Edexcel Maths M1

Topic Questions from Papers

Collisions

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1. A particle P of mass 1.5 kg is moving along a straight horizontal line with speed 3 m s^{-1}. Another particle Q of mass 2.5 kg is moving, in the opposite direction, along the same straight line with speed 4 m s^{-1}. The particles collide. Immediately after the collision the direction of motion of P is reversed and its speed is 2.5 m s^{-1}.

(a) Calculate the speed of Q immediately after the impact.

(3)

(b) State whether or not the direction of motion of Q is changed by the collision.

(1)

(c) Calculate the magnitude of the impulse exerted by Q on P, giving the units of your answer.

(3)

Leave blank

2. Two small steel balls A and B have mass 0.6 kg and 0.2 kg respectively. They are moving towards each other in opposite directions on a smooth horizontal table when they collide directly. Immediately before the collision, the speed of A is 8 m s^{-1} and the speed of B is 2 m s^{-1}. Immediately after the collision, the direction of motion of A is unchanged and the speed of B is twice the speed of A. Find

(a) the speed of A immediately after the collision,

(5)

(b) the magnitude of the impulse exerted on B in the collision.

(3)

Leave blank

2. (a) Two particles A and B, of mass 3 kg and 2 kg respectively, are moving in the same direction on a smooth horizontal table when they collide directly. Immediately before the collision, the speed of A is 4 m s^{-1} and the speed of B is 1.5 m s^{-1}. In the collision, the particles join to form a single particle C.

Find the speed of C immediately after the collision.

(3)

(b) Two particles P and Q have mass 3 kg and m kg respectively. They are moving towards each other in opposite directions on a smooth horizontal table. Each particle has speed 4 m s^{-1}, when they collide directly. In this collision, the direction of motion of each particle is reversed. The speed of P immediately after the collision is 2 m s^{-1} and the speed of Q is 1 m s^{-1}. Find

(i) the value of m,

(3)

(ii) the magnitude of the impulse exerted on Q in the collision.

(2)

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Question 2 continued

Q2

(Total 8 marks)

Leave blank

2. Two particles A and B have mass 0.4 kg and 0.3 kg respectively. They are moving in opposite directions on a smooth horizontal table and collide directly. Immediately before the collision, the speed of A is 6 m s^{-1} and the speed of B is 2 m s^{-1}. As a result of the collision, the direction of motion of B is reversed and its speed immediately after the collision is 3 m s^{-1}. Find

(a) the speed of A immediately after the collision, stating clearly whether the direction of motion of A is changed by the collision,

(4)

(b) the magnitude of the impulse exerted on B in the collision, stating clearly the units in which your answer is given.

(3)

Leave blank

4. A particle P of mass 0.3 kg is moving with speed u m s^{-1} in a straight line on a smooth horizontal table. The particle P collides directly with a particle Q of mass 0.6 kg, which is at rest on the table. Immediately after the particles collide, P has speed 2 m s^{-1} and Q has speed 5 m s^{-1}. The direction of motion of P is reversed by the collision. Find

(a) the value of u,

(4)

(b) the magnitude of the impulse exerted by P on Q.

(2)

Immediately after the collision, a constant force of magnitude R newtons is applied to Q in the direction directly opposite to the direction of motion of Q. As a result Q is brought to rest in 1.5 s.

(c) Find the value of R.

(4)

Leave blank

Question 4 continued

Q4

(Total 10 marks)

Leave blank

2. Two particles A and B, of mass 0.3 kg and m kg respectively, are moving in opposite directions along the same straight horizontal line so that the particles collide directly. Immediately before the collision, the speeds of A and B are 8 m s^{-1} and 4 m s^{-1} respectively. In the collision the direction of motion of each particle is reversed and, immediately after the collision, the speed of each particle is 2 m s^{-1}. Find

(a) the magnitude of the impulse exerted by B on A in the collision,

(3)

(b) the value of m.

(4)

Leave blank

1. Two particles A and B have masses 4 kg and m kg respectively. They are moving towards each other in opposite directions on a smooth horizontal table when they collide directly. Immediately before the collision, the speed of A is 5 m s^{-1} and the speed of B is 3 m s^{-1}. Immediately after the collision, the direction of motion of A is unchanged and the speed of A is 1 m s^{-1}.

(a) Find the magnitude of the impulse exerted on A in the collision.

(2)

Immediately after the collision, the speed of B is 2 m s^{-1}.

(b) Find the value of m.

(4)

Leave blank

1. Two particles P and Q have mass 0.4 kg and 0.6 kg respectively. The particles are initially at rest on a smooth horizontal table. Particle P is given an impulse of magnitude 3 N s in the direction PQ.

(a) Find the speed of P immediately before it collides with Q.

(3)

Immediately after the collision between P and Q, the speed of Q is 5 m s^{-1}.

(b) Show that immediately after the collision P is at rest.

(3)

Leave blank

3. Two particles A and B are moving on a smooth horizontal plane. The mass of A is km, where $2 < k < 3$, and the mass of B is m. The particles are moving along the same straight line, but in opposite directions, and they collide directly. Immediately before they collide the speed of A is $2u$ and the speed of B is $4u$. As a result of the collision the speed of A is halved and its direction of motion is reversed.

(a) Find, in terms of k and u, the speed of B immediately after the collision.

(3)

(b) State whether the direction of motion of B changes as a result of the collision, explaining your answer.

