Chapter 8 - Momentum, Impulse and Collisions

Physics 206

Group 1 Problems:
Problem 1:

$$\begin{aligned} \text{a) } x_{CM} &= 2.83 \text{ m} \\ y_{CM} &= 1.67 \text{ m} \\ v_{x,CM} &= 2.18 \text{ m/s} \\ v_{y,CM} &= -0.821 \text{ m/s} \end{aligned}$$

$$\begin{aligned} \text{b) } x_{CM} &= 21.1 \text{ m} \\ y_{CM} &= 3.17 \text{ m} \\ v_{x,CM} &= 1.56 \text{ m/s} \\ v_{y,CM} &= 16.1 \text{ m/s} \\ a_{x,CM} &= 48.4 \text{ m/s}^2 \\ a_{y,CM} &= 20.3 \text{ m/s}^2 \end{aligned}$$

Problem 2:

$$\begin{aligned} \text{a)} \vec{J} &= m(\sqrt{2gh} + \sqrt{2gH})\hat{\jmath} \\ &= 0.448 \text{ kg} \cdot \text{m/s} \\ \text{b)} \vec{F}_{ave} &= \frac{\Delta \vec{p}}{\Delta t} \\ &= 11.2 \text{ N} \end{aligned}$$

Problem 3: The astronaut makes it

Problem 4:

$$\begin{aligned} K_L &= \frac{m_H K_H}{m_L} \\ &= 250 \text{ J} \end{aligned}$$

Problem 5:

$$\begin{aligned} CM_5 &= 1.833 \\ CM_7 &= 2.5 \\ \Delta CM &= 0.667 \end{aligned}$$

Group 2 Problems:
Problem 6:

$$\begin{aligned} \text{(a) } v_f &= v \\ \text{(b) } v_f &= \frac{Mv}{M-m} \\ \text{(c) } v_f &= \frac{M - 1.2m}{M+m} v \end{aligned}$$

Problem 7: George and Ape do not make it.

Problem 8:

$$\begin{aligned} \text{(a) } a_m &= \frac{k\Delta x}{m} \\ a_{3m} &= \frac{k\Delta x}{3m} \\ \text{(b) } v_m &= \sqrt{\frac{3k}{4m}}\Delta x \\ v_{3m} &= \sqrt{\frac{k}{12m}}\Delta x \end{aligned}$$

Problem 9:

$$\begin{aligned} \vec{v}_{1,0} &= -\frac{m_1 + m_2}{m_1}\sqrt{1.5g\ell_2}\hat{\jmath} \\ \vec{v}_{2,0} &= -\frac{m_1 + m_2}{m_1}\sqrt{1.5g\ell_1}\hat{\imath} \end{aligned}$$

Problem 10:

$$v_{slab} = \frac{v}{5}$$

Group 3 Problems:
Problem 12:

$$\begin{aligned} \Delta x &= \frac{8v^2}{g}\sin(55)\cos(55) \\ W &= 6Mv^2\cos^2(55) \end{aligned}$$

Problem 13:

$$\begin{aligned} \text{(a) } \vec{v}_A &= -\sqrt{\frac{K}{2m}}\cos(50)\hat{\imath} - \sqrt{\frac{K}{2m}}\sin(50)\hat{\jmath} \\ \vec{v}_B &= -6\sqrt{\frac{K}{2m}}\hat{\imath} \\ \text{(b) } \vec{P} &= -m(4\cos(5)+6)\sqrt{\frac{K}{2m}}\hat{\imath} - 4m\sqrt{\frac{K}{2m}}\sin(50)\hat{\jmath} \\ \text{(c) } v_A &= \frac{1}{4}(4\cos(5)+6)\sqrt{\frac{K}{2m}} \\ v_B &= 4\sqrt{\frac{K}{2m}}\sin(50) \end{aligned}$$