Name: KEY

Date:

Section C D F

The Masters School
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Physics

Momentum III

1. Two carts with masses of 6.4 kg and 1.4 kg, respectively, move on a frictionless track with velocities of 5.0 m/s and 2.6 m/s. The carts stick together after colliding head-on. Find the final speed.

(1) (2)

$m_1v_{1,i} + m_2v_{2,i} = (m_1 + m_2) \cdot v_f$

$(6.4)(5) + (1.4)(2.6) = (7.8)\,V_f$

$35.64 = 7.8\,V_f$

$V_f = 4.57$ m/s

2. A 1750 kg car moving south at 14.5 m/s collides with a 2250 kg car moving north. The cars stick together and move as one unit after the collision at a velocity of 5.40 m/s to the north. Find the velocity of the 2250 kg car ***before*** the collision.

(1) (+) (2) (−)

$m_1v_{1,i} + m_2v_{2,i} = (m_1 + m_2) \cdot v_f$ (−) N ⟷ S (+)

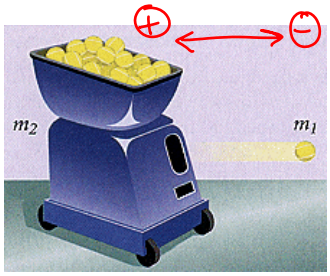
$(1750)(14.5) + (2250)(V_{2i}) = (1750 + 2250)(-5.4)$

$2250\,V_{2i} = -46{,}975$

$V_{2i} = -20.88$ m/s

$V_{2i} = 20.88$ m/s to the north

3. A tennis player places a 70 kg ball machine on a frictionless surface. The machine fires a 0.057 kg tennis ball horizontally with a velocity of 21 m/s toward the north. What is the final velocity of the machine? Give at least 4 decimal places in your answer.



$(m_1 + m_2) \cdot v_i = m_1v_{1,f} + m_2v_{2,f}$

$70.0 = M_1V_{1f} + M_2V_{2f}$

$-M_1V_{1f} = M_2V_{2F}$

$-(.057)(-21) = (69.943)(V_{2F})$

.0171 m/s $= V_{2f}$ (to the south)

4. A 65.0 kg ice skater moving forward with a velocity of 1.40 m/s throws a 0.160 kg snowball forward with a velocity of 20.0 m/s.

   a. What is the velocity of the ice skater after throwing the snowball? Disregard the friction between the skates and the ice.

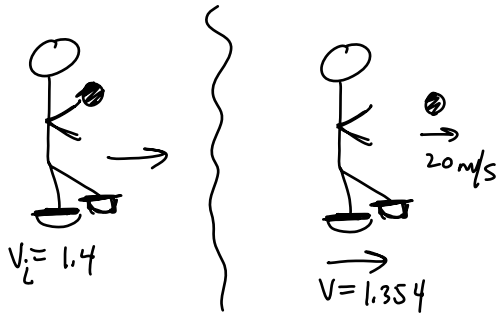
$(m_1 + m_2) \cdot v_i = m_1 v_{1,f} + m_2 v_{2,f}$

$(65 + .16)(1.4) = (65) V_{1f} + (.16)(20)$

$88.024 = 65\ V_{1f}$

$1.354\ m/s = V_{1f}$

(forward)



   b. A second skater initially at rest with a mass of 60.0 kg catches the snowball. What is the velocity of the second skater after catching the snowball in a perfectly inelastic collision?

$m_1 v_{1,i} + m_2 v_{2,i} = (m_1 + m_2) \cdot v_f$

$(60)(0) + (.16)(20) = (60.16)\ V_f$

$3.2 = 60.16\ V_f$

$.053\ m/s = V_f$

(In the direction the snowball was thrown)