(3)

Given that $k = \frac{7}{3}$,

(c) find, in terms of m and u, the magnitude of the impulse that A exerts on B in the collision.

(3)

Leave blank

3. Two particles A and B are moving on a smooth horizontal plane. The mass of A is $2m$ and the mass of B is m. The particles are moving along the same straight line but in opposite directions and they collide directly. Immediately before they collide the speed of A is $2u$ and the speed of B is $3u$. The magnitude of the impulse received by each particle in the collision is $\frac{7mu}{2}$.

Find

(a) the speed of A immediately after the collision,

(3)

(b) the speed of B immediately after the collision.

(3)

Leave blank

1. A particle A of mass 2 kg is moving along a straight horizontal line with speed $12\,\text{m s}^{-1}$. Another particle B of mass m kg is moving along the same straight line, in the opposite direction to A, with speed $8\,\text{m s}^{-1}$. The particles collide. The direction of motion of A is unchanged by the collision. Immediately after the collision, A is moving with speed $3\,\text{m s}^{-1}$ and B is moving with speed $4\,\text{m s}^{-1}$. Find

(a) the magnitude of the impulse exerted by B on A in the collision,

(2)

(b) the value of m.

(4)

Leave blank

2. Particle P has mass m kg and particle Q has mass $3m$ kg. The particles are moving in opposite directions along a smooth horizontal plane when they collide directly. Immediately before the collision P has speed $4u$ m s^{-1} and Q has speed ku m s^{-1}, where k is a constant. As a result of the collision the direction of motion of each particle is reversed and the speed of each particle is halved.

(a) Find the value of k.

(4)

(b) Find, in terms of m and u, the magnitude of the impulse exerted on P by Q.

(3)

Leave blank

1. Two particles B and C have mass m kg and 3 kg respectively. They are moving towards each other in opposite directions on a smooth horizontal table. The two particles collide directly. Immediately before the collision, the speed of B is $4\ \text{m s}^{-1}$ and the speed of C is $2\ \text{m s}^{-1}$. In the collision the direction of motion of C is reversed and the direction of motion of B is unchanged. Immediately after the collision, the speed of B is $1\ \text{m s}^{-1}$ and the speed of C is $3\ \text{m s}^{-1}$.

Find

(a) the value of m,

(3)

(b) the magnitude of the impulse received by C.

(2)

Leave blank

2. Particle P has mass 3 kg and particle Q has mass 2 kg. The particles are moving in opposite directions on a smooth horizontal plane when they collide directly. Immediately before the collision, P has speed 3 m s^{-1} and Q has speed 2 m s^{-1}. Immediately after the collision, both particles move in the same direction and the difference in their speeds is 1 m s^{-1}.

(a) Find the speed of each particle after the collision.

(5)

(b) Find the magnitude of the impulse exerted on P by Q.

(3)

Leave blank

1. A railway truck P, of mass m kg, is moving along a straight horizontal track with speed $15\,\text{m s}^{-1}$. Truck P collides with a truck Q of mass 3000 kg, which is at rest on the same track. Immediately after the collision the speed of P is $3\,\text{m s}^{-1}$ and the speed of Q is $9\,\text{m s}^{-1}$. The direction of motion of P is reversed by the collision.

Modelling the trucks as particles, find

(a) the magnitude of the impulse exerted by P on Q,

(2)

(b) the value of m.

(3)

Leave blank

1. Two particles A and B, of mass $5m$ kg and $2m$ kg respectively, are moving in opposite directions along the same straight horizontal line. The particles collide directly. Immediately before the collision, the speeds of A and B are $3\ \text{m s}^{-1}$ and $4\ \text{m s}^{-1}$ respectively. The direction of motion of A is unchanged by the collision. Immediately after the collision, the speed of A is $0.8\ \text{m s}^{-1}$.

(a) Find the speed of B immediately after the collision.

(3)

In the collision, the magnitude of the impulse exerted on A by B is 3.3 N s.

(b) Find the value of m.

(3)

Leave blank

1. Two particles P and Q have masses $4m$ and m respectively. The particles are moving towards each other on a smooth horizontal plane and collide directly. The speeds of P and Q immediately before the collision are $2u$ and $5u$ respectively. Immediately after the collision, the speed of P is $\frac{1}{2}u$ and its direction of motion is reversed.

(a) Find the speed and direction of motion of Q after the collision.

(4)

(b) Find the magnitude of the impulse exerted on P by Q in the collision.

(3)

Leave blank

1. Two particles A and B, of mass 2 kg and 3 kg respectively, are moving towards each other in opposite directions along the same straight line on a smooth horizontal surface. The particles collide directly. Immediately before the collision the speed of A is 5 m s^{-1} and the speed of B is 6 m s^{-1}. The magnitude of the impulse exerted on B by A is 14 N s. Find

(a) the speed of A immediately after the collision,

(3)

(b) the speed of B immediately after the collision.

(3)

Leave blank

1. Particle P has mass 3 kg and particle Q has mass m kg. The particles are moving in opposite directions along a smooth horizontal plane when they collide directly. Immediately before the collision, the speed of P is 4 m s^{-1} and the speed of Q is 3 m s^{-1}. In the collision the direction of motion of P is unchanged and the direction of motion of Q is reversed. Immediately after the collision, the speed of P is 1 m s^{-1} and the speed of Q is 1.5 m s^{-1}.

(a) Find the magnitude of the impulse exerted on P in the collision.

(3)

(b) Find the value of m.

(3)