

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
Department of Physics  
Experimental Study Group

Physics 8.012

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Kinematics in Polar Coordinates

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

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