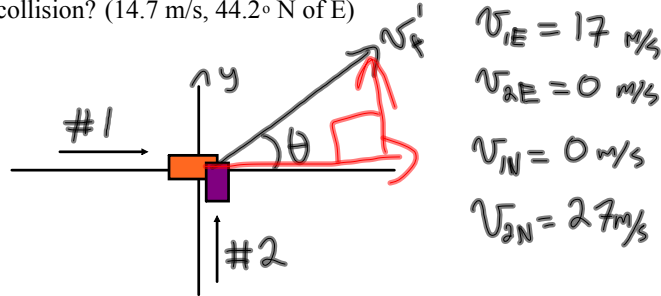


Example: A 1325 kg car moving north at 27.0 m/s collides with a 2165 kg car moving east at 17.0 m/s. They stick together. In what direction and with what speed do they move after the collision? (14.7 m/s, 44.2° N of E)



Conservation of mom. East-West

$$m_1 v_{1E} + m_2 v_{2E} = m_1 v_{1E}' + m_2 v_{2E}'$$

$$(2165)(17) + 0 = (2165 + 1325) v_{fE}$$

$$36805 = 3490 v_{fE}$$

$$\underline{10.5 \text{ m/s}} = v_{fE}$$

North-South

$$m_1 v_{1N} + m_2 v_{2N} = m_1 v_{1N}' + m_2 v_{2N}'$$

$$0 + (1325)(27) = (2165 + 1325) v_{fN}$$

$$35775 = 3490 v_{fN}$$

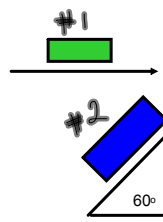
$$\underline{10.3 \text{ m/s}} = v_{fN}$$

$$\begin{aligned}
 |v_f| &= \sqrt{v_{fE}^2 + v_{fN}^2} \\
 &= \sqrt{(10.5)^2 + (10.3)^2} \\
 &= \underline{14.7 \text{ m/s}}
 \end{aligned}$$

$$\theta = \tan^{-1} \left| \frac{v_{fN}}{v_{fE}} \right| = \tan^{-1} \left| \frac{10.3}{10.5} \right| = 44^\circ$$

$$\boxed{v_f = 14.7 \text{ m/s} \text{ [E } 44^\circ \text{ N]}}$$

Example: A 1200 kg car is moving east at 30.0 m/s and collides with a 3600 kg car moving at 20.0 m/s in a direction  $60.0^\circ$  N of E. The vehicles interlock and move off together. Find their common velocity. (19.8 m/s,  $40.9^\circ$  N of E)



$$v_{1E} = 30.0 \text{ m/s}$$

$$v_{1N} = 0 \text{ m/s}$$

$$v_{2E} = 20 \cos 60$$

$$v_{2N} = 20 \sin 60$$

$$v'_{1E} = v'_{2E} = v_{fE}$$

$$v'_{1N} = v'_{2N} = v_{fN}$$

East-West (x-dir)

$$m_1 v_{1E} + m_2 v_{2E} = m_1 v'_{1E} + m_2 v'_{2E}$$

$$(1200)(30) + (3600)(20 \cos 60) = 4800 v_{fE} \quad (m_1 + m_2)$$

$$36000 + 36000 = 4800 v_{fE}$$

$$72000 = 4800 v_{fE}$$

$$\underline{15 \text{ m/s}} = v_{fE}$$

North-South

$$m_1 v_{1N} + m_2 v_{2N} = (m_1 + m_2) v_{fN}$$

$$0 + (3600)(20 \sin 60) = 4800 v_{fN}$$

$$62354 = 4800 v_{fN}$$

$$\underline{13 \text{ m/s}} = v_{fN}$$

$$|v_f| = \sqrt{v_{fE}^2 + v_{fN}^2}$$

$$= \sqrt{(15)^2 + (13)^2} = 19.8 \text{ m/s}$$

$$\theta = \tan^{-1} \left| \frac{v_{fN}}{v_{fE}} \right| = \tan^{-1} \left| \frac{13}{15} \right| = 41^\circ$$

$$\boxed{v_f = 19.8 \text{ m/s} [E 41^\circ N]}$$