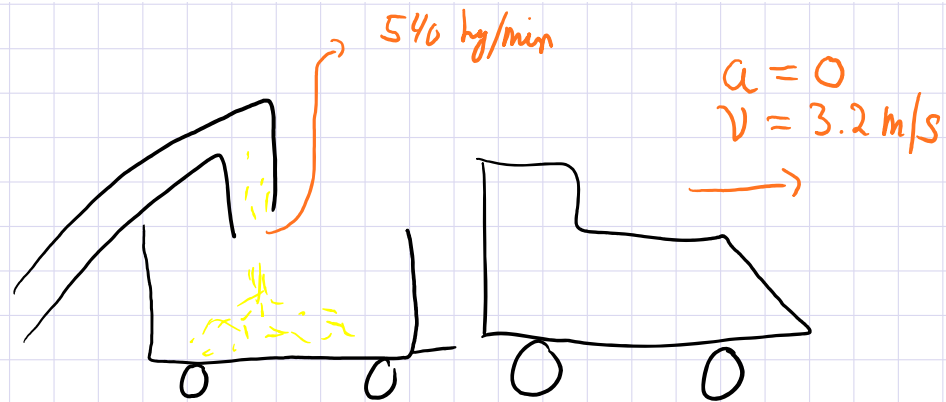
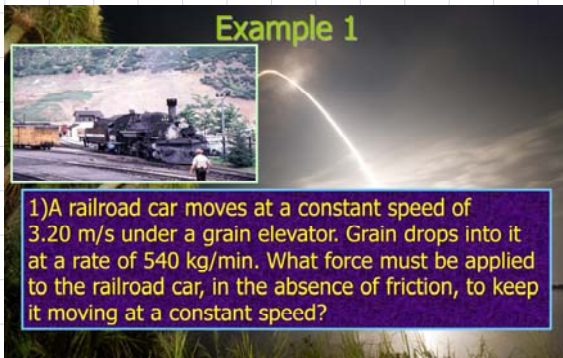


Example 1

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$$F = \frac{\Delta p}{\Delta t} = \frac{\Delta(mv)}{\Delta t}$$

$$F = \cancel{m} \frac{\Delta v}{\Delta t} + v \frac{\Delta m}{\Delta t} \leftarrow$$

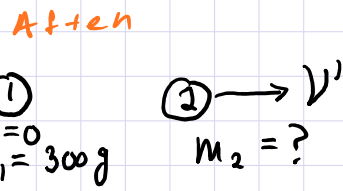
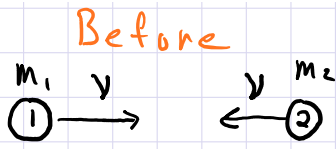
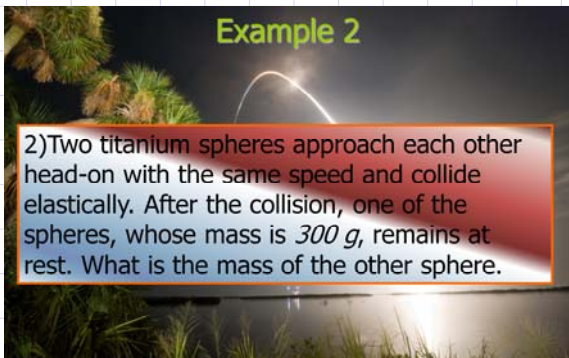
$$F = v \frac{\Delta m}{\Delta t}$$

$$F = (3.2 \text{ m/s}) (540 \text{ kg/min}) \left(\frac{1 \text{ min}}{60 \text{ s}} \right)$$

$$F = 28.8 \text{ N}$$

Example 2

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$$P_i = P_1 + P_2$$

$$P_i = m_1 v - m_2 v$$

$$P_i = (m_1 - m_2) v$$

$$KE_i = KE_1 + KE_2$$

$$KE_i = \frac{1}{2} m_1 v^2 + \frac{1}{2} m_2 v^2$$

$$KE_i = \frac{1}{2} v^2 (m_1 + m_2)$$

$$P_f = P_1' + P_2'$$

$$P_f = 0 + m_2 v'$$

$$P_f = m_2 v'$$

$$KE_f = KE_1' + KE_2'$$

$$KE_f = 0 + \frac{1}{2} m_2 v'^2$$

$$KE_f = \frac{1}{2} m_2 v'^2$$

$$P_i = P_f$$

$$(m_1 - m_2) v = m_2 v'$$

$$KE_i = KE_f$$

$$\frac{1}{2} v^2 (m_1 + m_2) = \frac{1}{2} m_2 v'^2$$

$$m_1 v^2 + m_2 v^2 = m_2 v'^2$$

$$m_1 v^2 = m_2 v'^2 - m_2 v^2$$

$$(2) m_1 v^2 = m_2 (v'^2 - v^2)$$

$$\frac{(2)}{(1)} \frac{m_1 v^2}{m_1 v} = \frac{m_2 (v'^2 - v^2)}{m_2 (v + v')}$$

