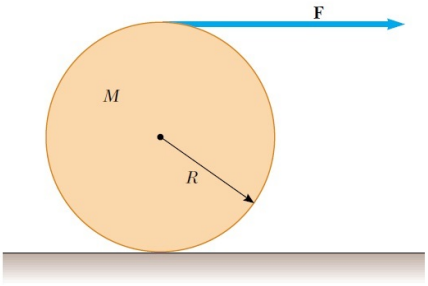
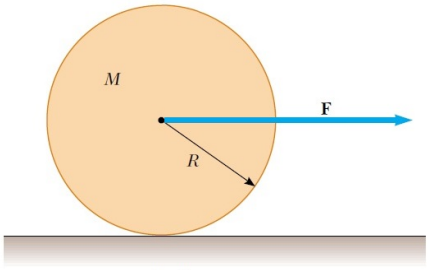
RECITATION 6

1) A string is wound around a uniform solid cylinder of radius $R = 0.1\,m$ and mass $M = 12\,kg$. The cylinder is then unwound under a constant force $F = 48\,N$ as shown in figure. Assume that the cylinder starts from rest and rolls without slipping on the horizontal surface. (The moment of inertia of the cylinder about its central axis is $I_{KM} = \frac{1}{2}MR^2$.) Calculate the force of static friction necessary to prevent slipping in the case of figure (I) and (II).

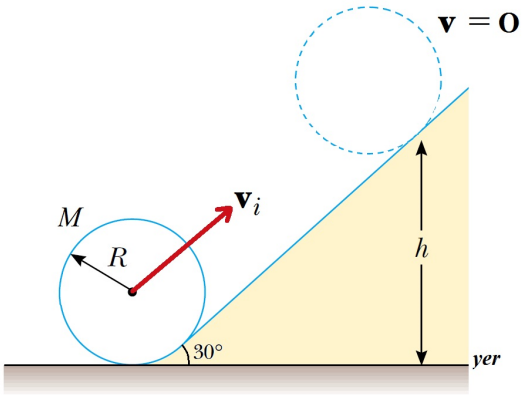


(I)

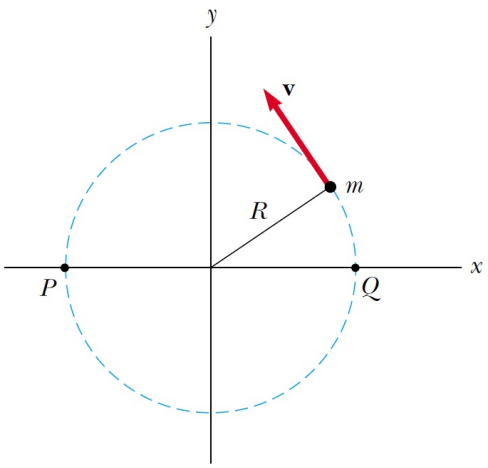


(II)

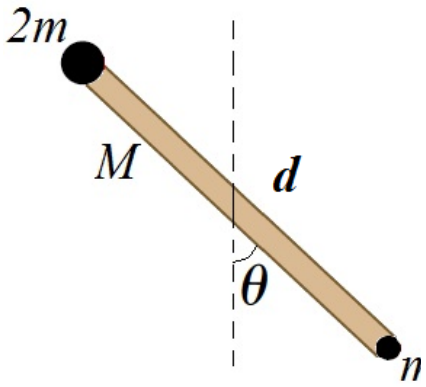
2) A uniform sphere of mass M and radius R rolls without slipping up an inclined plane with an initial speed of 5 *m/s*. The angle of the inclined plane is $30°$. The sphere starts from the bottom and reaches to height of h m. Find the distance that the block goes up the incline.



3) A particle of mass m moves in a circle of radius R at a constant speed $\vec{v}$, as shown in figure. If the motion begins at point Q, determine the angular momentum of the particle about point P as a function of time. Give the result in terms of unit vectors.



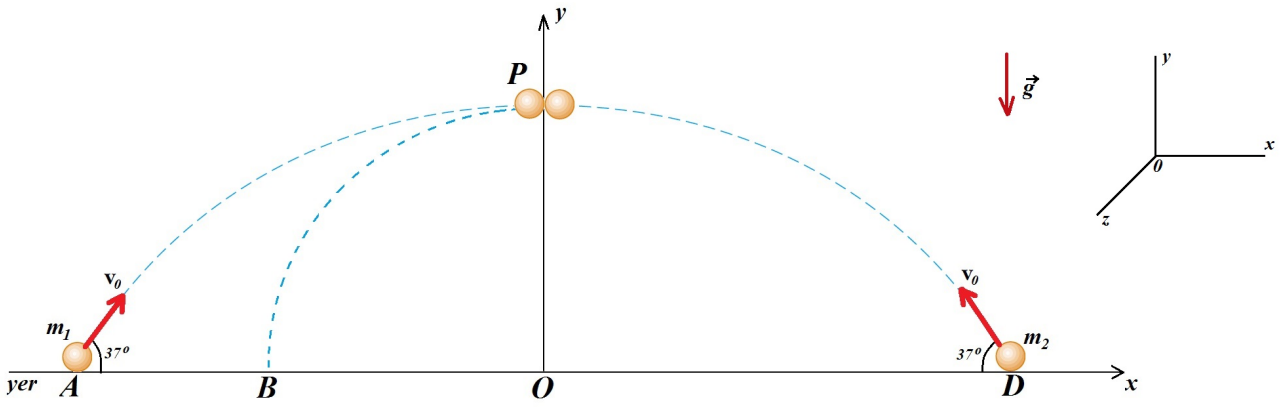
4) A uniform rod of length d and mass $M = 3m$ has small two small balls of mass $2m$ and m fastened to the two ends. The system (the rod and the balls) is pivoted about a frictionless fixed axle through its center on a vertical plane.



a) Find the angular acceleration of the system when the vertical angle is θ as shown in figure.

b) What is the magnitude of the angular momentum of the system when it comes to the vertical position from the horizontal position?

5)



Two objects with masses $m_1 = 2\ kg$ and $m_2 = 4kg$ are projected simultaneously with the same initial speed ($\upsilon = 20\ m/s$) and the same angle of projection $\theta = 37°$ so as to follow a common path of motion. They collide at the highest point *P* and stick together (completely ineleastic collision). Neglect air resistance.

a) Find the velocity in terms of unit vectors of the combined mass right after the collision.

b) How far from point *A* does the combined the mass land, assuming a level ground?

c) Find the angular momentum about the origin (point *O*) of the combined mass right before it hits the ground.

6) A uniform rod with mass *m* and length *d* is placed on the surface of a frictionless horizontal table. It is pivoted at its midpoint to the table and is free to rotate ($I_{CM} = md^2/12$). It is initially at rest. Two bullets, each with mass *m*, are fired simultaneously (at the same instant) and with the same speed υ as shown in figure. The bullets strike and stick to the rod.

a) Find the angular velocity of the rod-bullets system after the collision and show its direction.

b) Find the ratio of the kinetic energy after the collision to the kinetic energy before the collision $\frac{K_s}{K_i}$.