Hinkle, Zachary | EM Griffiths | 4/16/18 | 1/1

1.42

$x = s\cos\phi$

$y = s\sin\phi$

$z = z$

$$\vec{r} = s\hat{s} + z\hat{z} = x\hat{\imath} + y\hat{\jmath} + z\hat{k} = s\cos\phi\,\hat{\imath} + s\sin\phi\,\hat{\jmath} + z\hat{k}$$

$$\vec{e}_s = \frac{\partial \vec{r}}{\partial s} = \hat{s}(\phi) = \cos\phi\,\hat{\imath} + \sin\phi\,\hat{\jmath}$$

$$\vec{e}_\theta = \frac{\partial \vec{r}}{\partial \phi} = s\frac{\partial \hat{s}}{\partial \phi} = -s\sin\phi\,\hat{\imath} + s\cos\phi\,\hat{\jmath}$$

$$\vec{e}_z = \frac{\partial \vec{r}}{\partial z} = \hat{z} = \hat{k}$$

$$\vec{e}_s \cdot \vec{e}_s = \hat{s}\cdot\hat{s} = \cos^2\phi + \sin^2\phi = 1$$

$$\vec{e}_\phi \cdot \vec{e}_\phi = s^2\left(\frac{\partial \hat{s}}{\partial \theta}\right)^2 = s^2\sin^2\phi + s^2\cos^2\phi = s^2$$

$$\vec{e}_z \cdot \vec{e}_z = \hat{z}\cdot\hat{z} = \hat{k}\cdot\hat{k} = 1$$

$\Rightarrow$

$$\hat{s} = \cos\phi\,\hat{\imath} + \sin\phi\,\hat{\jmath}$$

$$\hat{\phi} = -\sin\phi\,\hat{\jmath} + \cos\phi\,\hat{\jmath} = \frac{\partial \hat{e}_s}{\partial \phi}$$

$$\hat{z} = \hat{k}$$