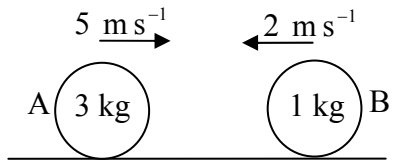
Impacts and Collisions

2011

5. A smooth sphere A, of mass 3 kg, collides directly with another smooth sphere B, of mass 1 kg, on a smooth horizontal table.



Before impact A and B are moving in opposite directions with speeds of $5\ \text{m s}^{-1}$ and $2\ \text{m s}^{-1}$, respectively.

The coefficient of restitution for the collision is $\frac{1}{7}$.

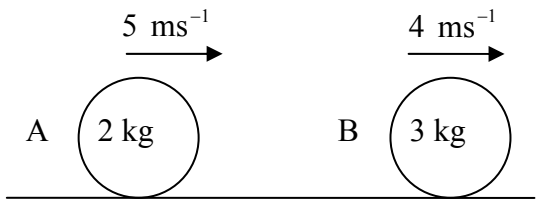
Find **(i)** the speed of A and the speed of B after the collision

(ii) the loss in kinetic energy due to the collision

(iii) the magnitude of the impulse imparted to B due to the collision.

2010

5. A smooth sphere A, of mass 2 kg, collides directly with another smooth sphere B, of mass 3 kg, on a smooth horizontal table.



A and B are moving in the same direction with speeds of $5\ \text{ms}^{-1}$ and $4\ \text{ms}^{-1}$ respectively.

The coefficient of restitution for the collision is $\frac{2}{3}$.

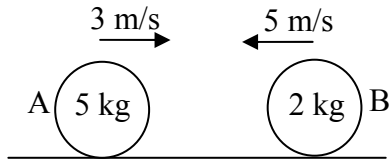
Find **(i)** the speed of A and the speed of B after the collision

(ii) the change in the kinetic energy of A due to the collision

(iii) the magnitude of the impulse imparted to A due to the collision.

2009

5. A smooth sphere A, of mass 5 kg, collides directly with another smooth sphere B, of mass 2 kg, on a smooth horizontal table.



Before impact A and B are moving in opposite directions with speeds 3 m/s and 5 m/s, respectively.

The coefficient of restitution for the collision is $\frac{3}{4}$.

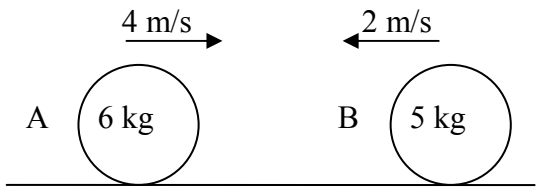
Find **(i)** the speed of A and the speed of B after the collision

(ii) the loss in kinetic energy due to the collision

(iii) the magnitude of the impulse imparted to B due to the collision.

2008

5. A smooth sphere A, of mass 6 kg, collides directly with another smooth sphere B, of mass 5 kg, on a smooth horizontal table.



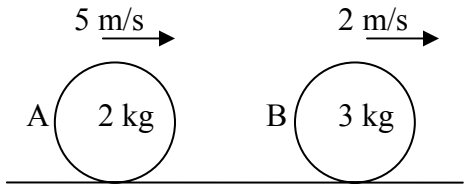
A and B are moving in opposite directions with speeds of 4 m/s and 2 m/s respectively.

The coefficient of restitution for the collision is $\frac{1}{10}$.

Find **(i)** the speed of A and the speed of B after the collision
(ii) the loss in kinetic energy due to the collision
(iii) the magnitude of the impulse imparted to A due to the collision.

2008

5. A smooth sphere A, of mass 2 kg, collides directly with another smooth sphere B, of mass 3 kg, on a smooth horizontal table.



A and B are moving in the same direction with speeds of 5 m/s and 2 m/s respectively.

The coefficient of restitution for the collision is $\frac{2}{3}$.

Find

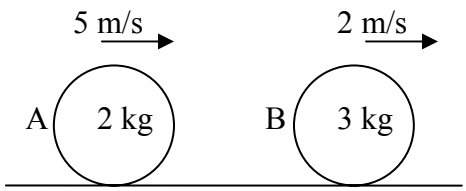
(i) the speed of A and the speed of B after the collision

(ii) the loss in kinetic energy due to the collision

(iii) the magnitude of the impulse imparted to B due to the collision.

