Question

Use the results that $\dot{\mathbf{e}}_r = \dot{\phi}\mathbf{e}_\phi$ and $\dot{\mathbf{e}}_\phi = -\dot{\phi}\mathbf{e}_r$ to show that in polar coordinates the time derivative of the position vector of a particle, $\mathbf{r} = r\mathbf{e}_r$, is $\dot{\mathbf{r}} = \dot{r}\mathbf{e}_r + r\dot{\phi}\mathbf{e}_\phi$

Answer

$\mathbf{v} = \dfrac{d}{dt}(r\mathbf{e}_r) = \dot{r}\mathbf{e}_r + r\dot{\mathbf{e}}_r = \dot{r}\mathbf{e}_r + r\dot{\phi}\mathbf{e}_\phi$