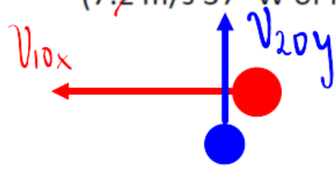
Test Review # 4

1/05/24 8:46 am

A 1.40×10^3 kg car is westbound at a velocity of 37.0 km/h when it collides with a 2.00×10^3 kg truck northbound at a velocity of 35.0 km/h. If these two vehicles lock together upon collision, what is the velocity of the vehicles after the collision? (7.2 m/s 37° W of N)



$P_{0x} = P_x$ (same)

$m_1 v_{10x} + m_2 v_{20x} = m_1 v_{1x} + m_2 v_{2x}$ (v_{20x} = zero)

$v_{1x} = v_{2x} = v_{1,2x}$

$v_{1,2x} = ?$

$m_1 v_{10x} = v_{1,2x}(m_1 + m_2)$

$-1.40\times10^3\ \text{kg} \cdot 37\ \frac{\text{km}}{\text{h}} = v_{1,2x}\left(1.4\times10^3 + 2\times10^3\right)\text{kg}$

$\frac{-51{,}800\ \frac{\text{km}}{\text{h}}}{3400} = v_{1,2x} = -15.2\ \frac{\text{km}}{\text{h}}$ West

$P_{0y} = P_y$ (zero; common factor!)

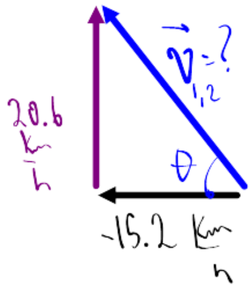
$m_1 v_{10y} + m_2 v_{20y} = m_1 v_{1y} + m_2 v_{2y}$

$m_2 v_{20y} = v_{1,2y}(m_1 + m_2)$

$2\times10^3\ \text{kg} \cdot 35\ \frac{\text{km}}{\text{h}} = v_{1,2y}\left(1.4\times10^3 + 2\times10^3\right)\text{kg}$

$70{,}000\ \frac{\text{km}}{\text{h}} = v_{1,2y} \cdot 3400$

$\frac{70{,}000}{3400}\ \frac{\text{km}}{\text{h}} = v_{1,2y} = 20.6\ \frac{\text{km}}{\text{h}}$ North



$v_{1,2}^2 = v_{1,2x}^2 + v_{1,2y}^2$

$v_{1,2} = \sqrt{15.2^2 + 20.6^2} = 25.6\ \frac{\text{km}}{\text{h}}$

$\theta = \tan^{-1}\left(\frac{v_y}{v_x}\right)$

$\theta = \tan^{-1}\left(\frac{20.6}{-15.2}\right) = -53.6^\circ$ N of W (better) or 36.4° W of N

$25.6\ \frac{\text{km}}{\text{h}} \times \frac{1000\ \text{m}}{1\ \text{km}} \times \frac{1\ \text{h}}{3600\ \text{s}} = 7.11\ \frac{\text{m}}{\text{s}}$

For your practice is CONVENIENT that you answer the following example.

2. A 6.2 kg object heading north at 3.0 m/s collides with an 8.0 kg object heading west at 3.5 m/s. If these two masses stick together upon collision, what is their velocity after collision? (2.4 m/s 56° W of N)