$$v = v' - v$$

$$2v = v'$$

$$v = \frac{1}{2} v'$$

$$m_1 v - m_2 v = m_2 v'$$

$$m_1 v = m_2 v + m_2 v'$$

$$(1) m_1 v = m_2 (v + v')$$

$$(v + v)(v' - v)$$

$$m_1 (\frac{1}{2} v') = m_2 (\frac{1}{2} v' + v')$$

$$\frac{1}{2} m_1 = m_2 (\frac{1}{2} + 1)$$

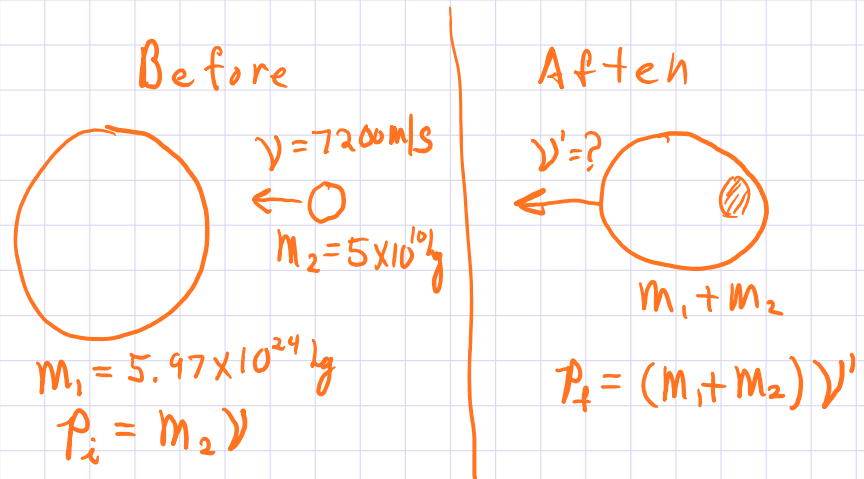
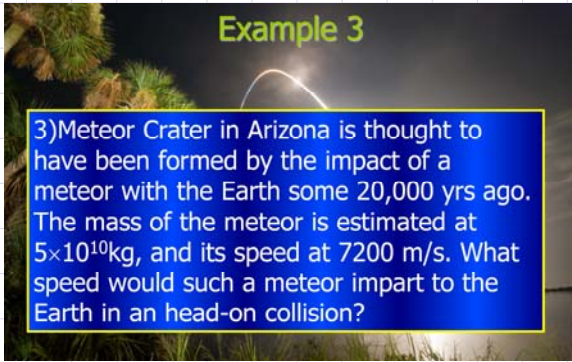
$$\frac{1}{2} m_1 = \frac{3}{2} m_2$$

$$m_1 = 3 m_2$$

$$m_2 = \frac{1}{3} m_1 = 100g$$

Example 3

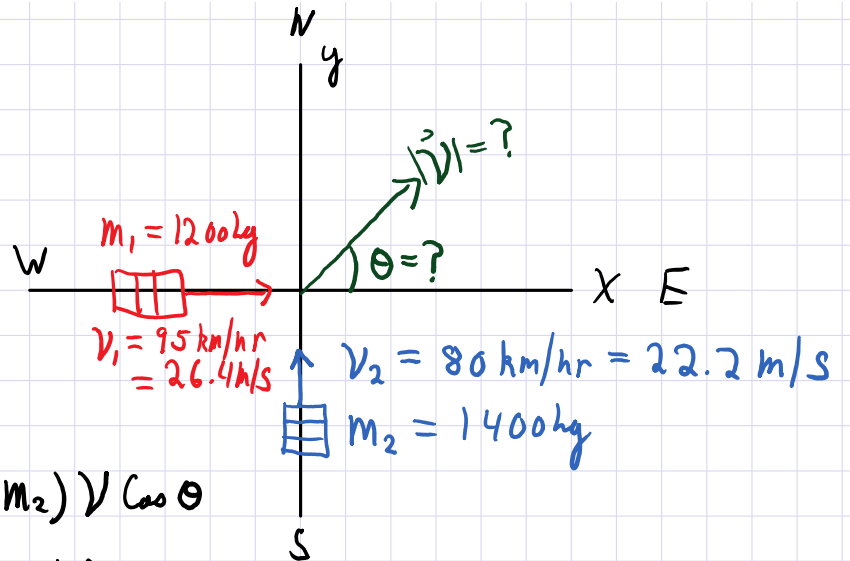
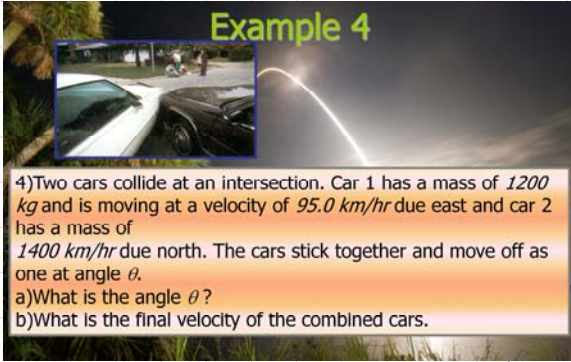
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$$p_f = p_i$$
$$(m_1 + m_2) v' = m_2 v$$
$$v' = v \frac{m_2}{(m_1 + m_2)} = (7200 \text{ m/s}) \frac{5 \times 10^{10} \text{ kg}}{(5.97 \times 10^{24} \text{ kg} + 5 \times 10^{10} \text{ kg})} = 6.03 \times 10^{-11} \text{ m/s}$$

