1. Find the volume of the tetrahedron trapped in the first octant beneath the plane $6x + 4y + 3z = 12$.

2. Set up and evaluate the following integrals:

   (a) $\iint_R 4\ dA$ where $R$ is the region trapped between $y = -x^2 + 9$ and $x - y + 3 = 0$.

   (b) $\iint_S 3\ dA$, where $S$ is the triangle with vertices $(0, 0)$, $(3, 4)$, and $(5, 0)$.

3. Rewrite the following iterated integrals by reversing the order of integration.

(a) $\int_0^1 \int_{x^3}^{\sqrt{x}} dy\ dx.$

(b) $\int_{-2}^0 \int_{2y+4}^{4-y^2} dx\ dy.$

4. Integration using polar coordinates:

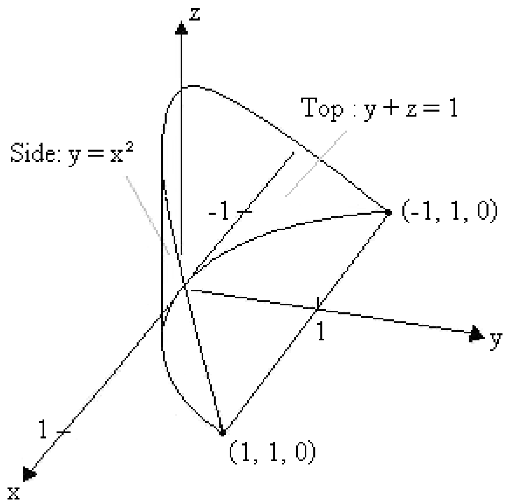
(a) Evaluate $\iint_S e^{x^2+y^2}\, dA$ where $S$ is the region between the concentric circles $x^2 + y^2 = 16$ and $x^2 + y^2 = 49$.

(b) Evaluate $\iint_S \frac{x}{x^2+y^2}\, dA$ where $S$ is the region outside the cardioid $r = 1 + \cos\theta$ and inside the circle $x^2 + \left(y - \frac{\sqrt{3}}{2}\right)^2 = \frac{3}{4}$.

5. Evaluate $\int_0^{84} \int_{y/36-7/3}^{0} e^{(3x+7)^2}\, dx\, dy$. (Suggestion: Change the order of integration).

6. Find the surface area of the paraboloid $z = 3 + x^2 + y^2$ that is cut off by the plane $z = 7$.

7. Consider the figure in the following drawing.




(a) Setup a triple integral for the volume of the region in the order $dz\ dy\ dx$.

(b) Setup a triple integral for the volume of the region in the order $dy\ dz\ dx$.

(c) Setup a triple integral for the volume of the region in the order $dx\ dz\ dy$.

8. Evaluate the following line integrals.

(a) $\int_C (x^2 + 2y)\ ds$, where $C$ is the L-shaped curve from $(0,0)$, to $(1,0)$, to $(1,1)$.

(b) $\int_C \left[\left(xy^2 + x^2\right)\ dx + \left(x^2 y + y^2\right)\ dy\right]$, where $C$ is a zig-zag-shaped curve from $(1,2)$, to $(2,3)$, to $(0,4)$, to $(1,5)$.

(c) $\int_C \left[-\frac{y^3}{3}\ dx + \frac{x^3}{3}\ dy\right]$, where $C$ is the boundary of the top half of the circle of $x^2 + y^2 = 25$. Assume the orientation is counterclockwise.

(d) $\int_C \left[ \left(6xy^3 + 2z^2\right) \ dx + 9x^2y^2 \ dy + (4xz + 1) \ dz \right]$, where $C$ is the path from $(0, 1, 0)$ to $(1, -1, 1)$ to $(2, 2, 2)$ to $(3, 4, 0)$ to $(3, 1, 0)$.

9. Find the work done by the force field

$$\mathbf{F} = \left\langle \frac{\cos\left(\ln(x - y + 1)\right)}{x - y + 1} + 2x \sin x^2, \frac{-\cos\left(\ln(x - y + 1)\right)}{x - y + 1} + 3y^2 e^{y^3} \right\rangle$$

to move an object counterclockwise around the boundary of the region in the first quadrant lying between the curves $y = x^2$ and $y = \sqrt{x}$.

10. Let $S$ be the tetrahedron trapped in the first quadrant beneath the plane $2x + 2y + z = 6$, and let $\mathbf{F} = x\mathbf{i} + y^2\mathbf{j} + z\mathbf{k}$. Find $\iint_{\partial S} \mathbf{F} \cdot \mathbf{n}\, dS$.

11. Let $S$ be the surface $z = x^2 + y^2 + 3$ that is cut off by the plane $z = 7$. Let $\mathbf{F} = -y\mathbf{i} + x\mathbf{j} + xyz^4\mathbf{k}$. Compute the surface integral $\iint_S (\nabla \times \mathbf{F}) \cdot \mathbf{n}\, dS$.