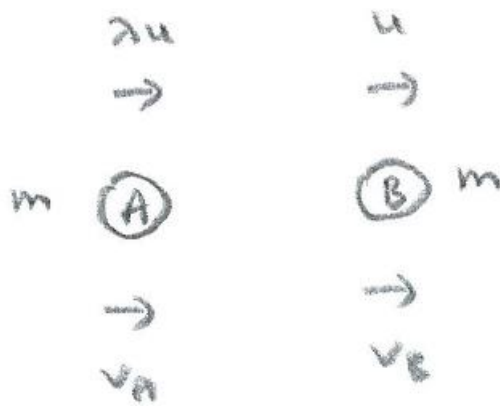# STEP, Collisions – Q4 (11/6/23)

Particles A and B have the same mass and are travelling on a smooth surface, along the same line and in the same direction, with the speed of A being λ times that of B, where $\lambda > 1$, so that A and B collide. Show that the direction of A is never reversed.

Solution

Conservation of momentum $\Rightarrow m\lambda u + mu = mv_A + mv_B$

By Newton's Law of Restitution, $v_B - v_A = e(\lambda - 1)u$

Substituting for v_B in the 1st eq'n,

$u(\lambda + 1) = v_A + v_A + e(\lambda - 1)u,$

so that $v_A = \frac{1}{2}u(\lambda + 1 - \lambda e + e)$

Then $v_A < 0 \Rightarrow \lambda + 1 - \lambda e + e < 0$

$\Rightarrow e(\lambda - 1) > \lambda + 1$

$\Rightarrow e > \frac{\lambda+1}{\lambda-1} > 1$, which is not possible.