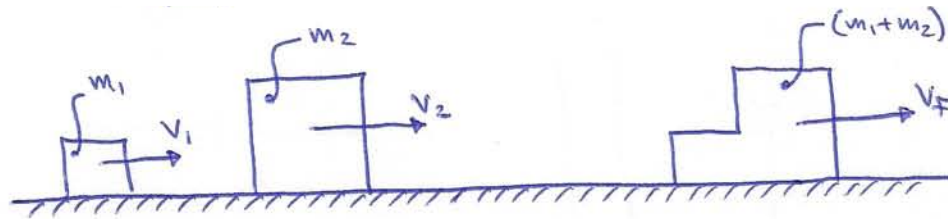


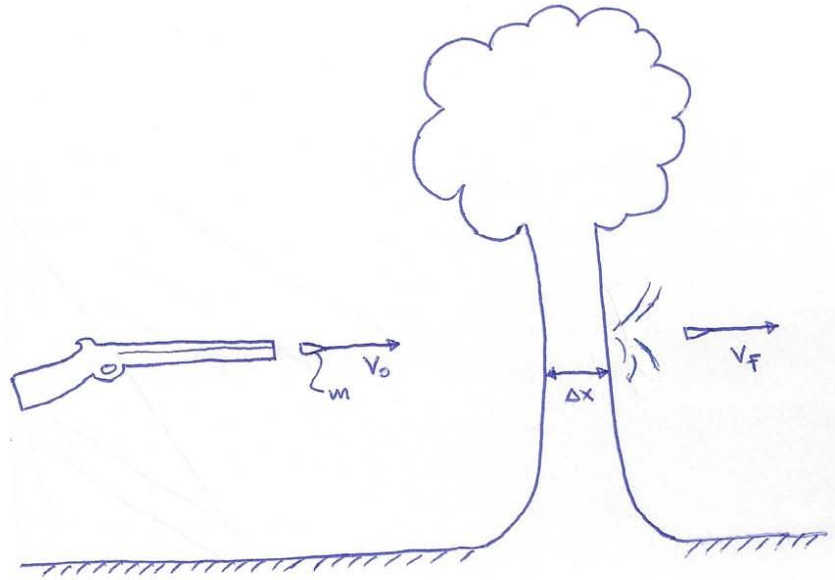
Determine the magnitude of the final velocity.

Given: m_1 , m_2 , v_{1o} and v_{2o}

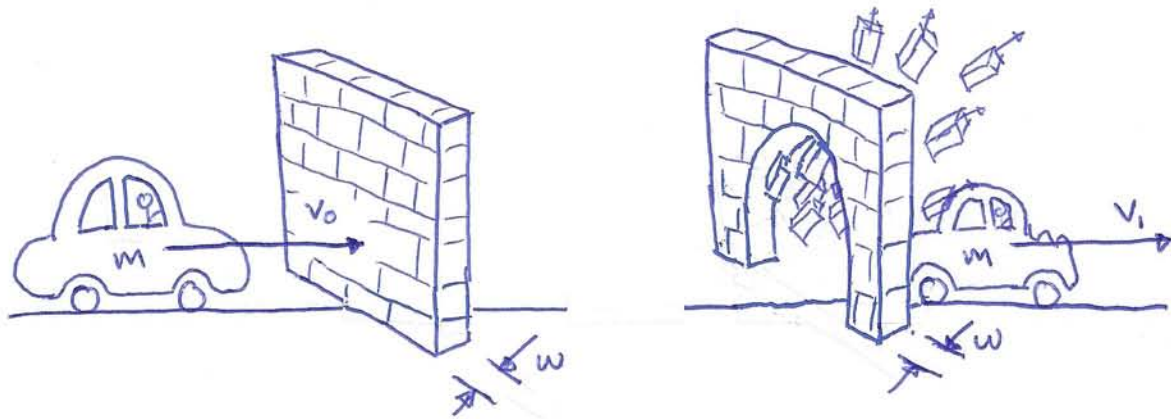


If a bullet is shot at a tree and exits the other side, determine the magnitude of the impulse the bullet felt., the magnitude of the average acceleration the bullet felt and the time the bullet was in the tree.

