

$$x=r\cos\phi, \ y=r\sin\phi, \ \phi=\tan^{-1}(y/x), \ \dot{\vec{r}}=\dot{r}\hat{r}+r\dot{\phi}\hat{\phi}, \ \vec{a}=(\ddot{r}-r\dot{\phi}^2)\hat{r}+(r\ddot{\phi}+2\dot{r}\dot{\phi})\hat{\phi}$$