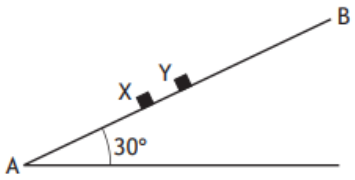
Y	Q	Momentum and Impulse
24	3	Particle A has a mass of 30 grams and is travelling in a straight line with velocity u m s^{-1}. It collides with a stationary particle B and rebounds with a speed of $\frac{u}{3}$ m s^{-1} in the opposite direction. Particle B begins to move with a velocity of $\frac{u}{2}$ m s^{-1} in the original direction of motion. Calculate the mass of particle B. **3**
23	1	An air hockey pusher of mass 48 grams is moving freely with a velocity of $16\mathbf{i}$ cm s^{-1} when it collides with a stationary puck of mass 32 grams. Immediately after the collision the pusher has a velocity of $(4\mathbf{i} - 8\mathbf{j})$ cm s^{-1}.  Calculate the magnitude of the velocity of the puck immediately after the collision. **3**
23	15	A bullet of mass m kg is fired at a block of wood of mass M kg which hangs vertically and at rest at the end of a light inextensible string. The bullet enters the block horizontally while travelling at a speed of u m s^{-1}, and becomes embedded in the block. The block then swings until it reaches a height h metres above its original position. Show that $h = \frac{1}{2g}\left(\frac{mu}{M+m}\right)^2$. **5**
22	1	An object of mass 8 kg is at rest on a smooth horizontal surface. A constant horizontal force of magnitude 65 newtons is applied for 1.2 seconds. (a) Calculate the speed of the object after this time. **2** The object then hits a wall and rebounds in the opposite direction with no loss of energy. (b) Calculate the magnitude of the impulse of the wall on the object. **2**
19	1	A body of mass 4 kg is moving with initial velocity $(3\mathbf{i} + 2\mathbf{j})$ m s^{-1}. It is given an impulse of $(6\mathbf{i} + \mathbf{j})$ Ns. Calculate the magnitude of the final velocity and the angle it makes with the x-axis. **4**
18	3	An object of mass 10 kg is projected along a rough horizontal surface with an initial speed of 12 m s^{-1}. The coefficient of friction between the object and the surface is 0·25. After travelling a distance of 20 metres along this rough surface it collides and coalesces with a stationary object of mass 5 kg. Find the speed of the combined objects immediately after the collision. **5**

18	17	A box of mass m kg is set in motion with an initial impulse I. As it moves along the surface it experiences a resistive force proportional to the square of its velocity $v\,\text{m s}^{-1}$. By setting up a differential equation, show that the velocity of the box after t seconds can be expressed as $v = \frac{mI}{Ikt + m^2}$, where k is a constant and t is measured from the moment of impulse.	5
17	8	Two particles, X and Y, have masses of 0·2 kg and 0·5 kg respectively. They are moving up a smooth plane AB, inclined at 30° to the horizontal as shown in the diagram.  The particles collide 3·5 metres from B when X is moving with a speed of $6\,\text{m s}^{-1}$ and Y is moving with a speed of $3\,\text{m s}^{-1}$. This collision causes X to come instantaneously to rest while Y continues to travel up the slope. Show that in the subsequent motion, Y comes to rest before reaching B.	6
16	1	A bicycle and rider have a total mass of 70 kg. They are travelling at $12\,\text{m s}^{-1}$. The cyclist applies the brakes for 1·5 seconds, resulting in a total resistive force of 180 newtons. What is the speed of the bicycle after 1·5 seconds?	3
16 Sp	1	A curling stone, P, of mass 18 kg is moving with velocity $\begin{pmatrix} 0 \\ -1{\cdot}1 \end{pmatrix}\,\text{m s}^{-1}$ relative to a suitable set of coordinate axes. It collides with a stationary curling stone, Q, of mass 20 kg. Q then moves off with velocity $\begin{pmatrix} 0{\cdot}36 \\ -0{\cdot}72 \end{pmatrix}\,\text{m s}^{-1}$. Calculate the speed with which P travels immediately after impact.	3