PH108 : Electricity & Magnetism

Weekly Quiz 2 - Use of Variable Unit Vectors

31 January, 2018

Answer

$\mathbf{r}$ = (R - vt)$\hat{r}$

$\mathbf{a}$ (+ $\omega^2\mathbf{r}$) = -2 ω v $\hat{\theta}$

Solution

$\mathbf{r}$ = (R - vt)$\hat{r}$ = (R - vt)(cos(ωt) $\hat{\imath}$ + sin(ωt) $\hat{\jmath}$)

$\implies \mathbf{v} = -v(cos(\omega t)\hat{\imath} + sin(\omega t)\hat{\jmath}) + (R - vt)(R - vt)(-sin(\omega t)\hat{\imath} + cos(\omega t)\hat{\jmath}) = -v\hat{r} + (R - vt)\hat{\theta}$

$\implies \mathbf{a} = -v\omega(-sin(\omega t)\hat{\imath}+cos(\omega t)\hat{\jmath})-v\omega(-sin(\omega t)\hat{\imath}+cos(\omega t)\hat{\jmath})+(R-vt)\omega^2(-cos(\omega t)\hat{\imath}-sin(\omega t)\hat{\jmath})$

$\implies \mathbf{a} + \omega^2\mathbf{r} = -2v\omega\hat{\theta}$