1. Find the work done by the vector field $\mathbf{F} = y\mathbf{i} - x\mathbf{j}$ along the boundary of the hemisphere $x^2 + y^2 + z^2 = 9$, $z \geq 0$, oriented counterclockwise, in two ways: First, compute the line integral directly, then, use Stoke's theorem.

2. Find the circulation of the field $\mathbf{F} = \begin{pmatrix} x^2 - y \\ 4z \\ x^2 \end{pmatrix}$ around the curve C in which the plane $z = 2$ meets the cone $z = \sqrt{x^2 + y^2}$, counterclockwise as viewed from above.

3. Evaluate $\oint_C \mathbf{F} \cdot d\mathbf{s}$ if $\mathbf{F} = \begin{pmatrix} xz \\ xy \\ 3xz \end{pmatrix}$ and C is the boundary of the portion of the plane $2x+y+z = 2$ in the first octant, traversed counterclockwise when viewed from above.

4. Calculate the work done by the vector field $\mathbf{F} = (y^2 + z^2)\mathbf{i} + (x^2 + y^2)\mathbf{j} + (x^2 + y^2)\mathbf{k}$ over the curve C which is the boundary of the square formed by the lines $x = \pm 1$, $y = \pm 1$, traversed counterclockwise when viewed from above.

5. Let $\mathbf{F} = \begin{pmatrix} y \\ x^2 \\ (x^2 + y^2)^{3/2} \sin e^{\sqrt{xyz}} \end{pmatrix}$. Find the outward flux of $\nabla \times \mathbf{F}$ over the elliptical surface Σ defined by $4x^2 + 9y^2 + 36z^2 = 36$, $z \geq 0$.

6. Let $f(x, y, z) = (x^2 + y^2 + z^2)^{-1/2}$. Show that the clockwise circulation of the field $\mathbf{F} = \nabla f$ around the circle $x^2 + y^2 = a^2$ in the xy-plane is zero by applying Stokes' Theorem.

7. Find the outward flux of $\mathbf{F} = x^2\mathbf{j} - xz\mathbf{k}$ through the surface cut out from the parabolic cylinder $y = x^2$, $-1 \leq x \leq 1$, by the planes $z = 0$ and $z = 2$.

8. Find the outward flux of $\mathbf{F} = xy\mathbf{i} - z\mathbf{k}$ through the closed cone $z = \sqrt{x^2 + y^2}$, $0 \leq z \leq 1$, that is, the union of the cone and a disk in the plane $z = 1$. Then find the flux through the open cone (that is, the one without the disk on top).