yohandi - Assignment 8

4 $\Sigma m_i = 14g + 42g + 14g = 70\ g$

$\Sigma m_i x_i = (14.0 + 42.12 + 14.24)\ g\ cm = 840\ g\ cm$

$\Sigma m_i y_i = (14.(-12) + 42.0 + 14(-12))\ g\ cm = -336\ g\ cm$

$x_{com} = \frac{\Sigma m_i x_i}{\Sigma m_i} = \frac{840}{70}\ cm = 12\ cm$

$y_{com} = \frac{\Sigma m_i y_i}{\Sigma m_i} = \frac{-336}{70}\ cm = -4.8\ cm$

14. $y_{max} = \frac{v_{2y}^2}{2g} = \frac{20^2 - 10^2}{2 \cdot 9{,}81} = 15{,}3\ m$

a) $y_{com_{max}} = \frac{\Sigma m_i y_i}{\Sigma m_i} = \frac{5 \cdot 0 + 3 \cdot 15{,}3}{5+3}\ m = 5.74\ m$

b) when y_{com} reach its maximum height, $v_{2y} = 0$.

resulting $v_2 = v_{2x} = v_{1x} = v_1$.

$\Rightarrow \frac{\Sigma m_i v_i}{\Sigma m_i} = \frac{(m_1 + m_2) v_1}{m_1 + m_2} = v_1 = 10.0\ m/s$ $(v = 10.0\,\hat{i} + 0\,\hat{j}\ m/s)$

c) $a_{com} = \frac{\Sigma m_i a_i}{\Sigma m_i} = \frac{(5.0 + 3.(-9.81))}{5+3}\ m/s^2 = -3.68\ m/s^2$ $(a = 0\,\hat{i} + (-3.68)\,\hat{j}\ m/s^2)$

38a) $I_x = \Delta P_x = 0$

$I_y = \Delta P_y = 300.10^{-3}(6.\sin 30° - 6\sin(-30°))\ kgm/s = 1.80\ kgm/s$

$I = I_x \hat{i} + I_y \hat{j} = 1.80\,\hat{j}\ kg\ m/s$

b. $F_x = \frac{I_x}{\Delta t} = 0$

$F_y = \frac{I_y}{\Delta t} = \frac{1.80}{10.10^{-3}} = 180\ N$

$F = F_x \hat{i} + F_y \hat{j} = 180\,\hat{j}\ N$

44. $(m_L v_{L0} + m_R v_{R0}) = (m_L v_{L1} + m_R v_{R1})$

$-m_L v_{L1} = m_R v_{R1}$ ....(1)

$\Delta E_{mec} + \Delta T_h = 0$

$\left(0 - \frac{1}{2} m_L v_{L1}^2\right) + (m_L \cdot g \cdot \mu_L \cdot d_L) = 0$

$g \cdot \mu_L \cdot d_L = \frac{1}{2} v_{L1}^2$ ...(2)

$\Delta E_{mec} + \Delta T_h = 0$

$(0 - \frac{1}{2} m_R v_{R1}^2) + (m_R\ g\ \mu_R\ d_R) = 0$

$g \cdot \mu_R \cdot d_R = \frac{1}{2} v_R^2$ ...(3)

$\frac{(2)}{(3)} \Rightarrow \frac{v_{L1}^2}{v_{R1}^2} = \frac{\mu_L \cdot d_L}{\mu_R \cdot d_R}$

$v_{R1} = \sqrt{v_{L1}^2 \frac{\mu_R \cdot d_R}{\mu_L\ d_L}}$

$v_{R1} = v_{L1} \sqrt{\frac{\mu_R\ d_R}{\mu_L \cdot d_L}}$ ...(4)

(4)→(1) $\Rightarrow -m_L v_{L1} = m_R \left(-v_{L1} \sqrt{\frac{\mu_R\ d_R}{\mu_L\ d_L}}\right)$

