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Del in Cylindrical Coordinates

Determine the del operator ∇ in cylindrical coordinates. There are several ways to do this, but a straightforward, though algebraically lengthy one, is to transform from Cartesian coordinates using

$$oldsymbol{
abla} = \hat{oldsymbol{x}} rac{\partial}{\partial x} + \hat{oldsymbol{y}} rac{\partial}{\partial y} + \hat{oldsymbol{z}} rac{\partial}{\partial z},$$

$$\hat{m{x}} = \cos\phi\hat{m{
ho}} - \sin\phi\hat{m{\phi}}, \qquad \hat{m{y}} = \sin\phi\hat{m{
ho}} + \cos\phi\hat{m{\phi}},$$

and

$$rac{\partial}{\partial x} = \cos\phirac{\partial}{\partial
ho} - rac{\sin\phi}{
ho}rac{\partial}{\partial\phi}, \qquad rac{\partial}{\partial y} = \sin\phirac{\partial}{\partial
ho} + rac{\cos\phi}{
ho}rac{\partial}{\partial\phi}.$$

✓ Completed

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