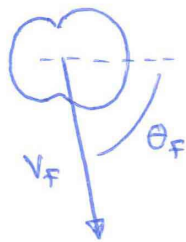
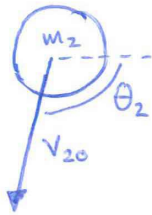
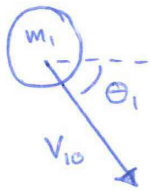
Given: m , v_o , v_f and Δx



Determine the average force and acceleration of the car as it smashed through the wall, given:
 $m = 1000 \text{ kg}$, $v_o = 30 \text{ m/s}$, $v_1 = 10 \text{ m/s}$, $w = 0.3 \text{ m}$

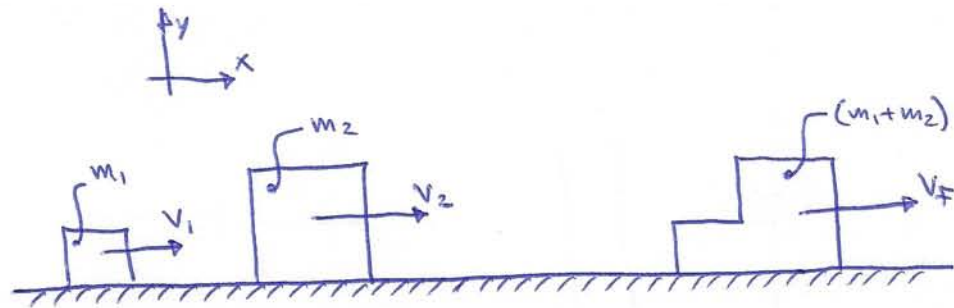


What is final velocity and direction of the two masses after they collide and stick together.
given: m_1 , m_2 , v_{10} , v_{20} , θ_1 and θ_2



Determine the magnitude of the final velocity.

Given: m_1 , m_2 , v_{1o} and v_{2o}



Conservation of momentum:

$$\Delta \vec{p} = \int \vec{F} dt = 0$$

Initial momentum:

$$p_{1x} = m_1 v_{1x} \quad , \quad p_{2x} = m_2 v_{2x}$$

Final momentum:

$$p_{fx} = (m_1 + m_2) v_{fx}$$

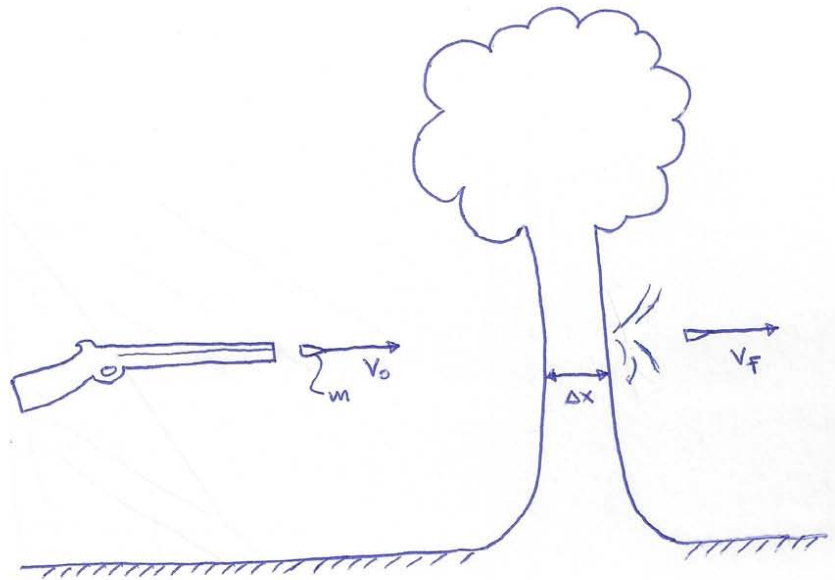
Conservation of momentum:

