More Practice with Collisions in 2D

SPH4U

1. A steel ball of mass 0.50 kg, moving with a velocity of 2.0 m/s [E], strikes a second ball of mass 0.30 kg, initially at rest. The collision is a glancing one, causing the steel ball to have a velocity of 1.5 m/s [30º N of E] after the collision. Determine the velocity of the second ball after the collision.

$m_A = 0.50\ kg$ $\quad v_A = 2.0\frac{m}{s}[E]$ $\quad v_A' = 1.5\frac{m}{s}[30^o\ N\ of\ E]$

$m_B = 0.30\ kg$ $\quad v_B = 0\frac{m}{s}$ $\quad v_B' = ?$

Determine the total East-West (x) and North-South (y) components of the momentum before:

$p_{TOTALx} = m_A v_{Ax} + m_B v_{Bx} =$

$p_{TOTALy} = m_A v_{Ay} + m_B v_{By} =$

Break $m v_A'$ down into its East-West (x) and North-South (y) components:

$m v_{Ax}' =$

$m v_{Ay}' =$

Calculate the East-West (x) and North-South (y) components of the second ball's momentum:

$m v_{Bx}' = p_{TOTALx} - m v_{Ax}' =$

$m v_{By}' = p_{TOTALy} - m v_{Ay}' =$

Find the momentum of the second ball (from the components) and the velocity (divide the momentum by the mass):

Answer: *1.7 m/s [43º E of S]*

2. Two cars collide at an intersection. One car of mass 1400 kg was travelling at 45 km/h [S]. The other car of mass 1300 kg was travelling at 39 km/h [E]. If the cars have a completely inelastic collision, what is their velocity just after the collision?

$m_A = 1400\ kg$ $\qquad$ $v_A = 45\frac{km}{h}[S] =$

$m_B = 1300\ kg$ $\qquad$ $v_B = 39\frac{km}{h}[E] =$

$v_{A+B}' = ?$

Determine the total East-West (x) and North-South (y) components of the momentum before:

$p_{TOTALx} = m_A v_{Ax} + m_B v_{Bx} =$

$p_{TOTALy} = m_A v_{Ay} + m_B v_{By} =$

Calculate the total momentum of the system before the collision (magnitude and direction):

$p_{TOTAL} =$ $\qquad$ $\theta =$

Note that $p_{TOTAL}' = p_{TOTAL}$.

Calculate the velocity of the cars total after the collision:

$v_{A+B}' = \frac{p_{TOTAL}'}{m_A + m_B} =$

Answer: *3.0 x 10^1 km/h [39^o E of S]*

Solve the following question on a separate piece of paper:

3. In a game of marbles, a collision occurs between two marbles of equal mass. One marble is initially at rest; after the collision, the marble acquires a velocity of 1.10 m/s at an angle of 40.0^o from the original direction of motion of the other marble, which has a speed of 1.36 m/s after the collision. What is the initial speed of the moving marble?

Answer: *2.00 m/s. For a full solution, refer to p. 256 – 257.*