5: A particle P of mass $2m$ and a particle Q of mass m are at rest on a smooth horizontal plane. Particle P is projected with speed u along the plane towards Q and the particles collide. The coefficient of restitution between the particles is e, where $e > 0$

(a) Show that the speed of Q after the collision is $\frac{2(1+e)u}{3}$

(5)

The total loss of kinetic energy due to the collision is $k(1 - e^2)mu^2$, where k is a constant.

(b) Find the value of k.

(5)

The magnitude of the impulse of Q on P in the collision is $\frac{8mu}{9}$

(c) Find the value of e.

(2)

After the collision, Q goes on to hit a vertical wall which is fixed at right angles to the direction of motion of Q. The coefficient of restitution between Q and the wall is f.

After Q has hit the wall, Q has the same speed as P.

(d) Find the value of f.

(3)

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Question 5 continued

(Total for Question 5 is 15 marks)