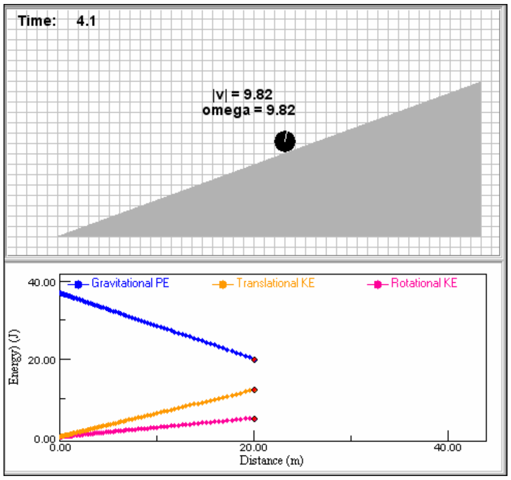
Worksheet for Exploration 11.3: Rolling down an Incline



A solid ball of radius 1.0 m rolls down an incline, as shown **(position is given in meters and time is given in seconds)**. The incline makes an angle θ with the horizontal. Adjust the mass (100 g < m < 500 g) and/or the angle (10° < θ < 40°) and watch the graph of gravitational potential energy and rotational and translational kinetic energy vs. time or distance. Restart.

Change the angle and the mass of the ball to determine the answers to the following questions.

a. What percent of the initial gravitational potential energy is converted into translational kinetic energy at the bottom of the hill?
   i. You can use conservation of energy to set this up, but note there are both types of kinetic energy.

$PE_{g\ initial}$=________

$KE_{trans\ bottom}$=________

$KE_{rot\ bottom}$=________

%Translational=_______

b. What percent of the initial gravitational potential energy is converted into rotational kinetic energy at the bottom of the hill?

%Rotational=_______

c. What is the ratio of KE_{rot} / KE_{trans}? What does this number correspond to?

d. How does the ratio of KE_{rot} / KE_{trans} depend on the mass of the ball? On the angle of the incline?

e. How would the animation change if the ball were replaced by a disk of the same radius?
   i. You may want to consider a hoop or spherical shell (large basketball).

Additional Questions

In order to roll down the ramp, friction was required. If the ball slipped down a frictionless ramp instead of rolling, it would have a different speed at the bottom. What is the ratio v_{bottom}(roll)/ v_{bottom}(slip).

Discuss qualitatively the role that friction plays in this problem. What type of friction, what determines the amount required to prevent slipping?

Discuss qualitatively what is happening with angular momentum in this problem.

The results of problems a-e can be obtained from energy considerations, instead can you set this problem up to use torques and forces to describe the motion. Discuss which method do you prefer and why.