2007

5. A smooth sphere A, of mass 2 kg, collides directly with another smooth sphere B, of mass 3 kg, on a smooth horizontal table.



A and B are moving in the same direction with speeds of 5 m/s and 2 m/s respectively.

The coefficient of restitution for the collision is $\frac{2}{3}$.

Find

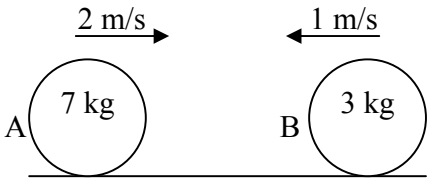
(i) the speed of A and the speed of B after the collision

(ii) the loss in kinetic energy due to the collision

(iii) the magnitude of the impulse imparted to B due to the collision.

2006

5. A smooth sphere A, of mass 7 kg, collides directly with another smooth sphere B, of mass 3 kg, on a smooth horizontal table.
A and B are moving in opposite directions with speeds of 2 m/s and 1 m/s respectively.



The coefficient of restitution for the collision is $\frac{1}{3}$.

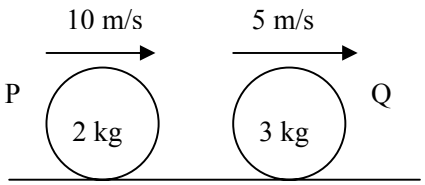
Find **(i)** the speed of A and the speed of B after the collision

(ii) the loss in kinetic energy due to the collision

(iii) the magnitude of the impulse imparted to A due to the collision.

2005

5. A smooth sphere P, of mass 2 kg, moving with a speed of 10 m/s collides directly with a smooth sphere Q, of mass 3 kg, moving in the same direction with a speed of 5 m/s on a smooth horizontal table.



The coefficient of restitution for the collision is *e*.

After the collision, sphere Q continues to travel in the same direction but with a speed of 8 m/s.

(i) Find the speed of P after the collision.

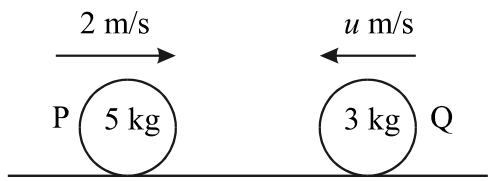
(ii) Find the value of *e*.

(iii) Find the fraction of kinetic energy lost due to the collision.

(iv) Find the magnitude of the impulse imparted to each sphere.

2004

5. **(a)** A smooth sphere P, of mass 5 kg, moving with a speed of 2 m/s collides directly with a smooth sphere Q, of mass 3 kg, moving in the opposite direction with a speed of u m/s on a smooth horizontal table.



The coefficient of restitution for the collision is $\frac{1}{2}$.

As a result of the collision, sphere P is brought to rest.

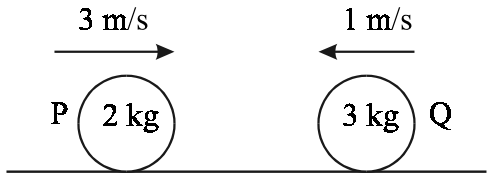
(i) Find the value of u.
(ii) Find the speed of Q after the collision.

(b) A ball is dropped from rest from a height of 1.25 m onto a smooth horizontal table. The ball hits the table with a speed of v m/s and then rebounds to a height of h metres above the table.
The coefficient of restitution between the ball and the table is 0.8.

(i) Find the value of v.
(ii) Find the value of h.

2003

5. A smooth sphere P, of mass 2 kg, moving with a speed of 3 m/s collides directly with a smooth sphere Q, of mass 3 kg, moving in the opposite direction with a speed of 1 m/s on a smooth horizontal table.
The coefficient of restitution for the collision is e.



As a result of the collision, sphere P is brought to rest.

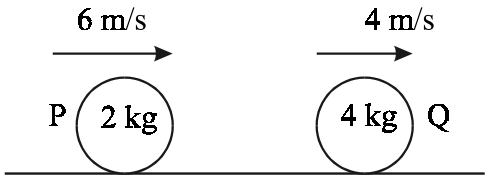
(i) Find the speed of Q after the collision.

