Homework Solutions
9/26/2007

Problems

30.

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$t = \sqrt{\frac{2d}{a}} = \sqrt{\frac{2(1.00m)}{9.8\frac{m}{s^2}}} = .04518s$$

$$v = \frac{\Delta x}{t} = \frac{2.00m}{0.4518s} = 4.427\frac{m}{s}$$

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2)v'$$

$$(8.00g)v_1 + 0 = (258g)\left(4.427\frac{m}{s}\right)$$

$$v_1 = 143\frac{m}{s}$$

34.

$$m_1 v_1 + m_2 v_2 + m_3 v_3 = (m_1 + m_2 + m_3)v'$$

$$(4.0kg)\left(5.0\frac{m}{s}\right) + (10kg)\left(3.0\frac{m}{s}\right) + (3.0kg)\left(-4.0\frac{m}{s}\right) = (17kg)v'$$

$$20kg\frac{m}{s} + 30kg\frac{m}{s} - 12kg\frac{m}{s} = (17kg)v'$$

$$v' = 2.2\frac{m}{s}$$

55. a.

$$m_1 v_1 = (m_1 + m_2)v'$$

$$v' = \frac{m_1 v_1}{(m_1 + m_2)} = \frac{(60.0kg)\left(4.00\frac{m}{s}\right)}{(60.0kg + 120kg)} = 1.33\frac{m}{s}$$

b.

$$\Sigma F_y = N - mg = 0$$

$$N = mg = (60.0kg)\left(9.80\frac{m}{s^2}\right) = 588N$$

$$F_k = \mu_k N = 0.400(588N) = 235N$$

c.

$$Ft = m\Delta v$$

$$t = \frac{m\Delta v}{F} = \frac{(60.0kg)\left(1.33\frac{m}{s} - 4.00\frac{m}{s}\right)}{-235N} = 0.681s$$

d.

$$\Delta p_{person} = m\Delta v = (60.0kg)\left(1.33\frac{m}{s} - 4.00\frac{m}{s}\right) = -160kg\frac{m}{s}$$

$$\Delta p_{cart} = m\Delta v = (120kg)\left(1.33\frac{m}{s} - 0\frac{m}{s}\right) = 160kg\frac{m}{s}$$

e.

$$v_{avg} = \frac{v_i + v_f}{2} = \frac{4.00\frac{m}{s} + 1.33\frac{m}{s}}{2} = 2.66\frac{m}{s}$$

$$\Delta x = v_{avg} \bullet t = \left(2.66\frac{m}{s}\right)(0.681s) = 1.82m$$

f.

$$v_{avg} = \frac{(v_i + v_f)}{2} = \frac{\left(0\frac{m}{s} + 1.33\frac{m}{s}\right)}{2} = 0.666\frac{m}{s}$$

$$\Delta x = v_{avg} \bullet t = \left(0.666\frac{m}{s}\right)(0.681s) = .454m$$

g.

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$$20kg\frac{m}{s}+30kg\frac{m}{s}-12kg\frac{m}{s}=(17kg)v'$$

$$v'=2.2\frac{m}{s}$$

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$$m_1v_1=(m_1+m_2)v'$$

$$v'=\frac{m_1v_1}{(m_1+m_2)}=\frac{(60.0kg)\left(4.00\frac{m}{s}\right)}{(60.0kg+120kg)}=1.33\frac{m}{s}$$

b.

$$\Sigma F_y=N-mg=0$$

$$N=mg=(60.0kg)\left(9.80\frac{m}{s^2}\right)=588N$$

$$F_k=\mu_kN=0.400(588N)=235N$$

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$$Ft=m\Delta v$$

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$$\Delta p_{person}=m\Delta v=(60.0kg)\left(1.33\frac{m}{s}-4.00\frac{m}{s}\right)=-160kg\frac{m}{s}$$

$$\Delta p_{cart}=m\Delta v=(120kg)\left(1.33\frac{m}{s}-0\frac{m}{s}\right)=160kg\frac{m}{s}$$

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$$v_{avg} = \frac{v_i + v_f}{2} = \frac{4.00\frac{m}{s} + 1.33\frac{m}{s}}{2} = 2.66\frac{m}{s}$$

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$$v_{avg} = \frac{\left(v_i + v_f\right)}{2} = \frac{\left(0\frac{m}{s} + 1.33\frac{m}{s}\right)}{2} = 0.666\frac{m}{s}$$

$$\Delta x = v_{avg} \bullet t = \left(0.666\frac{m}{s}\right)(0.681s) = .454m$$

g.

$$\Delta KE = \frac{1}{2}m\left(v_v^2 - v_i^2\right) = \frac{1}{2}(60.0kg)\left[\left(1.33\frac{m}{s}\right)^2 - \left(4.00\frac{m}{s}\right)^2\right]$$

$$\Delta KE = -427J$$

h.

$$\Delta KE = \frac{1}{2}m\left(v_v^2 - v_i^2\right) = \frac{1}{2}(120kg)\left[\left(1.33\frac{m}{s}\right)^2 - \left(0\frac{m}{s}\right)^2\right]$$

$$\Delta KE = 107J$$

i.

Mechanical energy is not conserved in inelastic collisions because although equal frictional forces act through equal times they do not act through equal distances. The total work done on the cart and person is –320J which becomes 320J of internal energy (thermal energy).

58.

$$v = \sqrt{2gh} = \sqrt{2\left(9.80\frac{m}{s^2}\right)(3.00m)} = 7.67\frac{m}{s}$$

$$m_1 v_1 = (m_1 + m_2)v'$$

$$v' = \frac{m_1 v_1}{(m_1 + m_2)} = \frac{(80.0kg)\left(7.67\frac{m}{s}\right)}{120kg} = 4.38\frac{m}{s}$$

$$h = \frac{v'^2}{2g} = \frac{\left(4.38\frac{m}{s}\right)^2}{2\left(9.80\frac{m}{s^2}\right)} = 0.980m$$