A. Let S be the closed surface consisting of the part of the paraboloid $y = x^2 + z^2$ where $0 \leq y \leq 1$ and the part of the plane $y = 1$ where $x^2 + y^2 \leq 1$. Find the flux of $\mathbf{F} = \langle 0, y, z \rangle$ through S (oriented outwards).

B. Let S be the helicoid given by $\mathbf{r}(u, v) = \langle u \cos v, u \sin v, v \rangle$, $0 \leq u \leq 1$, $0 \leq v \leq \pi$. Assuming mass density function $\sqrt{1 + x^2 + y^2}$, find the total mass of the helicoid.

C. Let S be the surface obtained by rotating the curve $\langle t, 1 + t^2, 0 \rangle$, $-1 \leq t \leq 1$, around the x-axis. Find the flux of $\mathbf{F} = \langle 0, z, -y \rangle$ through S.

D. Find the flux of $\mathbf{F} = \langle x, y, z/2 \rangle$ trough the ellipsoid $x^2 + y^2 + (z/2)^2 = 1$. Hint: parameterize the ellipsoid using *something like* spherical coordinates.

E. Use Stokes' Theorem to compute the line integral of $\mathbf{F} = \langle y, -x, 0 \rangle$ along the curve which is the intersection of $z = x^2 - y^2$ and $x^2 + y^2 = 1$.

F. Find the center of mass of the hemispherical shell $z = \sqrt{1 - x^2 - y^2}$ assuming it has constant density.