7. A particle P has mass $5m$ and a 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 Q is **reversed** as a result of the collision.

The coefficient of restitution between P and Q is e.

(a) Find the set of values of e for which the direction of motion of P is **unchanged** as a result of the collision.

(7)

In the collision, Q receives an impulse of magnitude $\frac{60}{7}mu$

(b) Show that $e = \frac{1}{5}$

(5)

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

Particle Q rebounds and there is a second collision between P and Q.

The coefficient of restitution between Q and the wall is $\frac{1}{3}$

(c) Find, in terms of m and u, the magnitude of the impulse received by Q in the second collision between P and Q.

(3)

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Question 7 continued

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TOTAL FOR PAPER IS 75 MARKS

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