Elastic Collisions

A collision is considered to be elastic if the kinetic energy is conserved.

$$E_{k\,total} = E'_{k\,total}$$

$E_k = \frac{1}{2}mv^2$

MP 5.14

	BEFORE		AFTER	
	golf	bill	golf	bill
m	0.0520 kg	0.155 kg	0.0520 kg	0.155 kg
v	+2.10 m/s	0	-1.04 m/s	v
p	0.1092 kg·m/s	0	-0.05408 kg·m/s	(0.155 kg)v

According to the Law of Conservation of Momentum:

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

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

$$0.1092\ \text{kg·m/s} = -0.05408\ \text{kg·m/s} + (0.155\text{kg})v$$

$$0.16328\ \text{kg·m/s} = (0.155\text{kg})v$$

$$v = +1.05\ \text{m/s}$$

$$\vec{v} = 1.05\ \text{m/s}\ [E]$$

Before the Collision

golf ball: $E_k = \frac{1}{2}(0.052\text{kg})(2.10\text{m/s})^2 = 0.11466\ \text{J}$

0.115 J

After the Collision

golf ball: $E_k = \frac{1}{2}(0.052\text{kg})(1.04\text{m/s})^2 = 0.028\underline{1}216\ \text{J}$

bill ball: $E_k = \frac{1}{2}(0.155\text{kg})(1.05\text{m/s})^2 = 0.085\underline{4}4375\ \text{J}$

$0.11\underline{2}56535\ \text{J}$

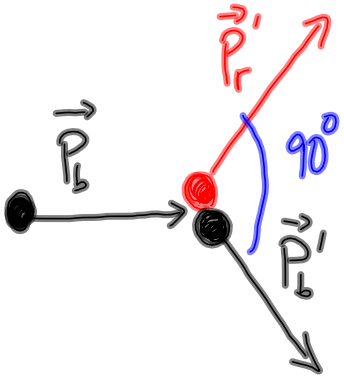
0.114 J

Since $E_{k\,total} = E'_{k\,total}$

the collision was elastic.

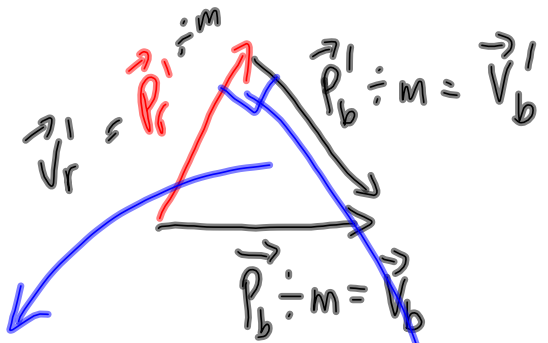
A special case:

- identical masses
- glancing collision
- one object is at rest initially
- elastic collision



According to L of C of M (LOCOM)

$$\vec{p}_b = \vec{p}_b' + \vec{p}_r'$$



Since this collision is elastic:

$$E_{k\,total} = E'_{k\,total}$$

$$E_{k_b} = E'_{k_b} + E'_{k_r}$$

$$\frac{1}{2}mv_b^2 = \frac{1}{2}mv_b'^2 + \frac{1}{2}mv_r'^2$$

$$v_b^2 = v_b'^2 + v_r'^2$$

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

Since the collision is elastic this is a right angle.

PP|515
P529|26-30
P626|38,41,45

TEST

§10-2 Connected masses → draw a FBD! ($F_{net} = ma$)

§10-3 Static Equilibrium → draw a FBD!

① small objects ⇒ $\vec{F}_{net} = 0$ (components)

② large objects ⇒ $\vec{\tau}_{net} = 0$ ($\Sigma\tau_{ccw} = \Sigma\tau_{cw}$)

$F_{net} = 0$ (components)

§10-4 2D Momentum

① momentum vector addition diagram

② before/after diagrams with x-y charts

LOCOM: $\vec{p}_{total} = \vec{p}'_{total}$ ($\vec{p} = m\vec{v}$)

Elastic: $E_{k\,total} = E'_{k\,total}$ ($E_k = \frac{1}{2}mv^2$)