8. A particle P has mass m and a particle Q has mass km, where k is a constant.

The particles are moving in opposite directions along the same straight line on a smooth horizontal surface.
Particle P collides directly with Q.

Immediately **before** the collision, the speed of P is $6u$ and the speed of Q is u.
Immediately **after** the collision, the speed of P is $2v$ and the speed of Q is $3v$.

As a result of the collision

- the direction of motion of P is unchanged
- the direction of motion of Q is reversed

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

(a) Find v in terms of u only.

(3)

(b) Find the value of k.

(3)

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 first collision between P and Q takes place at a distance d from the wall.

The second collision between P and Q takes place at a distance $\frac{1}{7}d$ from the wall.

The coefficient of restitution between Q and the wall is f

(c) Find the value of f

(5)

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Question 8 continued

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TOTAL FOR PAPER IS 75 MARKS

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