-y^2}}^{\sqrt{9-y^2}} \int_{0}^{9-3\sqrt{x^2+y^2}} dz \, dx \, dy \) by changing to cylindrical coordinates.

5. Let \( W \) be the solid region bounded above by the plane \( z = 5 \) and bounded below by the cone \( z^2 = x^2 + y^2 \). Use spherical coordinates to calculate \( \iiint_{W} \sqrt{x^2 + y^2 + z^2} \, dV \).

6. Let \( W \) be the region within the cylinder \( x^2 + y^2 = 2 \) between the \( xy \)-plane and the cone \( z = \sqrt{x^2 + y^2} \). Calculate the integral of \( f(x, y) = x^2 + y^2 \) over \( W \) using...

(a) ...rectangular coordinates.
(b) ...cylindrical coordinates.
(c) ...spherical coordinates.

Which of these do you think is easiest?