Math 211 Surface Integrals Practice

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

2. Calculate the surface integral $\iint_S z^2 dS$ where S is the boundary of the part of the sphere $x^2 + y^2 + z^2 = 4$ that lies on or above the plane $z = 1$.

3. Calculate the surface integral $\iint_S \mathbf{F} \cdot d\mathbf{S}$ where $\mathbf{F}(x, y, z) = \langle -y, x, 0 \rangle$ and S is the surface with parameterization $\mathbf{r}(u, v) = \langle u, v^2 - u, u + v \rangle$, $0 \leq u \leq 3, 0 \leq v \leq 4$.