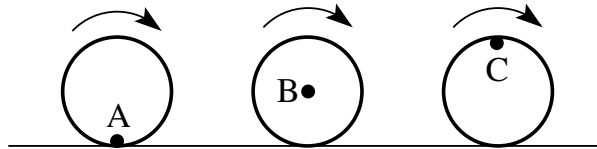


[mex173] Kinetic energy of rolling cylinder

A solid cylinder of mass m and radius a is rolling with angular velocity ω on a level surface. Calculate the translational, mixed, and rotational parts of the kinetic energy, $T = T_t + T_m + T_r$, from the general formula

$$T = \sum_{\alpha} \frac{1}{2} m_{\alpha} (\dot{\mathbf{R}} + \vec{\omega} \times \mathbf{r}_{\alpha})^2 = \frac{1}{2} \sum_{\alpha} m_{\alpha} \dot{\mathbf{R}}^2 + \sum_{\alpha} m_{\alpha} \dot{\mathbf{R}} \cdot \vec{\omega} \times \mathbf{r}_{\alpha} + \frac{1}{2} \sum_{\alpha} m_{\alpha} (\vec{\omega} \times \mathbf{r}_{\alpha})^2$$

by using three different body frames with origins at points A, B, C , respectively.



Solution: