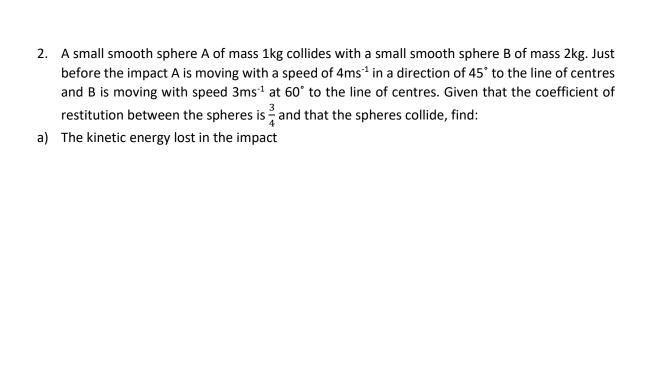# 5C Oblique Impacts with Two Smooth Spheres

1. A smooth sphere A, of mass 2kg and moving with speed 6ms^{-1} collides obliquely with a smooth sphere B of mass 4kg. Just before the impact B is stationary and the velocity of A makes an angle of 60˚ with the lines of centres of the two spheres. The coefficient of restitution between the spheres is $\frac{1}{4}$. Find the magnitudes and directions of the velocities of A and B immediately after the impact.

2. A small smooth sphere A of mass 1kg collides with a small smooth sphere B of mass 2kg. Just before the impact A is moving with a speed of 4ms^{-1} in a direction of 45˚ to the line of centres and B is moving with speed 3ms^{-1} at 60˚ to the line of centres. Given that the coefficient of restitution between the spheres is $\frac{3}{4}$ and that the spheres collide, find:

a) The kinetic energy lost in the impact

b) The magnitude of the impulse exerted on A by B

3. A smooth sphere A of mass 5kg is moving on a smooth horizontal surface with velocity $(2\boldsymbol{i} + 3\boldsymbol{j})ms^{-1}$. Another smooth sphere B of mass 3kg and the same radius as A is moving on the same surface with velocity $(4\boldsymbol{i} - 2\boldsymbol{j})ms^{-1}$. The spheres collide when their line of centres is parallel to $\boldsymbol{j}$. The coefficient of restitution between the spheres is $\frac{3}{5}$. Find the velocities of both spheres after the impact.

4. Two small smooth spheres A and B have equal radii. The mass of A is $2m$ kg and the mass of B is $3m$ kg. The spheres are moving on a smooth horizontal plane and they collide. Immediately before the collision the velocity of A is $5\boldsymbol{j}\ ms^{-1}$ and the velocity of B is $(3\boldsymbol{i} - \boldsymbol{j})\ ms^{-1}$. Immediately after the collision the velocity of A is $(3\boldsymbol{i} + 2\boldsymbol{j})\ ms^{-1}$. Find:

a) The speed of B immediately after the collision

b) A unit vector parallel to the line of centres of the spheres at the instant of collision