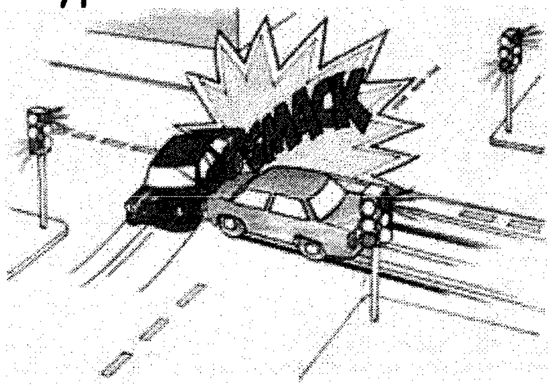
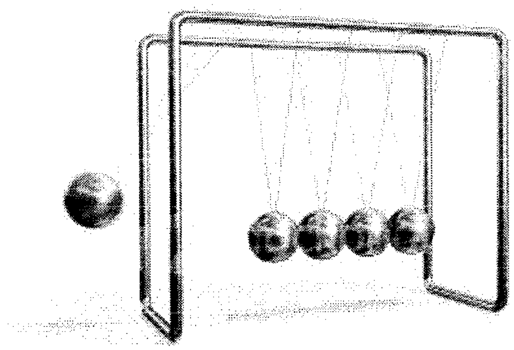
Physics 12 Section 7-4

Conservation of Energy and Momentum in Collisions

1. There are two basic types of collisions, elastic and inelastic.



2. Elastic collisions conserve both momentum and energy.



$$KE_{before} = KE_{after}$$
$$P_{before} = P_{after}$$

3. Inelastic collisions conserve only momentum.

$$P_{before} = P_{after}$$

Physics 12 Section 7-5
Elastic Collisions in one Dimension

1. Both momentum and kinetic energy is conserved.

$$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$$

$$\tfrac{1}{2}m_1v_1^2 + \tfrac{1}{2}m_2v_2^2 = \tfrac{1}{2}m_1v_1'^2 + \tfrac{1}{2}m_2v_2'^2$$

2. Rearranging the two above equations and you get:

$$m_1v_1 - m_1v_1' = m_2v_2' - m_2v_2$$

$$m_1(v_1 - v_1') = m_2(v_2' - v_2)$$

and

$$\tfrac{1}{2}m_1v_1^2 - \tfrac{1}{2}m_1v_1'^2 = \tfrac{1}{2}m_2v_2'^2 - \tfrac{1}{2}m_2v_2^2$$

$$m_1v_1^2 - m_1v_1'^2 = m_2v_2'^2 - m_2v_2^2$$

$$m_1(v_1^2 - v_1'^2) = m_2(v_2'^2 - v_2^2)$$

The above has a difference of two squares so you can factor it using:

$$(a - b)(a + b) = (a^2 - b^2)$$

$$m_1(v_1 - v_1')(v_1 + v_1') = m_2(v_2' - v_2)(v_2' + v_2)$$

Take the above equations and divide it, yes you can divide it, by the rearranges momentum equation.

$$\frac{m_1 (v_1 - v_1')(v_1 + v_1') = m_2 (v_2' - v_2)(v_2' + v_2)}{m_1 (v_1 - v_1') = m_2 (v_2' - v_2)}$$

You will notice that the $(v_1 - v_1')$ on the left and the $(v_2' - v_2)$ on the right, as well as the m, divide out of the equation.

$$(v_1 + v_1') = (v_2' + v_2)$$

$$v_1 + v_1' = v_2' + v_2$$

$$v_1 - v_2 = v_2' - v_1'$$

$$v_1 - v_2 = -(v_1' - v_2')$$

Example: A billiards ball of mass m moving with speed v collides head-on with a second ball of equal mass at rest ($v_2 = 0$). What are the speeds of the two balls after the collision, assuming it is elastic?