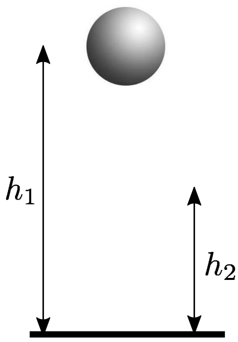
Chapter 6: Coefficient of restitution

Exercise 1

A spherical particle is dropped from a height $h_1 = 0.1$ m to a horizontal wall. After the impact with the wall, the particle bounces off and obtains a maximum height of $h_2 = 0.05$ m.

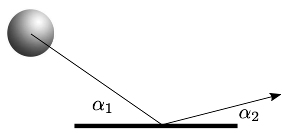


Show that the coefficient of restitution (along the normal to the plane of impact) can be found from $e = \sqrt{h_2/h_1}$ and calculate it.

Solution:
$e = 0.71$

Exercise 2

A spherical particle collides with a wall, where the impact angle (see the figure) is $\alpha_1 = 30°$. The velocity magnitude is 0.1 m/s. The particle mass is 10^{-6} kg.



After the collision, new angle α_2 becomes 20°. We know that the "normal" and "tangential" restitution coefficients are 0.75 and 0.6, respectively.

What is the new velocity magnitude of the particle?

Calculate also the loss of mechanical kinetic energy (assume that the particle does not rotate).

Solution:
v = 0.064 m/s; $E_{loss} = 2.95 \cdot 10^{-9}$ J.

Exercise 3

In this exercise, we will use the linear-spring and dashpot model. We return to Example 3.3.1 studied in one of the previous chapters ("Introduction to contact and impact mechanics"). Here, we will solve an "opposite case".

We focus on the situation where β_n was 0.3.

We see from Example 3.3.1 that a collision duration was $1.68 \cdot 10^{-7}$s (not so clearly seen from the graph there). Also, we see that the final relative speed was $-3.73 \cdot 10^{-3}$ m/s.

Use the knowledge from the present chapter to compute parameters β_n and k_n and see if they are really equal to 0.3 and $8 \cdot 10^5$ N/m (as specified in the text of Example 3.3.1).