2 Two particles, P and Q, of masses 3 kg and 5 kg respectively, are at rest on a smooth horizontal plane. P is projected at a speed of $4\,\text{m s}^{-1}$ directly towards Q. After P and Q collide, P has speed $1\,\text{m s}^{-1}$.

(a) Find the two possible speeds of Q after the collision. [3]

It is given that λ J of kinetic energy, where $\lambda > 0$, is lost during the collision.

(b) Find the value of λ. [2]

6 A particle A of mass 2.5 kg is released from rest from the top of a smooth plane, which makes an angle of $\sin^{-1} 0.2$ with the horizontal. The particle A collides 2 seconds later with a particle B, of mass 3 kg, which is moving up a line of greatest slope of the plane. The speed of B immediately before the collision is $3.5\,\text{m s}^{-1}$. Immediately after the collision, B has a velocity of $0.5\,\text{m s}^{-1}$ down the plane.

Find the distance A moves up the plane after the collision. [6]

4 A particle P of mass 0.1 kg is projected vertically upwards with speed $30\,\text{m}\,\text{s}^{-1}$ from horizontal ground. At the same instant a particle Q of mass 0.4 kg is projected vertically upwards with speed $10\,\text{m}\,\text{s}^{-1}$ from a height of 15 m above the ground. P and Q move in the same vertical line.

(a) Find the height above the ground at which P and Q collide. [4]

When P and Q collide, they coalesce.

(b) Find the speed of the combined particle at the instant that it reaches the ground. [5]

5 When a particle P of mass m kg has speed $u\,\text{m s}^{-1}$, its momentum is 4 N s and its kinetic energy is 16 J.

(a) Find the value of m and the value of u. [3]

P is now projected on a smooth horizontal surface with speed $v\,\text{m s}^{-1}$ directly towards a particle Q of mass 1.25 kg which is stationary. After P and Q collide, the velocity of P is $w\,\text{m s}^{-1}$ and the velocity of Q is $2w\,\text{m s}^{-1}$. The loss of kinetic energy in the collision is 25 J.

(b) Find the value of v and the value of w. [4]