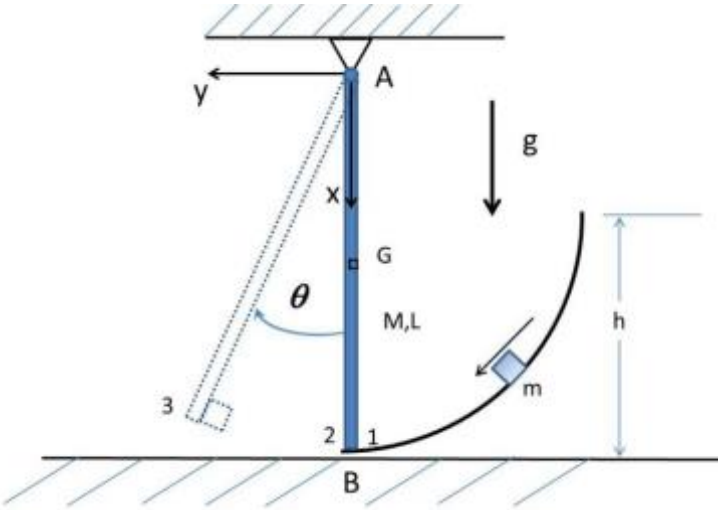
PH-103 Physics-1: Tutorial -4

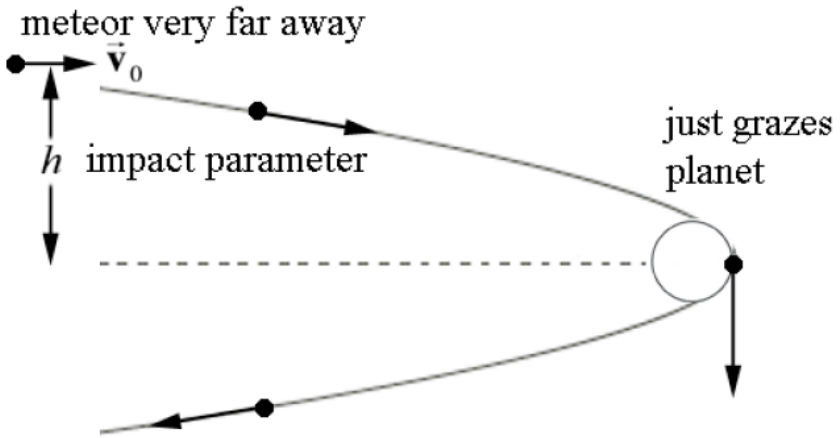
Spring Semester 2020, Dr. Neha Shah, Dr. Manas K Sarangi

1. A rigid body of radius of gyration k and radius R rolls without slipping down an inclined plane at an angle θ with the horizontal. (consider the example as discussed in the class)
   (a) Find the acceleration and frictional force acting on it.
   (b) Derive the condition for pure rolling from the frictional forces.

2. A particle of mass m slides down a frictionless surface. It then collides with and sticks to a uniform vertical rod of mass M and length L. Following the collision, the rod pivots about the point O. Point G is the mass center of the rod. Find the kinetic energy, T and the potential energy V of the system after collision as a function of θ and $\dot{\theta}$.



3. A meteor of mass m = 2.1 X 10^{13} Kg is approaching earth as shown in the figure. The distance *h* is called the impact parameter. Assuming the meteor started very far away from earth with a speed v0 = 1.0 X 10^{1} m/s, find the impact parameter such that the meteor just grazes the earth. (Mass and radius of earth are 5.98 X 10^{24} Kg and 6.37 X 10^{6} m respectively)



4. To identical masses are attached to the end of massless rigid arms as shown in the figure. The vertical portion of the rod is held in place by bearings that prevent vertical motion, but allow the shaft to rotate without friction. The shaft rotates with angular velocity Ω with respect to the O_{xyz} inertial frame. The arms are of length L. The frame A_{x1y1z1} rotates with the arms and attached masses. Note that the angle Φ is fixed. Find the kinetic and potential energy of the system.