

## § 10-4 Collisions + Explosions

Recall: momentum  $\vec{p} = m\vec{v}$

Conservation of Momentum  $\vec{P}_{\text{total}} = \vec{P}'_{\text{total}}$

(total momentum before)      (total momentum after)

\* In an isolated system (no friction)

MP | 505

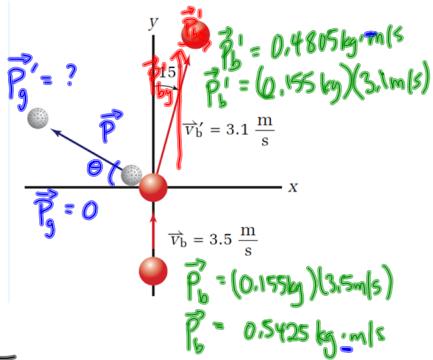
$$m_b = 0.155 \text{ kg}$$

$$m_g = 0.052 \text{ kg}$$

Set up an x-y chart  
for before + after:

BEFORE

	x	y
$\vec{P}_b$	0	+0.5425 kg·m/s
$\vec{P}_g$	0	0
$P_{\text{total}}$	0	+0.5425 kg·m/s

AFTER

	x	y
$\vec{P}_b$	+0.4805 sin 15°	+0.4805 cos 15°
$\vec{P}'_g$	x	y
$P'_{\text{total}}$	0	+0.5425 kg·m/s

Below the table, a right triangle is drawn with horizontal leg labeled  $0.1244 \text{ kg}\cdot\text{m/s}$ , vertical leg labeled  $0.0784 \text{ kg}\cdot\text{m/s}$ , and hypotenuse labeled  $0.147 \text{ kg}\cdot\text{m/s}$ . The angle between the horizontal leg and the hypotenuse is labeled  $\theta = 57.8^\circ$ .

$$\tan \theta = \frac{0.1244}{0.0784}$$

$$\theta = 57.8^\circ$$

$$c^2 = a^2 + b^2$$

$$c^2 = (0.0784)^2 + (0.1244)^2$$

$$c = 0.147 \text{ kg}\cdot\text{m/s}$$

Along the x-axis:

$$(0.4805 \text{ kg}\cdot\text{m/s}) \sin 15^\circ + x = c$$

$$x = 0.1244 \text{ kg}\cdot\text{m/s}$$

Along the y-axis:

$$0.4805 \cos 15^\circ + y = 0.5425 \text{ kg}\cdot\text{m/s}$$

$$y = 0.0784 \text{ kg}\cdot\text{m/s}$$

The momentum of the golf ball after the collision is:

$$0.147 \text{ kg}\cdot\text{m/s} [57.8^\circ \text{ CCW from } +y\text{-axis}]$$

$$\vec{V} = \frac{0.147 \text{ kg}\cdot\text{m/s}}{0.052 \text{ kg}} [57.8^\circ \text{ CCW from } +y\text{-axis}]$$

$$\vec{V} = 2.8 \text{ m/s} [58^\circ \text{ CCW from } +y\text{-axis}]$$

Alternative Solution (use a Momentum Vector Addition Diagram)

\* USE ONLY IF one of the objects is at rest (do not use with more than 3 momentum vectors)

$$\vec{P}_{\text{total}} = \vec{P}'_{\text{total}}$$

$$\vec{P}_b = \vec{P}'_b + \vec{P}'_g$$

 $\therefore$ ← draw a diagram  
show addition