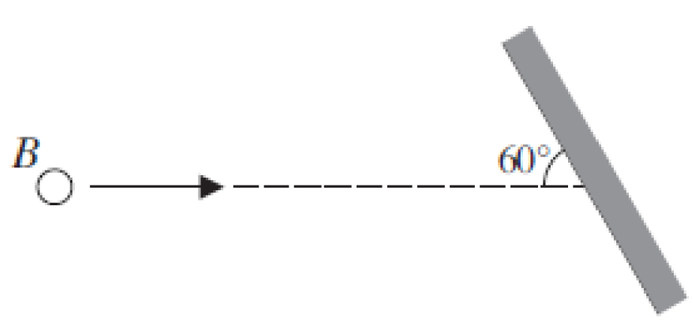
Momentum & Impulse

June2009

Two spheres A and B, of equal radius, have masses m_1 and m_2 respectively. They lie at rest on a smooth horizontal plane. Sphere A is projected directly towards sphere B with speed u and, as a result of the collision, A is brought to rest. Show that

(i) the speed of B immediately after the collision cannot exceed u, [2]

(ii) $m_1 \leqslant m_2$. [2]



After the collision, B hits a smooth vertical wall which is at an angle of 60° to the direction of motion of B (see diagram). In the impact with the wall B loses $\frac{2}{3}$ of its kinetic energy. Find the coefficient of restitution between B and the wall and show that the direction of motion of B turns through 90°. [8]

Nov 2011/22

Two smooth spheres P and Q, of equal radius, have masses m and $3m$ respectively. They are moving in the same direction in the same straight line on a smooth horizontal table. Sphere P has speed u and collides directly with sphere Q which has speed ku, where $0 < k < 1$. Sphere P is brought to rest by the collision. Show that the coefficient of restitution between P and Q is $\dfrac{3k+1}{3(1-k)}$. [6]

One third of the total kinetic energy of the spheres is lost in the collision. Show that

$$k = \tfrac{1}{3}(2\sqrt{3} - 3).$$ [5]

Nov2012/23

Three particles A, B and C have masses m, $2m$ and m respectively. The particles are able to move on a smooth horizontal surface in a straight line, and B is between A and C. Initially A is moving towards B with speed $2u$ and C is moving towards B with speed u. The particle B is at rest. The coefficient of restitution between any pair of particles is e. The first collision is between A and B.

(i) Show that the speed of B immediately before its collision with C is $\frac{2}{3}u(1+e)$. [4]

(ii) Find the velocity of B immediately after its collision with C. [3]

(iii) Given that $e > \frac{1}{2}$, show that there are no further collisions between the particles. [4]