

S.P. 2-L

For $\mathbf{A}(\mathbf{r}) = r \hat{\mathbf{a}}_r + \hat{\mathbf{a}}_\theta + r \cos \phi \hat{\mathbf{a}}_\phi$, find the value of $\oint_S \mathbf{A} \cdot d\mathbf{s}$ over the 3-D “Pac-Man” surface shown below, which is a unit sphere, minus the 45° “mouth” the top. The volume enclosed by S includes all points $0 \leq r \leq 1$, $\frac{\pi}{4} \leq \theta \leq \pi$, $0 \leq \phi \leq 2\pi$. Find the value of this flux integral by:

- Evaluating the surface integral directly
- Use of the divergence theorem

