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5. A dry cleaner throws a 22 kg bag of laundry onto a stationary 9 kg car. The cart and laundry bag begin moving at 3 m/s. Determine the speed with which the bag was thrown.

$m_A = 22\text{kg}$, $v_{Ai} = ?$, $m_B = 9\text{kg}$, $v_{Bi} = 0$ | $v_f = 3\text{m/s}$

$m_A v_{Ai} + m_B v_{Bi} = (m_A + m_B) v_f$

$(22\text{kg})(v_{Ai}) = (22\text{kg} + 9\text{kg})(3\text{m/s})$

$v_{Ai} = 4.23\text{m/s}$

6. A tennis player places a 55 kg ball machine on a frictionless surface. The machine fires a 0.057 kg tennis ball with a velocity of 36 m/s. How fast does the machine roll backwards?

$m_A = 55\text{kg}$, $v_{Ai} = 0$, $m_B = 0.057\text{kg}$, $v_{Bi} = 0$ | $v_{Af} = ?$, $v_{Bf} = 36\text{m/s}$

$m_A v_{Ai} + m_B v_{Bi} = m_A v_{Af} + m_B v_{Bf}$

$-m_A v_{Af} = m_B v_{Bf}$

$-(55\text{kg})(v_{Af}) = (0.057\text{kg})(36\text{m/s})$

$v_{Af} = -0.037\text{m/s}$

7. A 0.012 kg toy car moving at 0.2 m/s has a collision with a 0.02 kg toy car moving in the ***opposite*** direction at 0.3 m/s. After the collision, the 0.012 kg car moves ***backwards*** with a velocity of 0.37 m/s. Find the speed of the 0.02 kg car after the collision.

$m_A = 0.012\text{kg}$, $v_{Ai} = 0.2\text{m/s}$, $m_B = 0.02\text{kg}$, $v_{Bi} = -0.3\,\frac{\text{m}}{\text{s}}$ | $v_{Af} = -0.37\text{m/s}$, $v_{Bf} = ?$

$m_A v_{Ai} + m_B v_{Bi} = m_A v_{Af} + m_B v_{Bf}$

$(0.012\text{kg})(0.2\text{m/s}) + (0.02\text{kg})\left(-0.3\,\frac{\text{m}}{\text{s}}\right) = (0.012\text{kg})(-0.37\text{m/s}) + (0.02\text{kg})v_{Bf}$

$v_{Bf} = 0.042\text{m/s}$

8. A 65 kg ice skater moving with a velocity 2.5 m/s is holding a 0.15 kg snowball. She throws the snowball forward with a velocity of 32 m/s. relative to the ground. What is the speed of the ice skater after throwing the snowball?

$m_A = 65\text{kg}$, $v_{Ai} = v_{Bi} = 2.5\text{m/s}$, $m_B = 0.15\text{kg}$ | $v_{Af} = ?$, $v_{Bf} = 32\,\frac{\text{m}}{\text{s}}$

$(m_A + m_B)v_{Ai} = m_A v_{Af} + m_B v_{Bf}$

$(65\text{kg} + 0.15\text{kg})(2.5\text{m/s}) = (65\text{kg})(v_{Af}) + (0.15\text{kg})(32\text{m/s})$

$v_{Af} = 2.43\text{m/s}$

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