PHY 9A Discussion 9, Spring 2018

1. Moment of Inertia of Discrete Mass Distribution

Three point masses with the same mass, m, are placed at (x, y) = (1, 2), (-6, 3) and (-2, -3) on the x-y plane, and they are connected by massless rigid bars.

i. What is the moment of inertia about the x-axis? What is the moment of inertia about the y-axis?

ii. Calculate the moment of inertia about the z-axis. Is there any relationship with the previous results?

iii. Find the location of the rotation axis perpendicular to the x-y plane about which the moment of inertia is minimized. What is the value of the moment of inertia about the minimizing axis?

2. Rolling Disk

A uniform solid disk in a perpendicular plane has mass of 5 [kg] and a diameter of 1 [m]. It is currently rolling with a center-of-mass speed v_0 = 8 [m/s] on the horizontal ground without slipping, and it is about to climb a slope.

i. Calculate the moment of inertia of the disk around its center.

ii. Find the relationship between the center-of-mass speed and the angular speed of the disk. (Remember there is no slipping.)

iii. How high can the the disk climb up the slope measured from the ground?

iv. If the disk was initially at rest, find the horizontal distance needed to accelerate the disk to $v = v_0$ with a constant force F_0 = 5 [N] applied along a horizontal line going through the center of the disk. (Hints: First find the friction from the ground, and then use the equation for constant (angular) acceleration.)