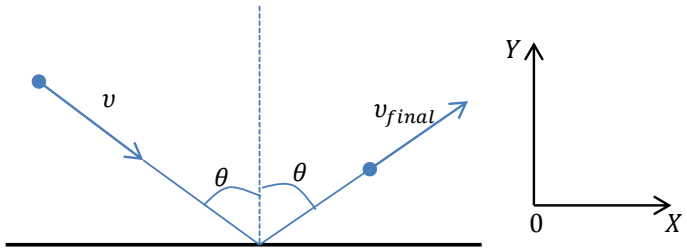
Problem:

A ball moving with speed v collides with a horizontal smooth surface at an angle theta with normal to surface as shown in the figure. If coefficient of restitution is ‘e’ , then find velocity after it re-bounces making same angle theta with the normal.

Solution:



Coefficient of restitution can be defined as (for example, for ball, bouncing from the floor):

$$e = \frac{v_{Yfinal}}{v_y}$$

and(as the surface is smooth with no friction):

$$v_x = v_{Xfinal} = vcos\theta$$

Where $v_{Yfinal}, v_y = vsin\theta$ – projections of final and initial velocities on axis OY;

v_{Xfinal}, v_x - projections of final and initial velocities on axis OX;

Thus,

$$v_{final} = \sqrt{{v_{Xfinal}}^2 + {v_{Yfinal}}^2} = \sqrt{{v_x}^2 + (ev_y)^2} = v\sqrt{sin^2\theta + e^2cos^2\theta}$$

Answer: $v_{final} = v\sqrt{sin^2\theta + e^2cos^2\theta}$.