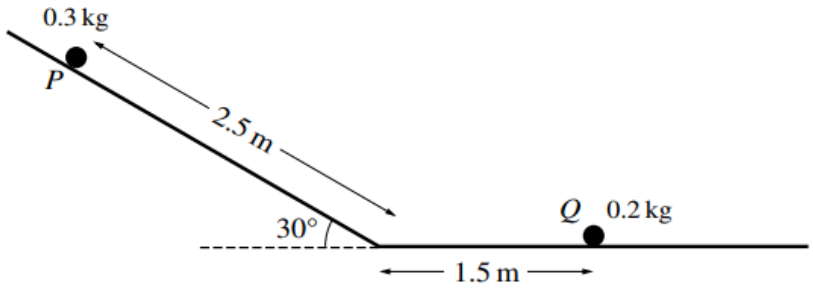
Momentum 1

Q1.



A particle P of mass 0.3 kg, lying on a smooth plane inclined at 30° to the horizontal, is released from rest. P slides down the plane for a distance of 2.5 m and then reaches a horizontal plane. There is no change in speed when P reaches the horizontal plane. A particle Q of mass 0.2 kg lies at rest on the horizontal plane 1.5 m from the end of the inclined plane (see diagram). P collides directly with Q.

(a) It is given that the horizontal plane is smooth and that, after the collision, P continues moving in the same direction, with speed $2\,\text{m s}^{-1}$.

Find the speed of Q after the collision. [5]

(b) It is given instead that the horizontal plane is rough and that when P and Q collide, they coalesce and move with speed $1.2\,\text{m s}^{-1}$.

Find the coefficient of friction between P and the horizontal plane. [5]

Q2.

4 Small smooth spheres A and B, of equal radii and of masses 4 kg and 2 kg respectively, lie on a smooth horizontal plane. Initially B is at rest and A is moving towards B with speed $10\,\text{m s}^{-1}$. After the spheres collide A continues to move in the same direction but with half the speed of B.

(a) Find the speed of B after the collision. [2]

A third small smooth sphere C, of mass 1 kg and with the same radius as A and B, is at rest on the plane. B now collides directly with C. After this collision B continues to move in the same direction but with one third the speed of C.

(b) Show that there is another collision between A and B. [3]

(c) A and B coalesce during this collision.

Find the total loss of kinetic energy in the system due to the three collisions. [5]

Momentum 1

Q3.

Particles P of mass m kg and Q of mass 0.2 kg are free to move on a smooth horizontal plane. P is projected at a speed of 2 m s^{-1} towards Q which is stationary. After the collision P and Q move in opposite directions with speeds of 0.5 m s^{-1} and 1 m s^{-1} respectively.

Find m. [3]

Q4.

A particle B of mass 5 kg is at rest on a smooth horizontal table. A particle A of mass 2.5 kg moves on the table with a speed of 6 m s^{-1} and collides directly with B. In the collision the two particles coalesce.

(a) Find the speed of the combined particle after the collision. [2]

(b) Find the loss of kinetic energy of the system due to the collision. [3]

Q5.

Two particles P and Q, of masses 0.2 kg and 0.5 kg respectively, are at rest on a smooth horizontal plane. P is projected towards Q with speed 2 m s^{-1}.

(a) Write down the momentum of P. [1]

(b) After the collision P continues to move in the same direction with speed 0.3 m s^{-1}.

Find the speed of Q after the collision. [2]

Q6.

Two small smooth spheres A and B, of equal radii and of masses 4 kg and m kg respectively, lie on a smooth horizontal plane. Initially, sphere B is at rest and A is moving towards B with speed 6 m s^{-1}. After the collision A moves with speed 1.5 m s^{-1} and B moves with speed 3 m s^{-1}.

Find the two possible values of the loss of kinetic energy due to the collision. [6]

Momentum 1

Q7.

Two particles P and Q of masses 0.2 kg and 0.3 kg respectively are free to move in a horizontal straight line on a smooth horizontal plane. P is projected towards Q with speed 0.5 m s^{-1}. At the same instant Q is projected towards P with speed 1 m s^{-1}. Q comes to rest in the resulting collision.

Find the speed of P after the collision. [3]

Q8.

Three particles P, Q and R, of masses 0.1 kg, 0.2 kg and 0.5 kg respectively, are at rest in a straight line on a smooth horizontal plane. Particle P is projected towards Q at a speed of 5 m s^{-1}. After P and Q collide, P rebounds with speed 1 m s^{-1}.

(a) Find the speed of Q immediately after the collision with P. [3]

Q now collides with R. Immediately after the collision with Q, R begins to move with speed V m s^{-1}.

(b) Given that there is no subsequent collision between P and Q, find the greatest possible value of V. [3]

Q9.

A particle A is projected vertically upwards from level ground with an initial speed of 30 m s^{-1}. At the same instant a particle B is released from rest 15 m vertically above A. The mass of one of the particles is twice the mass of the other particle. During the subsequent motion A and B collide and coalesce to form particle C.

Find the difference between the two possible times at which C hits the ground. [8]

Q10.

Particles P of mass 0.4 kg and Q of mass 0.5 kg are free to move on a smooth horizontal plane. P and Q are moving directly towards each other with speeds 2.5 m s^{-1} and 1.5 m s^{-1} respectively. After P and Q collide, the speed of Q is twice the speed of P.

Find the two possible values of the speed of P after the collision. [4]
