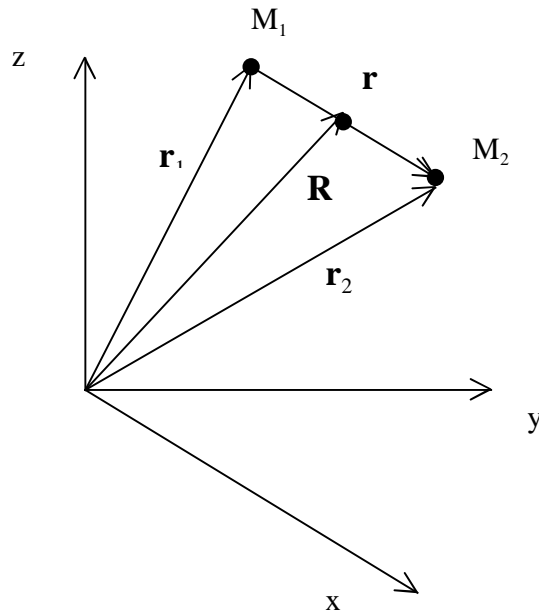


Separation of the Center-of-Mass



Define the center-of-mass

$$\mathbf{R} = (m_1\mathbf{r}_1 + m_2\mathbf{r}_2)/(m_1 + m_2)$$

and

$$\mathbf{R} = \mathbf{r}_2 - \mathbf{r}_1$$

$$T = \frac{1}{2}m_1(\dot{x}_1^2 + \dot{y}_1^2 + \dot{z}_1^2) + \frac{1}{2}m_2(\dot{x}_2^2 + \dot{y}_2^2 + \dot{z}_2^2)$$

For Homework: Rearrange to obtain \mathbf{r}_1 and \mathbf{r}_2 in terms of \mathbf{R} and \mathbf{r} and then show

$$T = \frac{1}{2}M(\dot{X}^2 + \dot{Y}^2 + \dot{Z}^2) + \frac{1}{2}\mu(\dot{x}^2 + \dot{y}^2 + \dot{z}^2)$$

where $M = m_1 + m_2$; $\frac{1}{\mu} = \frac{1}{m_1} + \frac{1}{m_2}$

and

$$\dot{\mathbf{R}} = \dot{X}\hat{x} + \dot{Y}\hat{y} + \dot{Z}\hat{z}$$

$$\dot{\mathbf{r}} = \dot{x}\hat{x} + \dot{y}\hat{y} + \dot{z}\hat{z},$$

where \hat{x} , \hat{y} , and \hat{z} are the usual unit vectors.