Momentum and collisions – AS Further Mathematics Mechanics

1. June/2022/Paper_7366/02/No.2

Two particles of equal mass are moving on a horizontal surface when they collide.

Immediately before the collision, their velocities are $\begin{bmatrix} 2 \\ 4 \end{bmatrix}$ m s⁻¹ and $\begin{bmatrix} 6 \\ -2 \end{bmatrix}$ m s⁻¹

As a result of the collision the particles coalesce to become a single particle.

Find the velocity of the single particle, immediately after the collision.

Circle your answer.

[1 mark]

$$\begin{bmatrix} 4 \\ 1 \end{bmatrix} m s^{-1} \qquad \begin{bmatrix} 4 \\ 3 \end{bmatrix} m s^{-1} \qquad \begin{bmatrix} 8 \\ 2 \end{bmatrix} m s^{-1} \qquad \begin{bmatrix} 8 \\ 6 \end{bmatrix} m s^{-1}$$

2. June/2022/Paper_7366/02/No.6

An ice hockey puck, of mass 0.2 kg, is moving in a straight line on a horizontal ice rink under the action of a single force which acts in the direction of motion.

At time t seconds, the force has magnitude (2t + 3) newtons.

The force acts on the puck from t = 0 to t = T

(a) Show that the magnitude of the impulse of the force is $aT^2 + bT$, where *a* and *b* are integers to be found.

[3 marks]

(b) While the force acts on the puck, its speed increases from 1 m s⁻¹ to 4 m s⁻¹
Use your answer from part (a) to find *T*, giving your answer to three significant figures.
Fully justify your answer.

[4 marks]

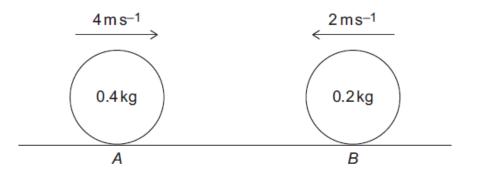


3. June/2022/Paper_7366/02/No.7

The particles *A* and *B* are moving on a smooth horizontal surface directly towards each other.

Particle A has mass 0.4 kg and particle B has mass 0.2 kg

Particle *A* has speed 4 m s^{-1} and particle *B* has speed 2 m s^{-1} when they collide, as shown in the diagram below.



The coefficient of restitution between the particles is *e*

(a) Find the magnitude of the total momentum of the particles before the collision.

[2 marks]

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(b) (i)	Show that the speed of <i>B</i> immediately after the collision is $(4e + 2) \text{ m s}^{-1}$	[3 marks]
<mark>(b) (</mark> ii)	Find an expression, in terms of <i>e</i> , for the speed of <i>A</i> immediately after the	collision. [2 marks]
(c)	Explain what happens to particle A when the collision is perfectly elastic.	[2 marks]