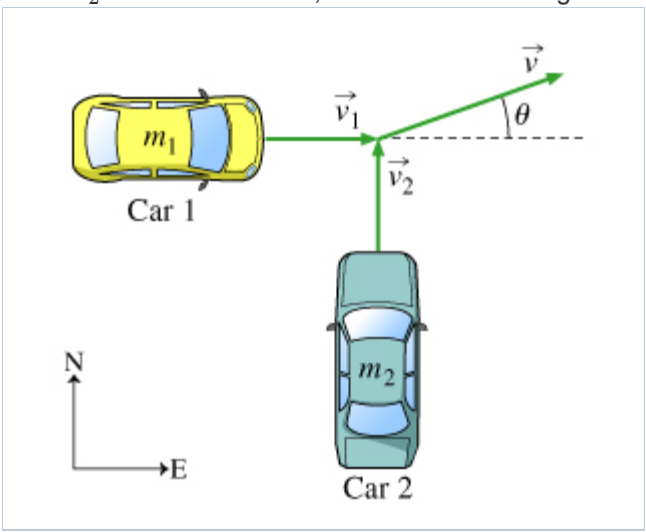
Description: Determine the final velocity of two linked cars after a perfectly inelastic collision at right angles. (version for algebra-based courses) (xyz-hat notation)

In this problem we will consider the collision of two cars initially moving at right angles. We assume that after the collision the cars stick together and travel off as a single unit. The collision is therefore completely inelastic.

The two cars shown in the figure, of masses m_1 and m_2, collide at an intersection. Before the collision, car 1 was traveling eastward at a speed of v_1, and car 2 was traveling northward at a speed of v_2. After the collision, the two cars stick together and travel off in the direction shown.



Part A

First, find the magnitude of $\vec{v}$, that is, the speed v of the two-car unit after the collision.

Express v in terms of m_1, m_2, and the cars' initial speeds v_1 and v_2.

View Available Hint(s) (4)

ANSWER:

- $\frac{m_1v_1+m_2v_2}{m_1+m_2}$
- $\frac{m_1v_1-m_2v_2}{m_1+m_2}$
- $\frac{\sqrt{(m_1v_1)^2+(m_2v_2)^2}}{m_1+m_2}$
- $\sqrt{v_1^2+v_2^2}$

Part B

Find the tangent of the angle θ.

Express your answer in terms of the magnitudes of the *initial* momenta of the two cars, p_1 and p_2, or the quantities given in the problem introduction.

View Available Hint(s) (1)

ANSWER:

$\tan(\theta) = \dfrac{p_2}{p_1}$

Also accepted: $\dfrac{m_2 v_2}{m_1 v_1}$

Part C

Suppose that after the collision, $\tan\theta = 1$; in other words, θ is 45 degrees. Which quantities then *must* have been equal *before* the collision?

ANSWER:

- (•) The magnitudes of the momenta of the cars
- ( ) The masses of the cars
- ( ) The speeds of the cars