

Problem 3.33 Transform the vector

$$\mathbf{A} = \hat{\mathbf{R}} \sin^2 \theta \cos \phi + \hat{\boldsymbol{\theta}} \cos^2 \phi - \hat{\boldsymbol{\phi}} \sin \phi$$

into cylindrical coordinates and then evaluate it at $P = (2, \pi/2, \pi/2)$.

Solution: From Table 3-2,

$$\begin{aligned} \mathbf{A} &= (\hat{\mathbf{r}} \sin \theta + \hat{\mathbf{z}} \cos \theta) \sin^2 \theta \cos \phi + (\hat{\mathbf{r}} \cos \theta - \hat{\mathbf{z}} \sin \theta) \cos^2 \phi - \hat{\boldsymbol{\phi}} \sin \phi \\ &= \hat{\mathbf{r}} (\sin^3 \theta \cos \phi + \cos \theta \cos^2 \phi) - \hat{\boldsymbol{\phi}} \sin \phi + \hat{\mathbf{z}} (\cos \theta \sin^2 \theta \cos \phi - \sin \theta \cos^2 \phi) \end{aligned}$$

At $P = (2, \pi/2, \pi/2)$,

$$\mathbf{A} = -\hat{\boldsymbol{\phi}}.$$
