7. Particle P has mass $4m$ and particle Q has mass $2m$.

The particles are moving in opposite directions along the same straight line on a smooth horizontal surface.

Particle P collides directly with particle Q.

Immediately **before** the collision, the speed of P is $2u$ and the speed of Q is $3u$.

Immediately **after** the collision, the speed of P is x and the speed of Q is y.

The direction of motion of each particle is reversed as a result of the collision.

The total kinetic energy of P and Q after the collision is half of the total kinetic energy of P and Q before the collision.

(a) Show that $y = \frac{8}{3}u$

(6)

The coefficient of restitution between P and Q is e.

(b) Find the value of e.

(3)

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

Particle Q rebounds.

The coefficient of restitution between Q and the wall is f.

Given that there is no second collision between P and Q,

(c) find the range of possible values of f.

(3)

Given that $f = \frac{1}{4}$

(d) find, in terms of m and u, the magnitude of the impulse received by Q as a result of its impact with the wall.

(2)

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TOTAL FOR PAPER IS 75 MARKS

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