9장 선운동량과 충돌

3. $\Delta\vec{P} = \vec{F}\Delta t \rightarrow \vec{F} = \dfrac{\Delta\vec{P}}{\Delta t} = m\left(\dfrac{\vec{v_f} - \vec{v_i}}{\Delta t}\right)$ 에서

$\vec{v_i} = (45.0\ \mathrm{m/s})\hat{i}$, $\vec{v_f} = (55.0\ \mathrm{m/s})\hat{j}$, 그리고 $\Delta t = 2.00\ \mathrm{ms}$

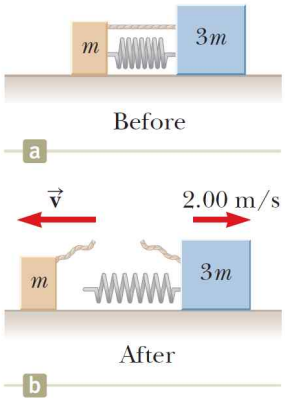
$$\overrightarrow{F_{on\ ball}} = m\frac{\vec{v_f} - \vec{v_i}}{\Delta t} = (0.145\ \mathrm{kg})\frac{(55.0\ \mathrm{m/s})\hat{j} - (45.0\ \mathrm{m/s})\hat{i}}{2.00 \times 10^{-3}\ \mathrm{s}}$$

$$= (-3.26\hat{i} + 3.99\hat{j})\ \mathrm{N}$$

운동의 3법칙에 의하여, $\overrightarrow{F_{on\ bat}} = -\overrightarrow{F_{on\ ball}}$ 이므로,

$$\overrightarrow{F_{on\ bat}} = (3.26\,\hat{i} - 3.99\hat{j})\ \mathrm{N}$$

6.



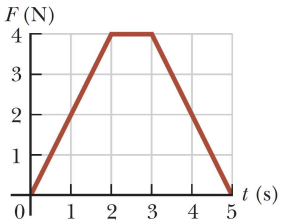
(a) $0 = m\vec{v_1} + (3m)\vec{v_2}$, $\vec{v_1} = -3\vec{v_2} = -6.00\hat{i}\ \mathrm{m/s}$

(b) $U = \dfrac{1}{2}mv_1^2 + \dfrac{1}{2}(3m)v_2^2$

$$= \frac{1}{2}(0.350\ \mathrm{kg})(-6.00\ \mathrm{m/s})^2 + \frac{1}{2}(1.05\ \mathrm{kg})(2.00\ \mathrm{m/s})^2$$

$$= 8.40\ \mathrm{J}$$

9.



(a)5.00 s시간 동안 힘의 충격량 = 5.00 s 시간 동안 그래프 면적

$$I = \left(\frac{0 + 4\ \mathrm{N}}{2}\right)(2\ \mathrm{s} - 0) + (4\ \mathrm{N})(3\ \mathrm{s} - 2\ \mathrm{s}) + \left(\frac{4\ \mathrm{N} + 0}{2}\right)(5\ \mathrm{s} - 3\ \mathrm{s}) = 12.0\ \mathrm{N \cdot s}$$

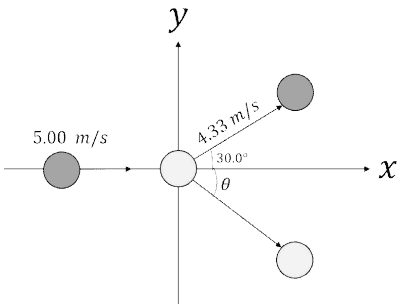
$$\therefore \vec{I} = 12.0\ \hat{i}\ \mathrm{N \cdot s}$$

(b) $\Delta\vec{p} = m\vec{v_f} - 0 = \vec{I} = 12.0\ \hat{i}\ \mathrm{N \cdot s}$, $\vec{v_f} = \dfrac{12.0\ \mathrm{N \cdot s}}{2.50\ \mathrm{kg}} = 4.80\hat{i}\ \mathrm{m/s}$

(c) $\vec{v_i} = -2.00\hat{i}\ \mathrm{m/s}$ 라면, $\vec{v_f} = \dfrac{\vec{I} + m\vec{v_i}}{m} = \dfrac{12.0\hat{i}\ \mathrm{N \cdot s}}{2.50\ \mathrm{kg}} - 2.00\hat{i}\ \mathrm{m/s} = 2.80\hat{i}\ \mathrm{m/s}$

(d) $\overrightarrow{F_{avg}} = \dfrac{\int_{t_i}^{t_f}\vec{F}dt}{\Delta t} = \dfrac{12.0\hat{i}\ \mathrm{N \cdot s}}{5.00\ \mathrm{s} - 0} = 2.40\hat{i}\ \mathrm{N}$

16.



x축 : $m\times(5.00\ \mathrm{m/s})+0\ =\ \mathrm{m}\times(4.33\ \mathrm{m/s})\cos 30.0^\circ+\mathrm{m}\times \mathrm{v}_{2,\mathrm{f,x}}$

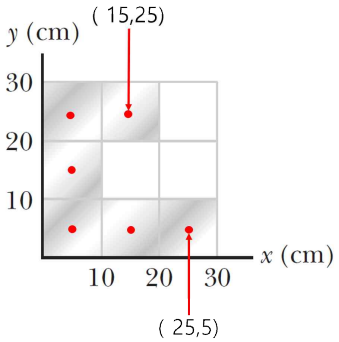
y축 : $0=m\times(4.33\ \mathrm{m/s})\sin 30.0^\circ-\mathrm{m}\times \mathrm{v}_{2\mathrm{f,y}}$

$$v_{2,f,x}=1.250\ \mathrm{m/s}\ ,\ v_{2,f,y}=-2.165\ \mathrm{m/s}$$

$$v_{2,f}=\sqrt{(1.250\ \mathrm{m/s})^2+(2.165\ \mathrm{m/s})^2}=2.50\ \mathrm{m/s}$$

$$\theta=\tan^{-1}\left(\frac{-2.165}{1.250}\right)=-60.0^\circ$$

18. 각 질량의 질량 중심의 위치를 그림에서 찾는다.



각 질량의 질량 중심의 위치를 그림에서 찾는다. 정사각형 물체들이므로 중심의 위치를 가운데에 있다.
중심들의 좌표는 맨 아래 오른쪽부터 시계방향으로,
$(25,5)(15,5)(5,5)(5,15)(5,25)(15,25)$이다. 단위는 cm.

$$x_{CM}=\frac{25+15+5+5+5+15}{6}\ \mathrm{cm}=11.7\ \mathrm{cm}$$

$$y_{CM}=\frac{5+5+5+15+25+25}{6}\ \mathrm{cm}=13.3\ \mathrm{cm}$$