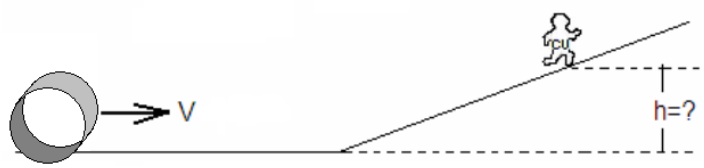
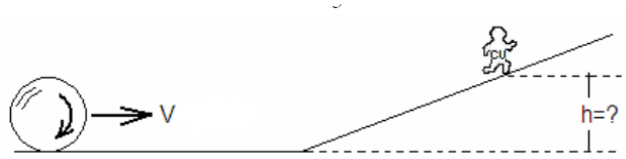
Physics I

Rolling

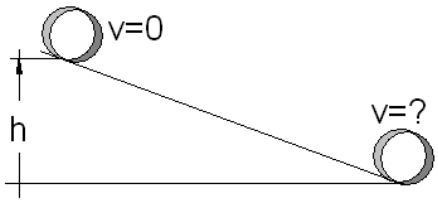
Problem 1.- An accidentally loosen concrete pipe in a construction site rolls toward you at 8.3m/s on a level surface. To protect your life, you run up an incline. How far up do you need to go to be safe?
The moment of inertia of a pipe is MR^2



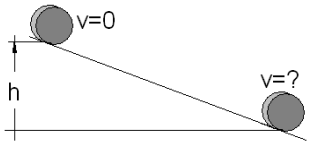
Problem 1a.- A giant spherical ball rolls toward you at 5m/s on a level surface. In order to protect your life, you run up an incline. How far up do you need to go to be safe?
Suggestion: use conservation of energy. The snowball will stop when all its kinetic energy, rotational and linear, is converted to potential energy.
The moment of inertia of a sphere is $\frac{2}{5}MR^2$



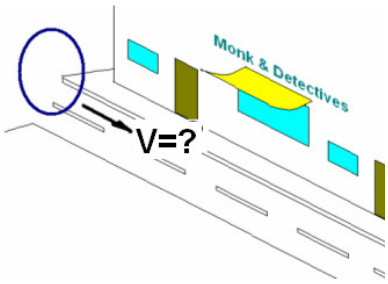
Problem 2.- A hoop rolls down an incline without slipping. Find its linear velocity after falling h=9.8m vertically. Assume its initial velocity was zero.
The moment of inertia of a hoop about its center is MR^2.



Problem 2a.- A solid cylinder rolls down an incline without slipping. Find its linear velocity after falling h=9.8m vertically. Assume its initial velocity was zero.
The moment of inertia of a cylinder about its center is $1/2MR^2$.



Problem 2b.- Lombard Street in San Francisco, California has a section that has a steep slope. Calculate the velocity of a **hoop** rolling down the incline after falling 5 m vertically. Assume the hoop started from rest. Moment of inertia of a hoop is MR^2.



Problem 3.- If a sphere and a solid cylinder roll down a slope, which one accelerates faster?

Problem 3a.- What about a hollow cylinder and a solid one? Which one will accelerate faster when rolling down a slope?

Problem 4.- An Atwood machine is made with two masses M_1=10kg and M_2=11kg. The pulley has a mass of 2kg, and it has a shape approximately the same as a disk.
Calculate how long it will take mass M_2 to fall 1m starting from rest.
The moment of inertia of a disk about its center is $1/2MR^2$.