STEP, Collisions – Q9 (11/6/23)

Two balls, A & B, collide directly on a smooth surface. Ball A has mass m, and travels towards ball B, whilst ball B has mass km, and travels away from ball A. Show that the reduction in speed of ball A, after the collision, is equal to k times the increase in speed of ball B.

Solution

Let the speeds of the balls be u_A & u_B before the collision, and v_A & v_B after the collision.

Then, by Conservation of Momentum,

$mu_A + kmu_B = mv_A + kmv_B$,

so that $u_A - v_A = k(v_B - u_B)$, as required

[Note: This also applies to cases where the balls are travelling towards each other, or where one of the balls is stationary.]