1. Evaluate the area of the part of the surface $z = xy$ that lies within the cylinder $x^2 + y^2 = 1$.

2. Find the extreme values of $f(x, y) = 4x + 2y + 1$ on the disc $x^2 + y^2 \leq 1$.

3. Let $D$ be the region that lies inside the circle $x^2 + y^2 = 2y$ but lies outside the circle $x^2 + y^2 = 1$. Now regard $D$ as a lamina, and suppose that the density function is given by $\rho(x, y) = \frac{1}{\sqrt{x^2 + y^2}}$. Find the mass of $D$.

4. There is a solid $E$ whose projection on the $xy$-pane is the disc $x^2 + y^2 \leq 1$. Suppose that the area of the cross-section of $E$ in the plane that is parallel to the $xz$-plane and passes through the point $(0, y, 0)$ is given by $A(y) = y^2$. Find the volume of $E$. 
5. (No partial credit) Consider the following vector fields. Answer your questions but there is no need for explanation.

(1) (2 points) Which picture represents the vector field $\langle \sin(2x), 0 \rangle$?

(2) (2 points) Which picture represents the vector field $\langle y, 1 \rangle$?

(3) (3 points) Which picture represents the vector field $\langle y, x \rangle$?

(4) (3 points) Which picture represents the gradient field of $f(x, y) = x^2 + y^2$?
6. Let $E$ be the solid region that lies above the $xy$-plane, below the surface $z = \sqrt{x^2 + y^2}$, and inside the sphere $x^2 + y^2 + z^2 = 9$. Find the volume of $E$.

7. Let $E$ be the solid region bounded by the planes $y = 0$, $x = 0$, $z = 1$, and $x + y - z = 0$. Evaluate the integral

$$\iiint_E x \, dV.$$