Problem 1: (30 pts.) At the intersection of High and Cattel St., a blue subcompact car with mass 950 kg traveling east ran the stop sign and collided with a maroon pickup truck with mass 1900 kg that was traveling south. The two vehicles stuck together as a result of the collision and, after the collision, the wreckage slid at 4.00 m/s in the direction 66.0° south of east (towards the WaWa parking lot). The collision occured during a heavy rainstorm, so the road was slick and you may ignore friction forces between the vehicles and the wet road.

a. (5 pts.) *Before doing any calculations*, can you assume that the total linear momentum of the two cars remains constant? Justify your answer briefly but clearly.

b. (5 pts.) *Before doing any calculations*, can you assume that the total mechanical energy of the two cars remains constant? Justify your answer briefly but clearly.

c. (20 pts.) Calculate the speed of each vehicle before the collision.

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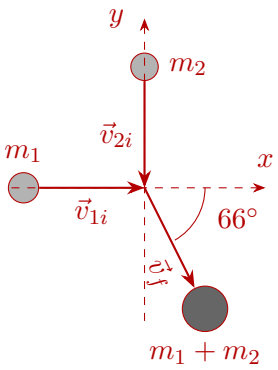
a. (5 pts.) *Before doing any calculations*, can you assume that the total linear momentum of the two cars remains constant? Justify your answer briefly but clearly. Yes. During the brief collision, the *net external force* is zero. Friction is negligible, and the forces between the cars are internal to the collision. (Gravity and the normal force cancel on each car.)

b. (5 pts.) *Before doing any calculations*, can you assume that the total mechanical energy of the two cars remains constant? Justify your answer briefly but clearly. No. You don't know if the internal forces between the cars are conservative or not.

c. (20 pts.) Calculate the speed of each vehicle before the collision.



Use conservation of momentum. Break things up into x and y components.

$$
\begin{aligned}
p_{xi} &= p_{xf} \\
m_1 v_{1ix} + m_2 v_{2ix} &= (m_1 + m_2) v_{fx} \\
m_1 v_{1ix} + 0 &= (m_1 + m_2) v_{fx} \\
v_{1ix} &= \frac{(m_1 + m_2)}{m_1} v_{fx} \\
v_{1ix} &= \left(\frac{950\,\text{kg} + 1900\,\text{kg}}{950\,\text{kg}} \right) (4.00\,\text{m/s}) \cos(-66°) = \boxed{4.88\,\text{m/s}} \\
p_{yi} &= p_{yf} \\
m_1 v_{1iy} + m_2 v_{2iy} &= (m_1 + m_2) v_{fy} \\
0 + m_2 v_{2iy} &= (m_1 + m_2) v_{fy} \\
v_{2iy} &= \frac{(m_1 + m_2)}{m_2} v_{fy} \\
v_{2iy} &= \left(\frac{950\,\text{kg} + 1900\,\text{kg}}{1900\,\text{kg}} \right) (4.00\,\text{m/s}) \sin(-66°) = \boxed{-5.48\,\text{m/s}}
\end{aligned}
$$