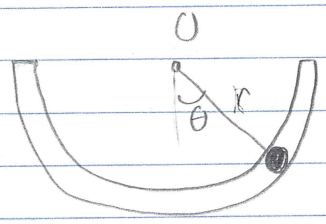
20-P-MOM-DY-42

A small particle is within a tube that is curved into a semicircle with a radius $r = 0.25\,m$. Determine the angular acceleration of the particle with respect to O when the angle $\theta = 30°$.



Solution: $\curvearrowleft + \sum M_O = \frac{dH_O}{dt}$ $\quad -mgr\sin\theta = \frac{d}{dt}(mvr)$

$g\sin\theta = a = \frac{dv}{dt} = \frac{d^2s}{dt}$ $\quad s = r\theta$ $\quad g\sin\theta = r\ddot{\theta}$

$mr^2\ddot{\theta} + \frac{d}{dt}mvr = 0$ $\quad r\ddot{\theta} + \frac{d}{dt}v = 0$ $\quad \frac{dv}{dt} = g\sin\theta$

$r\ddot{\theta} + g\sin\theta = 0$

$\ddot{\theta} + \frac{g}{r}\sin\theta = 0$

when $\theta = 30°$ $\quad \ddot{\theta} = -19.62\ m/s^2$