

Momentum in 1D

Question Paper 2

Level	A Level
Subject	Maths
Exam Board	AQA
Module	Mechanics 1
Topic	Momentum
Sub Topic	Momentum in 1D
Booklet	Question Paper - 2

Time Allowed: 60 minutes

Score: /48

Percentage: /100

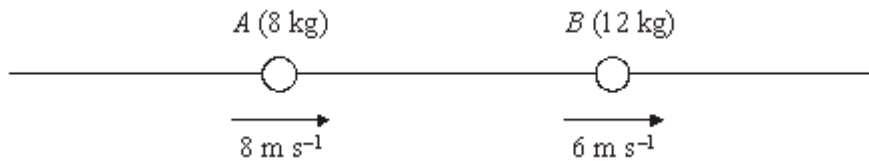
Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

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Q1. Two particles, A and B , are moving in the same direction along a straight line. Particle A has mass 8 kg and speed 8 m s^{-1} . Particle B has mass 12 kg and speed 6 m s^{-1} . The two particles collide.



- (a) If, during the collision, the two particles coalesce, find the speed of the combined particle. (3)
- (b) If, after the collision, particle A continues to move in the same direction at 6.5 m s^{-1} , find the speed of B after the collision. (3)
- (Total 6 marks)**

Q2. A particle A , of mass 0.1 kg , collides with a particle B , of mass 0.2 kg .

Immediately before the collision, the velocity of A is $\begin{bmatrix} 8 \\ 12 \end{bmatrix} \text{ m s}^{-1}$ and the velocity of B is $\mathbf{V} \text{ m s}^{-1}$.

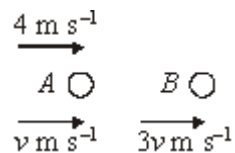
Immediately after the collision, the velocity of A is $\begin{bmatrix} -2 \\ 6 \end{bmatrix} \text{ m s}^{-1}$ and the velocity of B is $\begin{bmatrix} 6 \\ 0 \end{bmatrix} \text{ m s}^{-1}$.

- (a) Find \mathbf{V} . (4)
- (b) The collision occurs at the origin, O . After the collision, the particles continue to move with constant velocities.
- (i) Find the position vectors of A and B two seconds after the collision occurs. (2)
- (ii) Find the distance between A and B two seconds after the collision occurs. (3)
- (Total 9 marks)**

Q3. A particle A of mass $3m$ kg is moving with speed 4 m s^{-1} in a straight line on a smooth horizontal surface.

The particle collides with a stationary particle B of mass m kg.

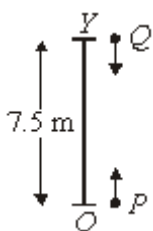
Immediately after the collision, A is moving with speed $v \text{ m s}^{-1}$, and B is moving with speed $3v \text{ m s}^{-1}$ in the same direction.



Find the value of v .

(Total 3 marks)

Q4. The point Y is 7.5 metres vertically above the point O . A particle P is projected vertically upwards from O and, at the same time, a particle Q is dropped from Y .



The time, t seconds, is measured from the start of the motion.

When $t = \frac{5}{7}$, P has risen 5 metres.

(a) (i) Find the distance that Q has fallen when $t = \frac{5}{7}$.

(2)

(ii) Verify that P and Q collide when $t = \frac{5}{7}$. (1)

(b) The masses of P and Q are 0.2 kg and 0.3 kg respectively. Immediately before the collision, P is moving vertically upwards with speed 3.5 m s^{-1} . The particles coalesce due to the collision. Use the conservation of momentum to find the magnitude and direction of the velocity of the combined particle immediately after the collision. (6)

(Total 9 marks)

Q5. Two particles, A and B , of masses $3m$ kg and m kg respectively, are moving in the same straight line and in the same direction on a horizontal surface. The particles collide directly. As a result of the collision, the particles coalesce to form a single particle C .

Immediately before the collision, A is moving with speed $v \text{ m s}^{-1}$ and B is moving with speed 2 m s^{-1} . Immediately after the collision, C is moving with speed 1.5 m s^{-1} .

(a) Find the value of v . (3)

(b) The surface on which the particles move is rough. After the collision, C moves with constant retardation and comes to rest at a distance of 3 metres from the point of collision. Find the magnitude of the retardation of C . (3)

(Total 6 marks)

Q6. Two particles, A and B , of masses $2m$ kg and m kg respectively, are moving directly **towards** each other on a smooth horizontal surface. The speeds of A and B are 2 m s^{-1} and 6 m s^{-1} respectively.

The particles A and B collide and subsequently move directly **away** from each other with speeds $3V \text{ m s}^{-1}$ and $V \text{ m s}^{-1}$ respectively.

Find the value of V .

(Total 4 marks)

Q7. A particle P moves with a constant velocity.

- (a) The particle passes through the points with the position vectors $\begin{bmatrix} -1 \\ 2 \end{bmatrix}$ and $\begin{bmatrix} 2 \\ 8 \end{bmatrix}$ at times $t = 0$ and $t = 3$ respectively. The units of distance and time are metres and seconds respectively.

Show that the velocity of P is $\begin{bmatrix} 1 \\ 2 \end{bmatrix} \text{ m s}^{-1}$.

(3)

- (b) When $t = 3$, the particle P , of mass 0.2 kg collides with a particle Q . The particle Q has

mass 0.1 kg and, immediately before the collision, it is moving with velocity

$$\begin{bmatrix} -5 \\ 5 \end{bmatrix} \text{ m s}^{-1}.$$

As a result of the collision, P and Q coalesce into a single particle, R .

Find the velocity of R immediately after the collision.

(4)

- (c) Assuming that the velocity of R remains constant, find the position vector of R three seconds after the collision.

(4)
(Total 11 marks)

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