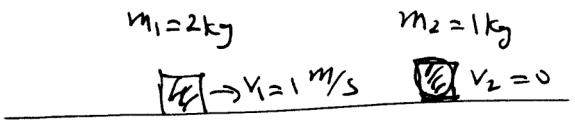
Chapter 7

Homework Solutions

(1)



$$\vec{P} = \vec{P}_1 + \vec{P}_2$$

$$\vec{P}_1 = (2 \times 1) = 2\ kg.m/s \rightarrow \text{(to the right)}$$

$$\vec{P}_2 = 0$$

$$\Rightarrow \vec{P} = 2 + 0 = \boxed{2\ kg.m/s \rightarrow}$$

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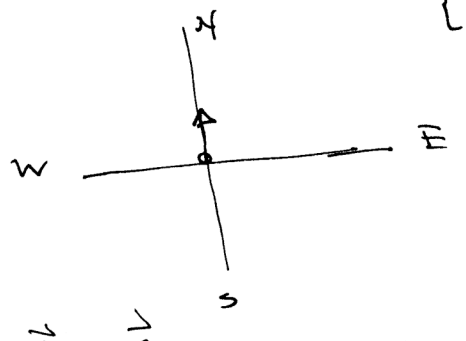

$\begin{cases} m_1 = 3\ kg \\ v_1 = 3\ m/s \uparrow \end{cases}$

$\begin{cases} m_2 = 4\ kg \\ v_2 = 5\ m/s \downarrow \end{cases}$

$\begin{cases} m_3 = 7\ kg \\ v_3 = 2\ m/s \uparrow \end{cases}$

$$\vec{P} = \vec{P}_1 + \vec{P}_2 + \vec{P}_3$$

$$\vec{P}_1 = 3 \times 3 = 9\ kg.m/s \uparrow$$

$$\vec{P}_2 = 4 \times 5 = 20\ kg.m/s \downarrow$$

$$\vec{P}_3 = 7 \times 2 = 14\ kg.m/s \uparrow$$

$$\rightarrow \vec{P} = 9 + 14 - 20 = \boxed{3\ kg.m/s \uparrow}$$

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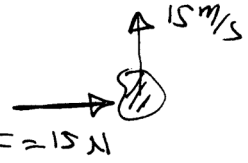
$$\begin{cases} m = 3\,kg \\ v = 15\,m/s \end{cases}$$

$\vec{P}_i = 3 \times 15 = 45$ N.S. ↑



The acting force causes a change in momentum

Given by:

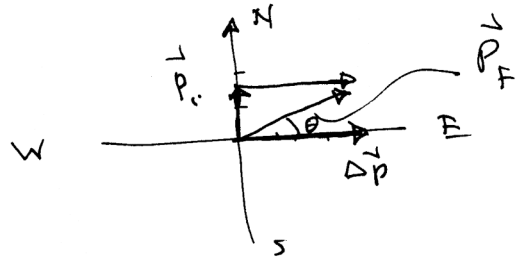
$$\vec{F} = \frac{\Delta \vec{P}}{\Delta t} \rightarrow \Delta \vec{P} = \vec{F}\,\Delta t = (15)(4)$$

$$= 60 \text{ N.S}$$

due East

Thus $\Delta \vec{P} = 60$ N.S. eastward

but $\Delta \vec{P} = \vec{P}_f - \vec{P}_i \rightarrow \vec{P}_f = \Delta \vec{P} + \vec{P}_i$



$$|\vec{P}_f| = \sqrt{P_i^2 + \Delta P^2} = \sqrt{45^2 + 60^2} = 75 \text{ N.S}$$

$$\theta = \tan^{-1}\frac{P_i}{\Delta P} \Rightarrow \boxed{\theta = 37^\circ}$$

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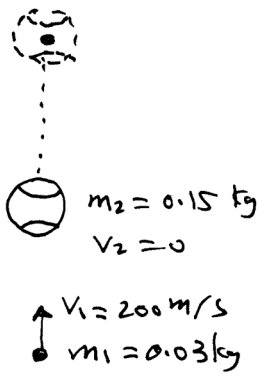

a) $\vec{p}_i = \vec{p}_{bullet} + \vec{p}_{baseball}$ ($\vec{p}_{baseball} = 0$)

