PHY 9A Discussion 8, Spring 2018

1. Bouncing Ball

First recall that the coefficient of restitution, e, is defined as the ratio of relative speeds of two objects before and after a collision:

$$e := \frac{\|{v_1}^f - {v_2}^f\|}{\|{v_1}^i - {v_2}^i\|} ,$$

and the collision is called elastic when $e = 1$, inelastic when $e < 1$, and completely inelastic when $e = 0$.

Now Bob vertically drops a tennis ball of 58.5 [g] mass from 1.5 [m] above the floor, and the "collision" between the ball and the floor is known to have $e = 0.65$.

i. What is the initial energy of the ball? What is the speed of the ball right before the first bounce?

ii. Find the speed of the ball right after the first bounce. How much energy is lost during the first bounce?

iii. Calculate the maximum height of the ball after the third bounce.

iv. How many bounces are needed so that the maximum height of the ball becomes smaller than 1 [mm]?

2. Supporting a Fishing Rod

A fishing rod of 0.3 [kg] mass and 2 [m] length with uniform mass distribution is supported by a frictionless bar at a point 70 [cm] above the ground, thereby making an angle of 30° with the ground.

i. Draw a free-body diagram for the rod, and explain why the ground cannot be frictionless. In which direction should the frictional force be?

ii. Find the magnitude of the force from the supporting bar.

iii. What is the minimum possible coefficient of the static friction?

iv. Could the length of the rod be 3 [m] with the same angle between the rod and the ground? Explain why or why not.