Energy in Collisions

Recall that momentum is conserved in every collision (isolated system)

$$\vec{P}_{total} = \vec{P}'_{total} \quad \text{or} \quad \sum \vec{P} = \sum \vec{P}'$$

Kinetic energy may or may not be conserved in a collision.

An elastic collision is a collision in which kinetic energy is conserved. NOT EVERY COLLISION IS AN ELASTIC COLLISION!

$$E_{k(total)} = E'_{k(total)}$$

$$E_{k_A} + E_{k_B} = E'_{k_A} + E'_{k_B}$$

RECALL:

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

MP|514

Use an mvp chart for a 1-dimensional collision

Use a vector addition diagram or an x-y chart (before/after) for a 2-D collision. (if it is a Δ)

+east
-west

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

$p = mv$

$$\vec{p}_{total} = \vec{p}\,'_{total}$$
$$\vec{p}_b + \vec{p}_g = \vec{p}_b\,' + \vec{p}_g\,'$$
$$0 + 0.1092\,kg{\cdot}m/s = (0.155kg)v - 0.05408\,kg{\cdot}m/s$$
$$(0.155kg)v = 0.16328\,kg{\cdot}m/s$$
$$v = +1.05\,m/s$$
$$\vec{v} = 1.05\,m/s\,[E]$$

BEFORE

$$E_{k_b} = 0$$
$$E_{k_g} = \tfrac{1}{2}(0.052kg)(2.10m/s)^2 = 0.11466\,J$$

$E_{k\,total} = 0.11466\,J$

AFTER

$$E_{k_b}' = \tfrac{1}{2}(0.155kg)(1.05m/s)^2 = 0.085444\,J$$
$$E_{k_g}' = \tfrac{1}{2}(0.052kg)(1.04\,m/s)^2 = 0.0281216\,J$$

0.1135656 J

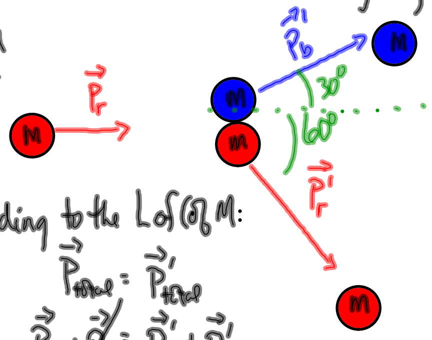
Since $E_{k\,total} = E_{k\,total}'$

the collision is elastic.

A Special case Scenario:

Consider two identical masses of mass m involved in a 2D collision where one mass was originally at rest:

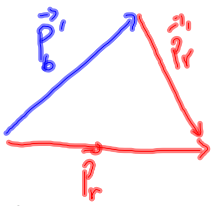
A diagram representing the situation



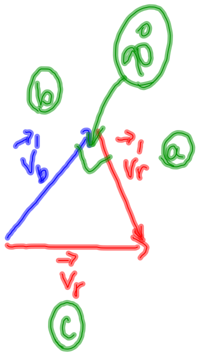
According to the L of C of M:

$$\vec{p}_{total} = \vec{p}_{total}'$$
$$\vec{p}_r + \cancel{\vec{p}_b} = \vec{p}_r' + \vec{p}_b'$$
$$\vec{p}_r = \vec{p}_r' + \vec{p}_b'$$

In an elastic collision:



$$E_{k_{total}} = E_{k_{total}}'$$
$$E_{k_r} + \cancel{E_{k_b}} = E_{k_r}' + E_{k_b}'$$
$$E_{k_r} = E_{k_r}' + E_{k_b}'$$
$$\cancel{\tfrac{1}{2}m}v_r^2 = \cancel{\tfrac{1}{2}m}(v_r')^2 + \cancel{\tfrac{1}{2}m}(v_b')^2$$
$$v_r^2 = (v_r')^2 + (v_b')^2$$
$$c^2 = a^2 + b^2$$



☆☆ **IF** there is an elastic collision between two
☆ identical masses where one object is initially at rest,
☆ then the paths of the objects after the collision will
☆ be at 90°.
☆ This is a special case scenario worth remembering!

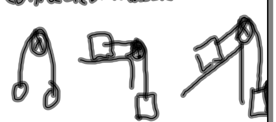
FOR REVIEW:

p529 | 26-30

p627 | 38, 41, 45

TEST

10-2 Connected Masses.



10-3 Static Equilibrium + Torque

10-4 2D Collisions

Nov 10-12:28 PM