(ii) Find the value of e.

(iii) Find the fraction of kinetic energy lost due to the collision.

2002

5. A smooth sphere P, of mass 2 kg, moving with a speed of 6 m/s collides directly with a smooth sphere Q, of mass 4 kg, moving in the same direction with a speed of 4 m/s on a smooth horizontal table.



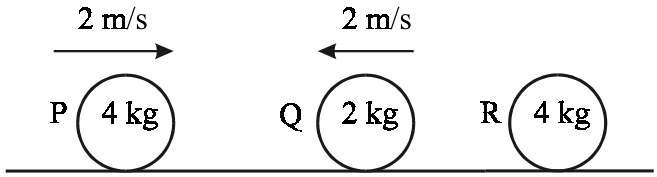
The coefficient of restitution for the collision is $\frac{1}{2}$.

(i) Find the speed of P and the speed of Q after the collision.

(ii) Find the loss in kinetic energy due to the collision.

2001

5. A smooth sphere P, of mass 4 kg, moving with a speed of 2 m/s collides directly with a smooth sphere Q, of mass 2 kg, travelling in the opposite direction with a speed of 2 m/s on a smooth horizontal table.
The coefficient of restitution for the collision is $\frac{1}{3}$.

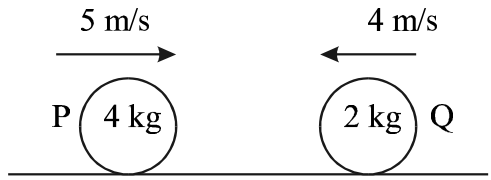


Find the speed of P and the speed of Q after the collision.

As a result of this collision Q goes on to collide directly with a stationary smooth sphere R, of mass 4 kg. The collision between Q and R causes Q to come to rest.

Find the coefficient of restitution for the collision between Q and R.

5. Two smooth spheres P and Q, of masses 4 kg and 2 kg respectively and travelling in opposite directions with speeds of 5 m/s and 4 m/s respectively, collide directly on a smooth horizontal table.
The coefficient of restitution between the spheres is *e*.
As a result of the collision P continues to move in the same direction with a speed of *e* m/s.



(i) Find the value of *e* .

(ii) Find the loss in kinetic energy due to the collision.

ANSWERS

2011
(i) $v_1 = 3$ m s^{-1} and $v_2 = 4$ m s^{-1}
(ii) KE lost = 18 J
(iii)Impulse = 6 N s or 6 kgms^{-1}

2010
(iv)$v_1 = 4$ m s^{-1} and $v_2 = 14/3$ m s^{-1}
(v) Change in KE of A = 9 J
(vi)Impulse = 2 N s

2009
(i) $v_1 = -1$ m s^{-1}, $v_2 = 5$ m s^{-1}
(ii) KE lost = 20 J
(iii)Impulse = 20 N s

2008
(i) $v_1 = 1$ m s^{-1}, $v_2 = 1.6$ m s^{-1}
(ii) KE lost = 48.6 J
(iii)Impulse = 18 Ns

2007
(i) $v_1 = 2$ m s^{-1}, $v_2 = 4$ m s^{-1}
(ii) KE lost = 3 J
(iii)Impulse = 6 Ns

2006
(i) $v_1 = 0.8$ m s^{-1}, $v_2 = 1.8$ m s^{-1}
(ii) KE lost = 8.4 J
(iii)Impulse = 8.4 N s

2005
(i) $v_1 = 5.5$ m s^{-1}
(ii) e = 0.5
(iii)Fraction of KE lost = 9/110 %
(iv)Impulse = 9 N s

2004 (a)
(i) u = 14/9 m s^{-1}
(ii) $v_2 = 16/9$ m s^{-1}

2004 (b)
v = 5 m s^{-1}
h = 0.8 m

2003
(i) $v_2 = 1$ m s^{-1}
(ii) e = 0.25
(iii)Fraction = 6/7 %

2002
(i) $v_1 =$ m s^{-1}, $v_2 = 5$ m s^{-1}
(ii) KE lost = 2 J

2001
(i) $v_1 = 2/9$ m s^{-1}, $v_2 = 14/9$ m s^{-1}
(ii) e = ½

2000 (a)
(i) e = ½
(ii) loss in KE = 40.5 J