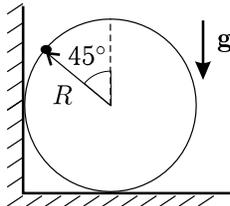


Homework 4. Energy and Momentum.

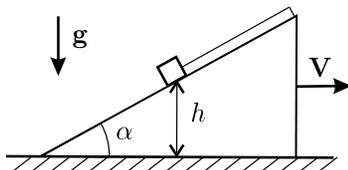
1. Smooth ball of mass M and radius R is sitting on a smooth horizontal table. A small block of mass m starts sliding down from the top of the ball with essentially zero velocity. Find the mass ratio, m/M , such that the block would leave the ball's surface at a height of $7R/4$ above the table?

2. A small weight is attached to a rigid massless hoop of radius R . The hoop is let go from the position depicted in the figure. At what distance from its initial position will the weight touch the floor? Neglect friction.

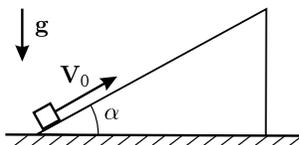


3. A little cube is suspended from a string attached to a smooth wedge of angle α . The wedge is moving with velocity V (see figure). At some point, the string is momentarily cut, but the wedge keeps moving with the same velocity. Assume that the initial height of the cube is h and find

- a) the time it will take for the cube to touch the floor
- b) the velocity V such that the cube's velocity when touching the floor is vertical



4. A cube is kicked with initial velocity V_0 up a smooth wedge placed on a smooth floor (see figure). The angle at the base of the wedge is α , and the masses of the wedge and cube are equal.



- a) After what time will the cube slide back to its original position on the wedge?
- b) What is the cube's velocity when it slides back to its original position on the wedge?

5. Two identical balls of mass m are fixed at the ends of a massless rod of length L that can rotate freely around a horizontal axle O (see figure). The axle divides the rod in a 2:1 ratio. The rod is originally horizontal and let go.

a) At what angle will the rod be, when the vertical component of the force exerted by the rod on the axle equals $2mg$?

b) What is the horizontal component of the force exerted by the rod on the axle at the same moment?

