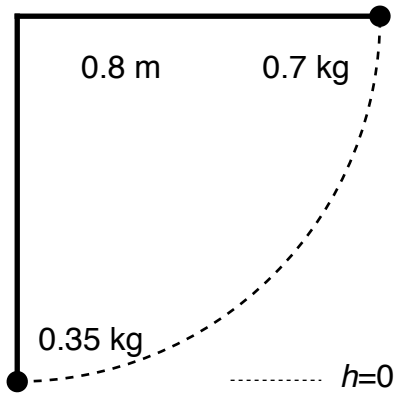
Colliding balls
from 1996 exam

A ball of mass 700g is fastened to a cord 800mm long and fixed at the far end at a support, and is released when the cord is horizontal. At the bottom of its path, the ball strikes a stationary 350g ball suspended from the same support with a cord 800mm long. The two balls stick together after the collision.

a) Calculate the speed of the falling ball just before it hits the stationary ball.

b) Calculate the speed of the two balls immediately after the collision.



Solution:

(a) Use conservation of mechanical energy to find the speed of the falling ball: take the height of the stationary ball to be h=0

$ME_i = U_i \quad (K_i = 0)$

$ME_f = K_f \quad (U_f = 0)$

so $K_f = \frac{1}{2}mv^2 = U_i = mgh$

$v^2 = 2gh = 2 \times 9.8 \times 0.8 = 15.68$

$v = 3.96$ ms^{-1}

(b) The balls stick together, so the collision is inelastic. Momentum is conserved, so

$p_i = p_f$

$p_i = 0.35 \times 0 + 0.7 \times 3.96 = 2.77$ kg ms^{-1}

$p_f = (m_1+m_2)v = (0.35 + 0.7)v = 1.05v$

so equating to p_i,

$v = 2.77/1.05 = 2.64$ ms^{-1}