Class Notes – Lecture 17 20 October 2009

From lecture 16: question 73

Assume both fall 1.2m

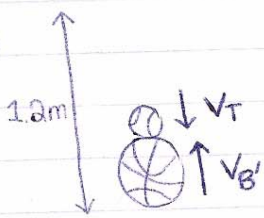
a) $V_T = -4.85\ m/s$

$V_B = -4.85\ m/s$

$\frac{1}{2} \cancel{m_B} V_B^2 = \cancel{m_B} g h$

$V_B = \sqrt{2gh}$ put in direction by hand

b)



$m_1 V_{1i} + m_2 V_{2i} = m_1 V_{1f} + m_2 V_{2f}$

$m_1 = m_B, \quad V_1 = V_B'$

$m_2 = m_T, \quad V_2 = V_T$

$m_B V_B' + m_T V_T = m_B V_{1f} + m_T V_{2f}$

$0.59(4.85) + .057(-4.85) = 0.59(V_{1f}) + .057(V_{2f})$

$0.59 V_{1f} + .057 V_{2f} = 2.58$ ①

Elastic Collision:

$\cancel{\frac{1}{2}} m_1 V_{1i}^2 + \cancel{\frac{1}{2}} m_2 V_{2i}^2 = \cancel{\frac{1}{2}} m_1 V_{1f}^2 + \cancel{\frac{1}{2}} m_2 V_{2f}^2$ not linear variables squared

For 1D: $m_1 V_{1i} - m_1 V_{1f} = -m_2 V_{2i} + m_2 V_{2f}$

$m_1 (V_{1i} - V_{1f}) = m_2 (V_{2f} - V_{2i})$ ②

$m_1 V_{1i}^2 - m_1 V_{1f}^2 = -m_2 V_{2i}^2 + m_2 V_{2f}^2$

$m_1 (V_{1i}^2 - V_{1f}^2) = m_2 (V_{2f}^2 - V_{2i}^2)$

$\cancel{m_1 (V_{1i} - V_{1f})} (V_{1i} + V_{1f}) = \cancel{m_2 (V_{2f} - V_{2i})} (V_{2f} - V_{2i})$ can cancel from equation 2

Therefore: $V_{1i} + V_{1f} = V_{2i} + V_{2f}$

$4.85 + V_{1f} = -4.85 + V_{2f}$

$V_{1f} - V_{2f} = -9.7$ ③

now, 1 and 3 are simultaneous:

$V_{1f} = 3.11\ m/s$

$V_{2f} = 12.81\ m/s$

b) $\frac{1}{2} \cancel{m_T} V_{2f}^2 = \cancel{m_T} g h'$

$h' = \frac{V_{2f}^2}{2g}$

$h' = 8.37\text{m}$

Inelastic Equations

KE not conserved (some lost @ collision)

p still conserved

DEMO: Bullet shot at ballistic pendulum; perfectly inelastic because bullet sticks inside pendulum. After collision, $v_{1f} = v_{2f}$.

Part 1: p conservation when bullet hits, find v_f

Part 2: conservation of energy

Sometimes, $KE_f > KE_i$, as in gun recoil so $p_f = 0$

CQ: gun (mass M), bullet (mass m), $v_b = +v_b$

$v_g = ???$

$0 = mv_b + Mv_g$

$v_g = -(m/M)\,v_b$

CQ: $\underbrace{\Delta p}_{0}$ and $\underbrace{\Delta KE}_{\frac{1}{2}mv_b^2\left(1+\frac{m}{M}\right)} = ???$

DEMO: To move, planes need air, changes p. In space, there is no air. To move, the astronaut, she must throw something away from the shuttle (direction she wants to go)