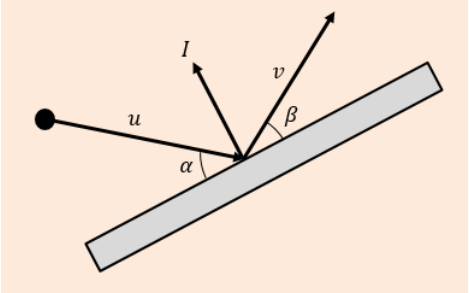
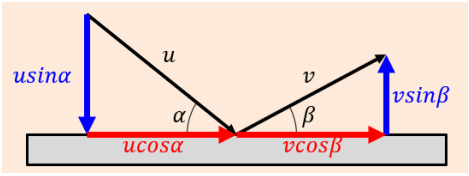
5A Oblique (Angled) Impact with a Plane





1. A smooth sphere S is moving on a smooth horizontal plane with speed u when it collides with a smooth fixed vertical wall. At the instant of collision the direction of motion of S makes an angle of 60° with the wall. The coefficient of restitution between S and the wall is $\frac{1}{4}$. Find:

a) The speed of S immediately after the collision

b) The angle of deflection of S

2. A small smooth ball is falling vertically. The ball strikes a smooth plane which is inclined at an angle $\theta$to the horizontal, where $tan\theta = \frac{1}{2}$. Immediately before striking the plane, the ball has speed $5ms^{-1}$. The coefficient of restitution between the ball and the plane is $\frac{1}{3}$. Find the speed of the ball immediately after the impact.

3. A small smooth ball of mass 2kg is moving in the xy plane and collides with a smooth fixed vertical wall which contains the $y-axis$. The velocity of the ball just before impact is $(-6\boldsymbol{i}-4\boldsymbol{j})ms^{-1}$. The coefficient of restitution between the ball and the wall is $\frac{1}{3}$. Find:

a) The velocity of the ball immediately after the impact

b) The kinetic energy lost as a result of the impact

c) The angle of deflection of the ball

Extra Q (not in book) to support Q11, 15 & 16 from 5A

4. A smooth sphere S, of mass m, is moving with velocity $7\boldsymbol{i} + 2\boldsymbol{j}$ when it collides with a smooth fixed vertical wall. After the collision the velocity of the sphere, S, is $3\boldsymbol{i} - 3\boldsymbol{j}$

a) Find the impulse exerted by the wall on the ball.

b) Use the scalar product to find the coefficient of restitution between the sphere and the wall.

Key Point: Remember that the scalar product can be used to break down vector velocities in given directions!

Scalar multiply a velocity vector by the unit vector in a given direction to find the breakdown of the original velocity vector in the unit vector's direction.