# Tutorial 9

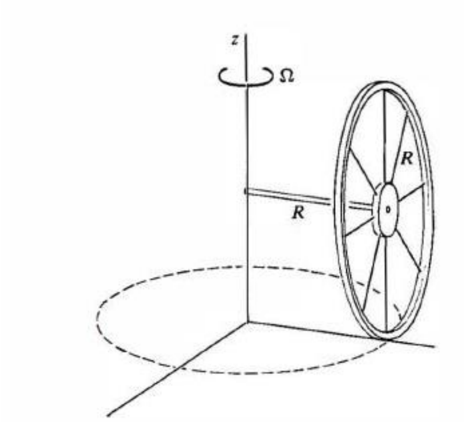
# PHY 101

Q1. A thin hoop of mass M and radius R rolls without slipping about the z axis. It is supported by an axle of length R through it's centre, as shown. The hoop circles around the z axis with angular velocity Ω.

(a) What is the instantaneous angular velocity ω of the hoop?

(b) What is the angular momentum L of the hoop? Is L parallel to ω?

(Note: the moment of inertia of the hoop for an axis along its diameter is $\frac{1}{2}MR^2$.)




Q2.A bowling ball of mass 4.0kg, a moment of inertia of $1.6 \times 10^{-2}$ kgm$^2$ and a radius of 0.10m. If it rolls down the lane without slipping at a linear speed of 4msec$^{-1}$, what is its total energy?

Q3. A 0.250-kg object ($m_1$) is slid on a frictionless surface into a dark room, where it strikes an initially stationary object with mass of 0.400 kg ($m_2$). The 0.250-kg object emerges from the room at an angle of 45.0º with its incoming direction. The speed of the 0.250-kg object is originally 2.00 m/s and is 1.50 m/s after the collision. Calculate the magnitude and direction of the velocity ($v'_2$ and $\vartheta_2$) of the 0.400-kg object after the collision.

Q4. A meteor enters Earth's atmosphere as shown in fig. and is observed by someone on the ground before it burns up in the atmosphere. The vector $\vec{r}$ = 25 km $\hat{\imath}$ + 25 km $\hat{\jmath}$ gives the position of the meteor with respect to the observer. At the instant the observer sees the meteor, it has linear momentum $\vec{p}$ = (15.0 kg)(−2.0 km/s $\hat{\jmath}$), and it is accelerating at a constant 2.0 m/s$^2$ ($-\hat{\jmath}$) along its path, which for our purposes can be taken as a straight line. What is the angular momentum of the meteor about the origin, which is at the location of the observer?