2D Collisions

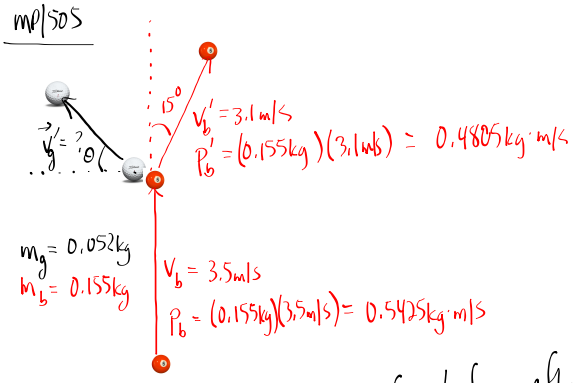
Recall the Conservation of Momentum:

$$\vec{P}_{total} = \vec{P}'_{total}$$ ← neglecting friction

$\vec{P} = m\vec{v}$

$$\begin{bmatrix} P_{x\,total} = P'_{x\,total} \\ P_{y\,total} = P'_{y\,total} \end{bmatrix}$$ (in an isolated system)

mp1505



Method 1 -> use an x-y chart for before + after

BEFORE

	x	y
p_g	0	0
p_b	0	+0.5425
p_{tot}	0	+0.5425 kg·m/s

AFTER

	x	y
p_g	x	y
p_b	+0.4805 sin15°	+0.4805 cos15°
p_{tot}	0	+0.5425 kg·m/s

Along the x-axis:

$$x + 0.4805\sin 15^0 = 0$$

$$x = -0.4805\sin 15^0$$

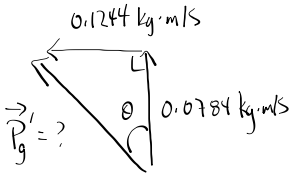
$$x = -0.1244\ kg\cdot m/s$$

Along the y-axis:

$$y + 0.4805\cos 15^0 = 0.5425$$

$$y = 0.5425 - 0.4805\cos 15^0$$

$$y = 0.0784\ kg\cdot m/s$$



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

$$c = 0.1470\ kg\cdot m/s$$

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

$$\theta = 58^0$$

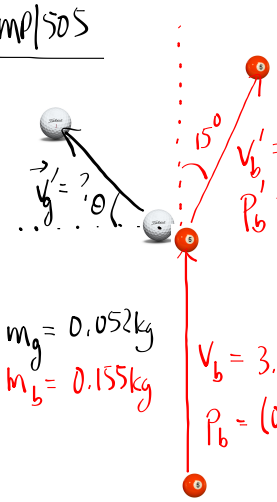
$$\vec{v} = \frac{\vec{p}}{m}$$

$$\vec{v} = \frac{0.1470\ kg\cdot m/s}{0.052kg}\ [58^0\ CCW\ from\ the\ original\ dir\ of\ bill\ ball]$$

$$\vec{v} = 2.8\ m/s\ [58^0\ CCW\ from\ the\ original\ dir\ of\ bill\ ball]$$

The velocity of the golf ball after the collision

mp 505

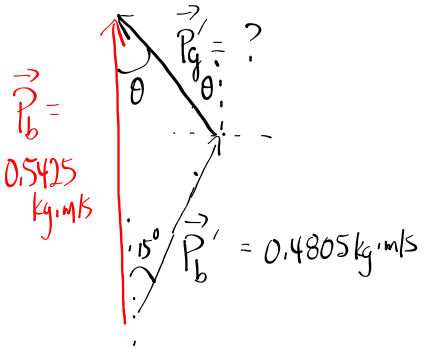


Method 2 → momentum vector addition diagram

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

$$\cancel{0}\ \vec{P}_g + \vec{P}_b = \vec{P}'_g + \vec{P}'_b$$

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



$$c^2 = a^2 + b^2 - 2ab\cos C$$

$$c^2 = 0.4805^2 + 0.5425^2 - 2(0.4805)(0.5425)\cos 15°$$

$c = 0.147\ kg\cdot m/s$

÷ mass to get $\vec{v}$

$$\frac{0.4805}{\sin\theta} = \frac{0.147}{\sin 15}$$

$\theta = 58°$

TO DO

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