20.2: The Divergence Theorem

Calculus III

College of the Atlantic. Winter 2016

1. Consider the vector field $\vec{F} = z^2\hat{k}$. Calculate the total flux out of a cube of side c, centered at the point $(1, 2, 3)$. Do this two ways:

   (a) By evaluating the flux integrals directly.

   (b) By using the divergence theorem.

2. Consider the vector field $\vec{F} = \vec{r}$. Calculate the total flux out of a cylinder of radius 3, centered on the z axis, between the xy plane and the plane at $z = 4$. Do this two ways:

   (a) By evaluating the flux integrals directly.

   (b) By using the divergence theorem.

3. Consider the electric field $\vec{E} = \vec{r}/r^3$. We have seen that $\nabla \cdot \vec{E} = 0, r \neq 0$.

   (a) Directly calculate the flux flowing out of a sphere of radius a centered at the origin.

   (b) Can we use the divergence theorem to evaluate the flux integral? Why or why not?