

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

8 Momentum

Exercise B, Question 5

Question:

A particle has mass 2 kg and velocity $(7\mathbf{i} + 2\mathbf{j}) \text{ m s}^{-1}$ when it collides with a particle of mass m , which is moving parallel to the unit vector \mathbf{j} . After the collision the two particles move together with velocity $(2\mathbf{i} + \mathbf{j}) \text{ m s}^{-1}$.

- (a) Find m .
- (b) Find the velocity of B before the collision.

Solution:

Let the original velocity of the particle of mass m to be $k\mathbf{j}$.
Using conservation of momentum;

$$2 \begin{bmatrix} 7 \\ 2 \end{bmatrix} + m \begin{bmatrix} 0 \\ k \end{bmatrix} = (2 + m) \begin{bmatrix} 2 \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} 14 \\ 4 + mk \end{bmatrix} = \begin{bmatrix} 4 + 2m \\ 2 + m \end{bmatrix}$$

(a) Using i components; $14 = 4 + 2m$
 $\therefore m = 5$

Using j components; $4 + mk = 2 + m$
 (b) since $m = 5$; $4 + 5k = 7$
 $\therefore k = \frac{3}{5}$

\therefore Velocity of B before the collision was $0.6\mathbf{j} \text{ m s}^{-1}$.