

Electromagnetic Theory: Homework 7

Due: 13 September 2019

1 Divergence and curl in spherical coordinates

Let

$$\mathbf{v} = 2\hat{\mathbf{r}} + 2\hat{\boldsymbol{\theta}}$$

in spherical coordinates.

- a) Determine the divergence of \mathbf{v} .
- b) Determine the curl of \mathbf{v} .
- c) Is the sketch of \mathbf{v} in the yz -plane consistent with your results?

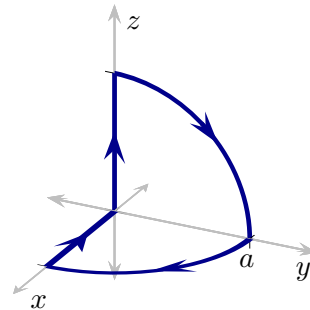
2 Stoke's theorem in spherical coordinates

Let

$$\mathbf{v} := 2ar\hat{\boldsymbol{\theta}} + r^2\hat{\boldsymbol{\phi}}$$

where $a > 0$ is a constant.

- a) Determine $\oint \mathbf{v} \cdot d\mathbf{l}$ along the illustrated curve.
- b) Verify Stoke's theorem for this example.



3 Divergence theorem in spherical coordinates

Let

$$\mathbf{v} := r \cos \theta \hat{\mathbf{r}} - r \sin \theta \hat{\boldsymbol{\theta}} + r \cos \phi \hat{\boldsymbol{\phi}}$$

where $a > 0$ is a constant. Consider the conical section of a sphere of radius a as illustrated. The angle from the z axis to the conical section is $\pi/6$ and the top of the conical section is a portion of a sphere of radius a .

- a) Determine $\oint \mathbf{v} \cdot d\mathbf{a}$ across the surface.
- b) Verify the divergence theorem for this example.