Example 4

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$$P_{xi} = m_1 v_1 \qquad P_{xf} = (m_1 + m_2) v \cos \theta$$

$$P_{yi} = m_2 v_2 \qquad P_{yf} = (m_1 + m_2) v \sin \theta$$

$$x: m_1 v_1 = (m_1 + m_2) v \cos \theta \quad (1)$$

$$y: m_2 v_2 = (m_1 + m_2) v \sin \theta \quad (2)$$

$$\frac{(2)}{(1)} \quad \frac{m_2 v_2}{m_1 v_1} = \frac{(m_1 + m_2) v \sin \theta}{(m_1 + m_2) v \cos \theta}$$

$$m_2 v_2 = (m_1 + m_2) v \sin \theta$$

$$v = \frac{m_2 v_2}{(m_1 + m_2) \sin \theta}$$

$$v = \frac{(1400 \text{ kg})(22.2 \text{ m/s})}{(2600 \text{ kg}) \sin(44.45^\circ)}$$

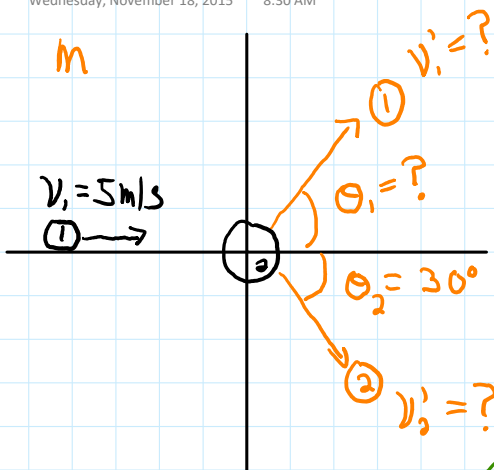
$$v = 17.07 \text{ m/s}$$

$$\tan \theta = \frac{m_2 v_2}{m_1 v_1}$$

$$\tan \theta = \frac{(1400 \text{ kg})(22.2 \text{ m/s})}{(1200 \text{ kg})(26.4 \text{ m/s})}$$

$$\tan \theta = .981$$

$$\theta = 44.45^\circ$$



$$P_{xi} = m v_i$$

$$P_{yi} = 0$$

$$KE_i = \frac{1}{2} m v_i^2$$

$$P_{xf} = m v_1' \cos \theta_1 + m v_2' \cos \theta_2$$

$$P_{yf} = m v_1' \sin \theta_1 - m v_2' \sin \theta_2$$

$$KE_f = \frac{1}{2} m v_1'^2 + \frac{1}{2} m v_2'^2$$

$$x: m v_i = m v_1' \cos \theta_1 + m v_2' \cos \theta_2$$

$$\textcircled{1} v_i = v_1' \cos \theta_1 + v_2' \cos \theta_2 \quad \leftarrow$$

$$y: 0 = m v_1' \sin \theta_1 - m v_2' \sin \theta_2$$

$$\textcircled{2} 0 = v_1' \sin \theta_1 - v_2' \sin \theta_2$$

$$KE: \frac{1}{2} m v_i^2 = \frac{1}{2} m v_1'^2 + \frac{1}{2} m v_2'^2$$

$$v_i^2 = v_1'^2 + v_2'^2 \quad \leftarrow$$

$$\Rightarrow \theta_1 = 60^\circ$$



$$\rightarrow v_1' = v_2' \frac{\sin \theta_2}{\sin \theta_1}$$

$$v_i = v_2' \left(\frac{\sin \theta_2}{\sin \theta_1} \right) \cos \theta_1 + v_2' \cos \theta_2$$

$$v_i = v_2' \left[\frac{\sin \theta_2}{\sin \theta_1} \cos \theta_1 + \cos \theta_2 \right]$$

$$v_2' = \frac{v_i}{\frac{\sin \theta_2}{\sin \theta_1} \cos \theta_1 + \cos \theta_2} = \frac{5 \text{ m/s}}{\frac{\sin(30^\circ)}{\sin(60^\circ)} \cos(60^\circ) + \cos(30^\circ)}$$

$$v_2' = 4.33 \text{ m/s}$$

$$v_1' = (4.33 \text{ m/s}) \frac{\sin(30^\circ)}{\sin(60^\circ)} = 2.5 \text{ m/s}$$