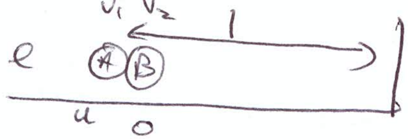
Collision (I) :



Both mass m

PCM : $mu + m(0) = mv_1 + mv_2$

$\boxed{u = v_1 + v_2}$

NLR : $v_2 - v_1 = -e(u_2 - u_1)$

$\Rightarrow v_2 - v_1 = -e(0 - u)$

$\boxed{v_2 - v_1 = eu}$

$\rightarrow 2v_2 = u + eu$

$\underbrace{v_2 = \frac{u}{2}(1+e)}$

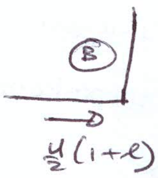
$\therefore v_1 + \frac{u}{2}(1+e) = u$

$v_1 = u - \frac{u}{2} - \frac{u}{2}e$

$v_1 = \frac{u}{2} - \frac{u}{2}e$

$\underbrace{v_1 = \frac{u}{2}(1-e)}$

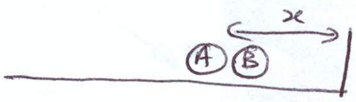
Collision (II) :



NLR $\Rightarrow$ Rebounds with speed $e\frac{u}{2}(1+e)$ in opposite dir^n.

Let next impact take place x metres from wall.

Collision (III)



Let t_1 be time for B to reach wall [time between Coll (I) and Coll (II)]

In this time (B) travels 1m at speed $\frac{u}{2}(1+e)$ m/s. (Constant speed)

$$\Rightarrow t_1 = \frac{1}{\frac{u}{2}(1+e)} = \frac{2}{u(1+e)}$$

In this time A travels = (speed)(time) $= \frac{u}{2}(1-e)\left(\frac{2}{u(1+e)}\right) = \frac{1-e}{1+e}$ metres.

and then A is $1 - \left(\frac{1-e}{1+e}\right) = \frac{2e}{1+e}$ metres from the wall.

Let t_2 be time for (B) to travel from wall to meet A again.

Let (B) travel x metres from wall to meet A, at a speed $\frac{eu}{2}(1+e)$

$$\therefore t_2 = \frac{x}{\frac{eu}{2}(1+e)}$$

But in the same time, t_2, A will have travelled $\frac{2e}{1+e} - x$ metres towards wall at a speed $\frac{u}{2}(1-e)$

$$\therefore t_2 = \frac{\frac{2e}{1+e} - x}{\frac{u}{2}(1-e)}$$

$$\frac{x}{\ldots(1+e)} = \frac{\frac{2e}{1+e} - x}{\frac{u}{2}(1-e)} \Rightarrow x(1-e) = e(2e) - e(1+e)x$$

$\Rightarrow x - ex + ex + e^2x = 2e^2$

$\Rightarrow \boxed{x = \frac{2e^2}{1+e^2}}$ qed. (! Phew !)

$$\ldots e) = \frac{1}{\frac{u}{2}(1+e)} + \frac{x}{\frac{eu}{2}(1+e)} \Rightarrow x = \frac{2e^2}{1+e^2}.$$ (Quicker!)