A1) many solutions

A2) Momentum is conserved in this collision. the Two cars become 1 body afterwards.

$$p_B = p_A$$

$$p_A + p_B = p_{AB}$$

$$mV_A + mV_B = 2mV_{AB}$$

$$m(-12) + m(7) = 2mV_{AB}$$

$$-5 = 2V_{AB}$$

$$V_{AB} = -2.50\ m/s$$

2.50 m/s West

A3) the collision is elastic. the momentum of the ball changes due to impulse by ground.

A3) $PE_+ = KE_B$

$mgh = \frac{1}{2}mV^2$

$(9.81)(2.33) = \frac{1}{2}V^2$

$V_i = -6.76\ m/s$ elastic $V_f = +6.76\ m/s$

$m = .025\ kg$

$\Delta t = .123s$

$\Delta p = F\Delta t$

$m\Delta V = F\Delta t$

$m(V_f - V_i) = F\Delta t$

$(.025)(6.76 + 6.76) = F(.123)$

$F = 2.75\ N$

A4) As the astroblaster falls it gains momentum due to the impulse of gravity. When it impacts the ground the momentum of all the balls is transfered to the little ball so it leaves at a high velocity.

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22-142 100 SHEETS
22-144 200 SHEETS
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A5) Momentum is conserved so the momentum must be zero before and after

A5)

$m_E = 5.97 \times 10^{24}\ kg$

$P_B = P_A$

$P_B = P_u + P_E$

$0 = m_u v_u + m_E v_E$

$0 = (70)(7.66) + (5.97 \times 10^{24}) v_E$

$\boxed{v_E = -8.98 \times 10^{-23}\ m/s}$

A6) Momentum must be conserved during this inelastic collision, the bodies merg after the collision.

A6)

$P_B = P_A$

$P_{BII} + P_C = P_{BC}$

$m_B v_B + m_c v_c = m_{BC} v_{BC}$

$(.05)(380) + 0 = (3.05) v_{BC}$

$\boxed{v_{BC} = 6.23\ m/s}$

A7) Both momentum and KE are conserved.

A7)

$P_B = P_A$

$P_B + \cancel{P_R}^{0} = P_B' + P_R'$

$(.05)(380) = (.05)v_B' + (3) v_R'$

$380 = v_B' + 60 v_R'$

$v_B' = 380 - 60 v_R'$

$KE_B = KE_A$

$KE_B = KE_B' + KE_R'$

$\frac{1}{2}(.05)(380)^2 = \frac{1}{2}(.05) v_B'^2 + \frac{1}{2}(3) v_R'^2$

$380^2 = v_B'^2 + 60 v_R'^2$

$380^2 = (380 - 60 v_R')^2 + 60 v_R'^2$

$380^2 = 380^2 - 2(380)(60) v_R' + 3600 v_R'^2 + 60 v_R'^2$

$0 = -2(380)(60) v_R' + 3660 v_R'^2$

$\boxed{v_B' = -368\ m/s \quad v_R' = 12.4\ m/s}$

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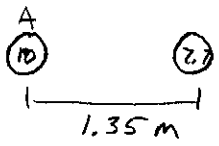
A8)



$m_T x_{cm} = m_1 x_1 + m_2 x_2$

$17.7\, x_{cm} = 10(0) + (7.7)(1.35)$

$x_{cm} = .587\ m$ from center 10

A9) you have same mass as friend. Momentum is conserved so the velocity must lower.

A9)

$P_B = P_A$

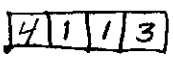
$P_u + P_f = P_{uf}$

$(42)0 + (42+4)(2.53) = (42+4+42)\, V_{uf}$

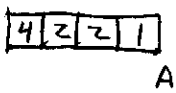
$V_{uf} = 1.32\ m/s$

B1)

x) A



y)



z) ½ way up

$m_T = 9m$

$m_T x_{cm} = m_1 x_1 + m_2 x_2 + m_3 x_3 + m_4 x_4$

$9m\, x_{cm} = 4m(\tfrac{1}{2}L) + m(1.5L) + m(2.5L) + 3m(3.5L)$

$9\, x_{cm} = 2L + 1.5L + 2.5L + 10.5L$

$x_{cm} = 1.83L$

$m_T y_{cm} = m_1 y_1 + m_2 y_2 + m_3 y_3 + m_4 y_4$

$9m\, y_{cm} = m(.5L) + 2m(1.5L) + 2m(1.5L) + 4m(3.5L)$

$9\, y_{cm} = .5L + 3L + 3L + 14L$

$y_{cm} = 2.28L$

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22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS
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B2) Momentum is conserved when the bullet hits the block. The collision gives the block & bullet combo KE. It swings upward till this KE is changed to PE.

B2)
$$P_B = P_A$$
$$P_{B1} + \cancel{P_{B1}^{0}} = P_{BB}$$
$$(.035)(430) = (.035 + 2.78)\, V_{BB}$$
$$V_{BB} = 5.35 \text{ m/s}$$

$$KE_B = PE_T$$
$$\tfrac{1}{2} \cancel{m_{BB}} V_{BB}^2 = \cancel{m_{BB}}\, g h$$
$$\tfrac{1}{2}(5.35)^2 = (9.81)h$$
$$\boxed{h = 1.46 \text{ m}}$$

B3) Momentum is conserved in this inelastic collision.

B3)
$$P_B = P_A$$
$$P_m + P_s = P_{ms}$$
$$(85)(8) + 0 = (85 + 40)\, V_{ms}$$
$$\boxed{V_{ms} = 5.44 \text{ m/s}}$$

B4) The friction provides the impulse to bring the momentum of the block to zero.

B4)
$$F_f = \mu F_N = \mu mg$$
$$F\Delta t = \Delta p = m\Delta V$$
$$\mu mg\, \Delta t = m(V_f - V_i)$$
$$-(.84)(9.81)\Delta t = (0 - 4.4)$$
$$\boxed{\Delta t = .534 \text{ s}}$$

B5) momentum is conserved in the system.

B5)

$P_B = P_A$

$0 = P_6 + P_B$

$0 = (3.5)V_6 + (.06)(430)$

$\boxed{V_6 = -7.37\ m/s}$

B6) the momentum is conserved. Since it is an elastic collision and they have the same mass the first body stops and the second moves off with the first's velocity.

B6)

$\Delta p = F\Delta t$

$P_2 - P_1 = F\Delta t$

$(5)(3) - 0 = F(.103)$

$\boxed{F = 146\ N}$

B7) The momentum of the system is transfered to the superball

B7)

$PE_T = KE_B$

$mgh = \frac{1}{2}mv^2$

$(9.81)(1) = \frac{1}{2}V^2$

$V = 4.43\ m/s$

$P_{13} = P_A$

$P_{SBB} = P_S$

$(.012 + .2)(4.43) = (.012)V_S$

$V_S = 78.2\ m/s$

$KE_B = PE_T$

$\frac{1}{2}mv^2 = mgh$ $\quad \frac{1}{2}(78.2)^2 = (9.81)h$

$\boxed{h = 312\ m}$

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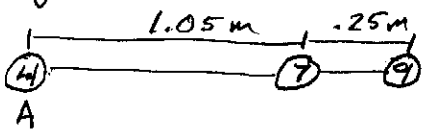
B87



$$m_T x_{cm} = m_1 x_1 + m_2 x_2 + m_3 x_3$$

$$(4+7+9)\, x_{cm} = 4(0) + 7(1.05) + 9(1.30)$$

$$\boxed{x_{cm} = .952\,m}$$

22-141 50 SHEETS
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22-144 200 SHEETS
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