$$\Delta p_x = 0 = [(m_1 + m_2) v_{fx}] - [m_1 v_{1x} + m_2 v_{2x}]$$

$$v_{fx} = \frac{m_1 v_{1x} + m_2 v_{2x}}{m_1 + m_2}$$

If a bullet is shot at a tree and exits the other side, determine the magnitude of the impulse the bullet felt., the magnitude of the average acceleration the bullet felt and the time the bullet was in the tree.

Given: m , v_0 , v_f and Δx



Conservation of momentum:

$$\Delta \vec{p} = \int \vec{F} dt = \vec{F}_{\text{AVE}} \Delta t = \vec{J}$$

$$\boxed{J_x = p_{x_f} - p_{x_0} = m(v_f - v_0)}$$

Kinematics:

$$\vec{v}^2 = \vec{v}_0^2 + 2\vec{a}(\Delta \vec{x}) \Rightarrow v_{x_f}^2 = v_{x_0}^2 + 2a_x \Delta x$$

$$\boxed{a_x = \frac{v_{x_f}^2 - v_{x_0}^2}{2 \Delta x}}$$

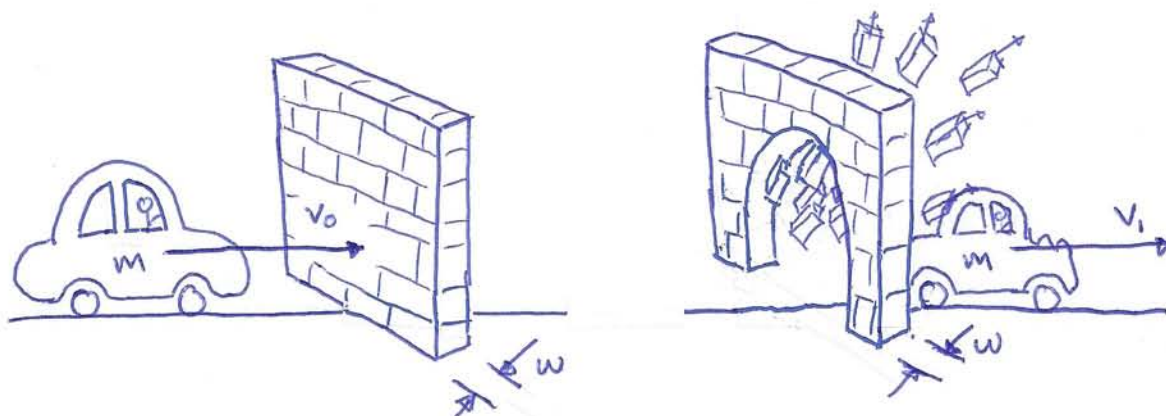
$$\vec{x} = \vec{x}_0 + \left(\frac{\vec{v} + \vec{v}_0}{2} \right) t \Rightarrow \Delta x = \left(\frac{v_{x_f} + v_{x_0}}{2} \right) t$$

$$\boxed{t = \frac{2 \Delta x}{v_{x_f} + v_{x_0}}}$$

Newton's 2nd Law

$$\sum \vec{F} = m\vec{a} \Rightarrow \boxed{F_{\text{AVE}} = m a_x}$$

Determine the average force and acceleration of the car as it smashed through the wall, given:
 $m = 1000 \text{ kg}$, $v_o = 30 \text{ m/s}$, $v_1 = 10 \text{ m/s}$, $w = 0.3 \text{ m}$



Momentum

$$p_o = m v_o$$

$$p_1 = m v_1$$

$$\Delta p = F_{\text{AVE}} \Delta t \quad \Rightarrow \quad F_{\text{AVE}} = \frac{m(v_1 - v_o)}{\Delta t}$$