$m_R = m_L \left(\sqrt{\frac{\mu_L\ d_L}{\mu_R\ d_R}}\right)$

$m_L + m_R = m_L \left(1 + \sqrt{\frac{\mu_L\ d_L}{\mu_R\ d_R}}\right)$

$= 2.0\left(1 + \sqrt{\frac{0.35 \cdot 0.15}{0.50 \cdot 0.30}}\right) kg$

$= 3.2\ kg$

57a $M v_{M0} + m \cdot v_{m0} = (M+m) v$

$v = \frac{0 + 60.22.10^{-3}}{300.10^{-3}}$

$v = 4.4\ m/s$

b $E_{loss} = K - K'$

$= \frac{1}{2} m v_{m0}^2 - \frac{1}{2}(M+m) v^2$

$= \frac{1}{2}(60.10^{-3})(22^2) - \frac{1}{2}(300.10^{-3})(4.4)^2\ J$

$= 23232\ J$

$\frac{U_s}{K} = \frac{E_{loss}}{K} = \frac{23232}{\frac{1}{2}(60.10^{-3})(22^2)} = \frac{4}{5}$

66. $m_1 v_{10} + m_2 v_{20} = m_1 v_{11} + m_2 v_{21}$

$m_1 \cdot 3 + 0 = m_1 (v_{11}) + \frac{2}{5} m_1 (v_{21})$

$5 v_{11} + 2 v_{21} = 15\ m/s$

$\frac{1}{2} m_1 v_{10}^2 + \frac{1}{2} m_2 v_{20}^2 = \frac{1}{2} m_1 v_{11}^2 + \frac{1}{2} m_2 v_{21}^2$

$m_1 \cdot g + 0 = m_1 (v_{11})^2 + \frac{2}{5} m_1 (v_{21})^2$

$5 v_{11}^2 + 2 v_{21}^2 = 45\ m/s$

$5\left(\frac{(15 - 2 v_{21})}{5}\right)^2 + 2 v_{21}^2 = 45$

$225 - 60 v_{21} + 4 v_{21}^2 + 10 v_{21}^2 = 225$

$\Rightarrow v_{21} = \frac{60}{14} = 4.3\ m/s$

$\Rightarrow v_{11} = \frac{15 - 2 \cdot \frac{60}{14}}{5} = 1.3\ m/s$

a. $\frac{1}{2} m_1 v_{11}^2 = m_1 \cdot \mu\ d_1\ g$

$d_1 = \frac{1}{2} \frac{(1.3)^2}{0.5.9.8}\ m = 0.17\ m$

b. $\frac{1}{2} m_2 v_{21}^2 = m_2\ \mu\ d_2\ g$

$d_2 = \frac{1}{2} \frac{(4.3)^2}{0.5\ 9.8}\ m = 1.9\ m$

72 $\tan(\theta_1) = 2$

$\sin(\theta_1) = -\frac{2}{\sqrt{5}}$

$\cos(\theta_1) = \frac{1}{\sqrt{5}}$

$m_1 v_{1ix} + m_2 v_{2ix} = m_1 v_{1fx} + m_2 \cdot v_{2fx}$

$m_1 (3v_0) = m_1 (\sqrt{5} v_0) \cdot \cos(\theta_1) + (2m_1) v_2 \cos(\theta_2)$

$2 v_0 = 2 v_2 \cos(\theta_2)$

$v_0 = v_2 \cos(\theta_2) \quad ...(1)$

$m_1 \cdot v_{1iy} + m_2 \cdot v_{2iy} = m_1 \cdot v_{1fy} + m_2 \cdot v_{2fy}$

$0 = m_1 (\sqrt{5} v_0) \cdot \sin(\theta_1) + (2m_1) v_2 \cdot \sin(\theta_2)$

$v_0 = v_2 \sin(\theta_2) \quad ...(2)$

$\frac{(2)}{(1)} = \tan(\theta_2) = 1$

a) $\theta_2 = 45^0$

b) $v_2 = \sqrt{v_2 \cos(\theta_2)^2 + v_2 \sin(\theta_2)^2}$

$= \sqrt{v_0^2 + v_0^2}$

$= \sqrt{2} \cdot v_0$

c) $\Delta K_T = \left(\frac{1}{2} m_1 (3v_0)^2 + 0\right) - \left(\frac{1}{2} m_1 (\sqrt{5} v_0)^2 + \frac{1}{2} m_2 (\sqrt{2} v_0)^2\right)$ ($m_2 = 2m_1$)

$= \frac{1}{2} m_1 v_0^2 (9 - 5 - 4)$

$= m_1 v_0^2 = 0$

$\Rightarrow$ the collision is elastic