4.2) Direct collision with a smooth plane

Worked example

A Particle collides normally with a fixed vertical plane. The speed immediately before the collision is 6 ms^{-1}. The speed immediately after the collision is 2 ms^{-1}. Find the value of the coefficient of restitution, e.

Your turn

A Particle collides normally with a fixed vertical plane. The speed immediately before the collision is 8 ms^{-1}. The speed immediately after the collision is 2 ms^{-1}. Find the value of the coefficient of restitution, e.

$\frac{1}{4}$

Worked example

A small sphere collides normally with a fixed vertical wall. Before the impact the sphere is moving with a speed of $8\ ms^{-1}$ on a smooth horizontal floor. The coefficient of restitution between the sphere and the wall is 0.4. Find the speed of the sphere after the collision.

Your turn

A small sphere collides normally with a fixed vertical wall. Before the impact the sphere is moving with a speed of $4\ ms^{-1}$ on a smooth horizontal floor. The coefficient of restitution between the sphere and the wall is 0.2. Find the speed of the sphere after the collision.

$0.8\ ms^{-1}$

Worked example

A particle falls $45\ cm$ from rest onto a smooth horizontal plane. It then rebounds to a height of $20\ cm$. Find the coefficient of restitution between the particle and the plane.

Your turn

A particle falls $22.5\ cm$ from rest onto a smooth horizontal plane. It then rebounds to a height of $10\ cm$. Find the coefficient of restitution between the particle and the plane.

0.667 (3 sf)

Worked example

A particle of mass m kg lies on a smooth horizontal surface. Initially the particle is at rest at a point O midway between a pair of fixed parallel vertical walls, which are 4 m apart. At time $t = 0$ the particle is projected from O with speed $u\ ms^{-1}$ in a direction perpendicular to the walls. The coefficient of restitution between the particle and each wall is $\frac{1}{3}$. The magnitude of the impulse on the particle due to the first impact with a wall is $\lambda mu\ Ns$.

a) Find the value of λ

The particle returns to O, having bounced off each wall once, at time $t = 12$ seconds.

b) Find the value of u

Your turn

A particle of mass m kg lies on a smooth horizontal surface. Initially the particle is at rest at a point O midway between a pair of fixed parallel vertical walls, which are 2 m apart. At time $t = 0$ the particle is projected from O with speed $u\ ms^{-1}$ in a direction perpendicular to the walls. The coefficient of restitution between the particle and each wall is $\frac{2}{3}$. The magnitude of the impulse on the particle due to the first impact with a wall is $\lambda mu\ Ns$.

a) Find the value of λ

The particle returns to O, having bounced off each wall once, at time $t = 3$ seconds.

b) Find the value of u

a) $\lambda = \frac{5}{3}$

b) $u = \frac{25}{12}$

Worked example

A ball is dropped from a height of hm. The coefficient of restitution between the ball and the ground is e. What is the total distance travelled by the ball before it comes to rest permanently?

Your turn

A ball is dropped from a height of hm. The coefficient of restitution between the ball and the ground is e. Show that the total distance travelled by the ball before it comes to rest permanently is

$$\frac{h(1+e^2)}{1-e^2}$$

Shown