

QQQ – Further Mechanics 1 – Chapter 4 – Collisions in One Dimension (Version 2)

Total Marks: 25

(25 = Platinum, 23 = Gold, 20 = Silver, 17 = Bronze)

1. A particle Q of mass $3m$ is at rest on a smooth horizontal plane. A particle P of mass m is moving along the plane when it collides directly with Q .

The speed of P immediately before the collision is u .

The direction of motion of P is reversed by the collision.

The coefficient of restitution between P and Q is e .

(a) Show that the speed of P immediately after the collision is $\frac{u(3e - 1)}{4}$ (6)

(b) State the full range of possible values of e . (1)

Given that $e = \frac{1}{2}$

(c) find, in terms of m and u , the magnitude of the impulse exerted by P on Q in the collision. (3)

(Total 10 marks)

2. A particle A of mass $2m$ is moving in a straight line with speed $3u$ on a smooth horizontal plane. Particle A collides directly with a particle B of mass m which is at rest on the plane.

The coefficient of restitution between A and B is e , where $e > 0$

(a) Show that the speed of B immediately after the collision is $2u(1 + e)$. (6)

After the collision, B hits a smooth fixed vertical wall which is perpendicular to the direction of motion of B .

(b) Show that there will be a second collision between A and B . (3)

The coefficient of restitution between B and the wall is $\frac{1}{2}$

Find, **in simplified form**, in terms of m , u and e ,

(c) the magnitude of the impulse received by B in its collision with the wall, (3)

(d) the loss in kinetic energy of B due to its collision with the wall. (3)

(Total 15 marks)