

Collisions/ Explosions in 1D

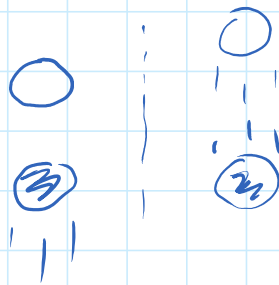
Monday, April 9, 2018 9:14 AM

During a collision or explosion the total momentum of all objects remain constant: The conservation of momentum

$$P_{\text{before}} = P_{\text{after}}$$

Collision - elastic: the $E_{k \text{ before}} = E_{k \text{ after}}$
 - inelastic: $E_{k \text{ before}} \neq E_{k \text{ after}}$

Ex: A red ball ($m=0.5\text{kg}$) travels at 4.0m/s [N] and collides with a stationary green ball ($m=1.5\text{kg}$). The red ball travels at 2m/s [S] after collision. Determine the velocity of green ball; whether its elastic/inelastic



$$P_b = P_a$$

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

$$(.5\text{kg})(4) + (1.5)(0) = (.5\text{kg})(-2\text{m/s}) + (1.5)v_2'$$

$$2 = -1 + 1.5v_2'$$

$$v_2' = 2\text{m/s} \text{ [N]}$$

$$E_{k_b} \stackrel{?}{=} E_{k_a}$$

$$\frac{1}{2}(.5)(4)^2 + 0 = \frac{1}{2}(.5)(-2)^2 + \frac{1}{2}(1.5)(2)^2$$

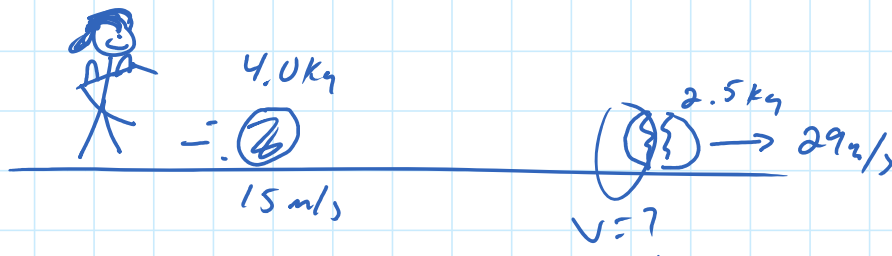
$$4 = 1 + 3$$

$$4 = 4 \quad \checkmark \text{ elastic}$$

Ex A 4.0kg bowling ball traveling at 15m/s down a

bowling lane spontaneously explodes into 2 pieces.

A 2.5 kg chunk travels down the lane at 29 m/s knocking down all the pins. Find the velocity of the other piece.



$$P_b = P_a$$

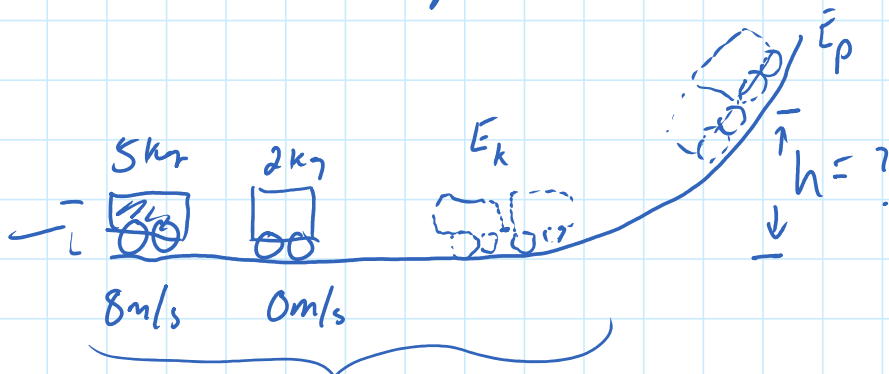
$$Mv = m_1 v_1 + m_2 v_2$$

$$4(15) = (2.5)(29 \text{ m/s}) + (1.5)v$$

$$60 = 72.5 + 1.5v$$

$$v = -8.3 \text{ m/s}$$

Ex 2 carts collide, stick together and travel up a hill. How high if no friction.



$$P_b = P_a$$

$$m_1 v_1 + m_2 v_2 = Mv$$

$$(5)(8) + 2(0) = 7v$$

$$v = 5.7 \text{ m/s}$$

$$E_b = E_a$$

$$E_k + \cancel{E_p} = \cancel{E_k} + E_p + \cancel{E_h}$$

$$\frac{1}{2}(7)(5.7)^2 = (7)(9.8)h$$

$$h = 1.67 \text{ m}$$