$\vec{p}_i = (0.03)(200) = 6$ kg·m/s

$\vec{p}_f = \vec{p}_{bullet + baseball}$

$\vec{p}_f = (0.15 + 0.03)V \rightarrow \vec{p}_f = 0.18V$

but $\vec{p}_i = \vec{p}_f \rightarrow 6 = 0.18V \rightarrow \boxed{V = 33.3 \text{ m/s}}$

b) $K_i + U_i + W_{nc} = K_f + U_f$ ($U_i = 0$, $K_f = 0$)

$\frac{1}{2}(0.18)(33.3)^2 + (f)(37)(\cos 180^\circ) = (0.18)(9.8)(37)$

$99.8 \qquad -1 \qquad 65$

$\boxed{f = 0.94 \text{ N}}$

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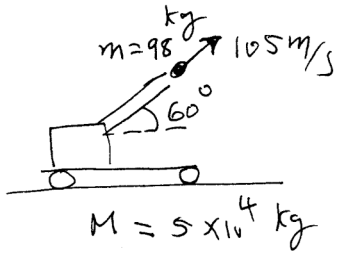

$\vec{P}_i = 0$

before firing, the cannon is at rest.

$\vec{P}_f = \vec{P}_{ball} + \vec{P}_{Cannon}$

$P_{f_x} = P_{ball}\cos 60^\circ + P_{Cannon}$

$\downarrow$

$P_{f_x} = \underbrace{(98 \times 105)\cos 60^\circ}_{5145} + P_{Cannon}$

but $P_i = P_{fx} \rightarrow$

$0 = 5145 + P_{Cannon} \rightarrow$

$P_{Cannon} = -5145 \text{ kg·m/s}$

$\downarrow$

$(5 \times 10^4 - 98)\, V_{recoil} = -5145$

$$\boxed{V_{recoil} = 0.10 \text{ m/s}}$$

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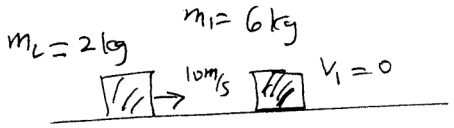

$$\vec{P}_i = (2 \times 10) + 0 = 20 \text{ kg} \cdot \text{m/s}$$

$$\vec{P}_f = (2 \times v_1') + (6 \times v_2') = 2v_1' + 6v_2'$$

but $P_i = P_f \rightarrow$

$$\cancel{2}^{1} v_1' + \cancel{6}^{3} v_2' = \cancel{20}^{10} \qquad (1)$$

Also $K_i = K_f \Rightarrow$ (no friction)

$$\cancel{\tfrac{1}{2}}\,\cancel{(2)}^{1}(10)^2 + 0 = \cancel{\tfrac{1}{2}}\,\cancel{(2)}^{1} v_1'^2 + \cancel{\tfrac{1}{2}}\,\cancel{(6)}^{3} v_2'^2$$

$$100 = v_1'^2 + 3v_2'^2 \qquad (2)$$

$$\begin{cases} v_1' + 3v_2' = 10 \rightarrow v_1' = 10 - 3v_2' \\ v_1'^2 + 3v_2'^2 = 100 \end{cases}$$

$$(10 - 3v_2')^2 + 3v_2'^2 = 100 \Rightarrow 12v_2'^2 - 60v_2' = 0$$

$$12v_2' - 60 = 0 \rightarrow \boxed{v_2' = 5 \text{ m/s}}$$

$$v_1' = 10 - 3 \times 5 = \boxed{-5 \text{ m/s}}$$

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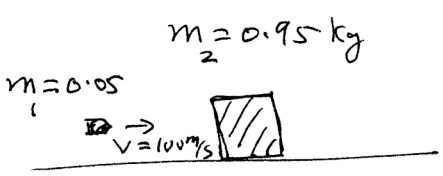

$$\vec{P}_i = \vec{P}_{bullet} + \cancel{P_{block}}^{\,0} = (0.05)(100) = 5 \text{ kg}\cdot\text{m/s}$$

$$\vec{P}_f = \vec{P}_{bullet+block} = \underbrace{(\cancel{0.95} + 0.05)}_{1.0}\vec{V}$$

$$\Rightarrow \vec{P}_i = \vec{P}_f$$

$$5 = (1.0)V \rightarrow \boxed{V = 5 \text{ m/s}}$$