Massachusetts Institute of Technology
Department of Physics
Experimental Study Group

Physics 8.012 **Fall Term 2010**

Kinematics in Polar Coordinates

$$\vec{\boldsymbol{r}} = r\hat{\boldsymbol{r}} \qquad \vec{\boldsymbol{v}} = \dot{r}\hat{\boldsymbol{r}} + r\dot{\theta}\hat{\boldsymbol{\theta}} \qquad \vec{\boldsymbol{a}} = \left(\ddot{r} - r(\dot{\theta})^2\right)\hat{\boldsymbol{r}} + \left(2\dot{r}\dot{\theta} + r\ddot{\theta}\right)\hat{\boldsymbol{\theta}}$$

$$\vec{\boldsymbol{r}} = r\hat{\boldsymbol{r}} \qquad \vec{\boldsymbol{v}} = \frac{dr}{dt}\hat{\boldsymbol{r}} + r\frac{d\theta}{dt}\hat{\boldsymbol{\theta}} \qquad \vec{\boldsymbol{a}} = \left(\frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2\right)\hat{\boldsymbol{r}} + \left(2\frac{dr}{dt}\frac{d\theta}{dt} + r\frac{d^2\theta}{dt^2}\right)\hat{\boldsymbol{\theta}}$$