Kinematics

$$x_1 = x_o + \left(\frac{v_1 + v_o}{2} \right) \Delta t \quad \Rightarrow \quad \Delta t = \frac{2(x_1 - x_o)}{v_o + v_1}$$

$$v_1^2 = v_o^2 + 2 a \Delta x \quad \Rightarrow \quad a_{\text{AVE}} = \frac{v_1^2 - v_o^2}{2 \Delta x}$$

Newton's 2nd Law (check)

$$\sum \vec{F} = m \vec{a} \quad \Rightarrow \quad F_{\text{AVE}} = m a_{\text{AVE}}$$

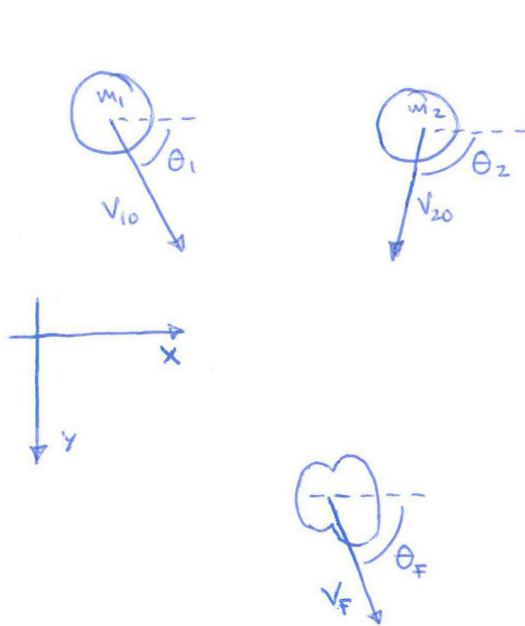
$$\Delta t = \frac{2(0.3)}{30 + 10} = 0.015 \text{ s}$$

$$F_{\text{AVE}} = \frac{(1000)(10 - 30)}{0.015} = -1333333 \text{ N}$$

$$a_{\text{AVE}} = \frac{10^2 - 30^2}{2(0.3)} = -1333 \text{ m/s}^2 \quad (136 \text{ g's})$$

very large #'s
 "w" was estimated
 too small or " $v_o - v_1$ "
 too large.

What is final velocity and direction of the two masses after they collide and stick together.
given: m_1 , m_2 , v_{10} , v_{20} , θ_1 and θ_2



Initial

$$P_{0x} = m_1 v_{10} \cos \theta_1 + m_2 v_{20} \cos \theta_2$$

$$P_{0y} = m_1 v_{10} \sin \theta_1 + m_2 v_{20} \sin \theta_2$$

Final

$$P_{Fx} = (m_1 + m_2) v_F \cos \theta_F$$

$$P_{Fy} = (m_1 + m_2) v_F \sin \theta_F$$

Conservation of Momentum:

$$\vec{P}_F - \vec{P}_0 = \int \vec{F}_{NET} dt \quad \text{(no external force)}$$

$$P_{Fx} = P_{0x} \Rightarrow [(m_1 + m_2) v_F \cos \theta_F] = [m_1 v_{10} \cos \theta_1 + m_2 v_{20} \cos \theta_2] \quad (1)$$

$$P_{Fy} = P_{0y} \Rightarrow [(m_1 + m_2) v_F \sin \theta_F] = [m_1 v_{10} \sin \theta_1 + m_2 v_{20} \sin \theta_2] \quad (2)$$

Divide eq. (2) by (1) and solve for θ

$$\tan \theta_F = \frac{m_1 v_{10} \sin \theta_1 + m_2 v_{20} \sin \theta_2}{m_1 v_{10} \cos \theta_1 + m_2 v_{20} \cos \theta_2}$$

Solve for v_F in eq. (1)

$$v_F = \frac{m_1 v_{10} \cos \theta_1 + m_2 v_{20} \cos \theta_2}{(m_1 + m_2) \cos \theta_F}$$