

Momentum 2 Dimensional example 2

A 15.0 kg body moving at 2.0 m/s @ 30 degrees when it collides and becomes coupled to a 25.0 kg body which was initially moving 180 degrees at a speed of 4.0 m/s. What is the common velocity after collision? Determine if the collision is elastic or inelastic ( $KE = \frac{1}{2}mv^2$ ).

$\vec{P}_A + \vec{P}_B = \vec{P}'$   
 $m_1 \vec{v}_1 + m_2 \vec{v}_2 = (m_1 + m_2) \vec{v}'$   
 $(15)(2) + (25)(4) = (40)\vec{v}'$   
 $30\hat{i} + 100\hat{j} = 40\vec{v}'$   
 $\vec{v}' = \frac{104.4}{40} = 2.61\text{ m/s}$   
 $\vec{v}' = 2.61\hat{i} + 1.63\hat{j}$   
 $\theta = \tan^{-1}\left(\frac{1.63}{2.61}\right) = 33.3^\circ$

$KE = KE'$   
 $\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 = \frac{1}{2}(m_1 + m_2)v'^2$   
 $\frac{1}{2}(15)(2)^2 + \frac{1}{2}(25)(4)^2 = \frac{1}{2}(40)(2.61)^2$   
 $30 + 200 = 20(2.61)^2$   
 $230 = 136.24$   
 $\% \text{ diff} = \left| \frac{230 - 136}{230} \right| \times 100 = 40.8\%$

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