# Momentum & Impulse

June 04 No3

Three smooth uniform spheres, A, B and C, lie at rest in this order in a straight line on a smooth horizontal surface. Their masses are 0.6 kg, 1.2 kg and 0.6 kg respectively, and their sizes are equal. Sphere A is projected towards B with speed $4\,\text{m s}^{-1}$, and hits B directly. B moves on to hit C directly. Find the velocities of A, B and C after the second impact, given that the coefficient of restitution is $\frac{1}{2}$ for each impact. State whether there will be any further impacts between any of the spheres. [7]

June 09 No5

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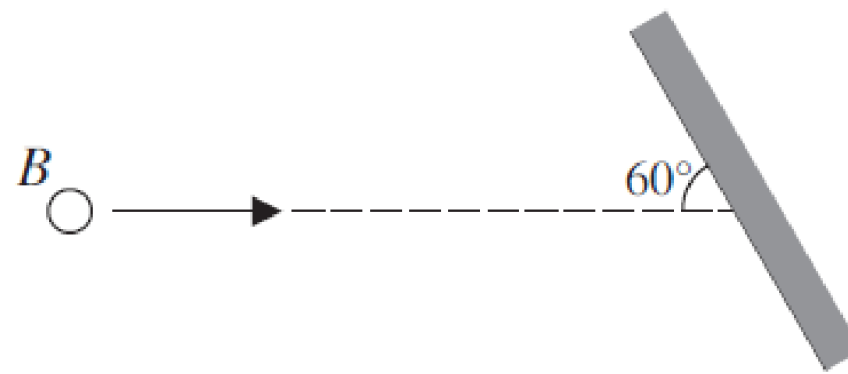
After the collision, B hits a smooth vertical wall which is at an angle of $60°$ to the direction of motion of B (see diagram). In the impact with the wall B loses $\frac{2}{3}$ of its kinetic energy. Find the coefficient of restitution between B and the wall and show that the direction of motion of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

June 10 No4

A small ball P, of mass 40 grams, is dropped from rest at a point A which is 10 m above a fixed horizontal plane. At the same instant an identical ball Q is dropped from rest at the point B, which is vertically below A and at a height of 5 m above the plane. The coefficient of restitution between Q and the plane is $\frac{1}{2}$. Find the magnitude of the impulse exerted on Q by the plane. [4]

The balls collide after Q rebounds from the plane and before Q hits the plane again. Find the height above the plane of the point at which the collision occurs. [6]