

**Example:**

In each of the collisions below determine the velocity of body B after the collision and whether the collision is elastic or inelastic. If it is inelastic, determine the loss or gain of kinetic energy.

1. Body A has a mass 1.0 kg and is moving to the right with a speed of 2.0 m s<sup>-1</sup>. Body B has a mass of 2.0 kg and is moving to the left with a speed of 4.0 m s<sup>-1</sup>. After the collision, A recoils to the left with a speed of 6.0 m s<sup>-1</sup>.

$$\vec{P}_{total}(before) = \vec{P}_{total}(after)$$

$$m_A u_A + m_B u_B = m_A v_A + m_B v_B$$

$$(1.0\text{kg})(2.0\text{ms}^{-1}) + (2.0\text{kg})(-4.0\text{ms}^{-1}) = (1.0\text{kg})(-6.0\text{ms}^{-1}) + (2.0\text{kg})v_B$$

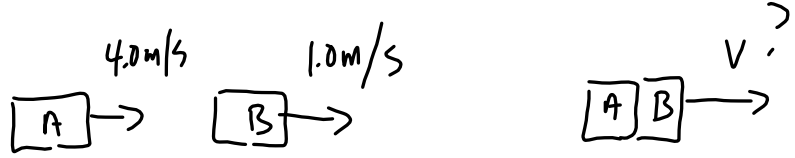
$$2.0\text{kg}\cdot\text{ms}^{-1} - 8.0\text{kg}\cdot\text{ms}^{-1} = -6.0\text{kg}\cdot\text{ms}^{-1} + (2.0\text{kg})v_B$$

$$0 = (2.0\text{kg})v_B$$

$$v_B = 0\text{ms}^{-1}$$

Before:  
 A: 2.0J } 18J  
 B: 16J }  
 After: ELASTIC  
 A: 18J } 18J  
 B: 0J }

2. Body A has a mass 2.0 kg and a velocity of +4.0 m s<sup>-1</sup> and a body B has mass 4.0 kg and velocity +1.0 m s<sup>-1</sup>. Body A overtakes body B and after the collision has a velocity of +2.0 m s<sup>-1</sup>.



$$(2.0\text{kg})(+4.0\text{ms}^{-1}) + (4.0\text{kg})(+1.0\text{ms}^{-1}) = (6.0\text{kg})v_{AB}$$

$$8.0\text{kg}\cdot\text{ms}^{-1} + 4.0\text{kg}\cdot\text{ms}^{-1} = (6.0\text{kg})v_{AB}$$

$$12\text{kg}\cdot\text{ms}^{-1} = (6.0\text{kg})v_{AB}$$

$$v_{AB} = +2.0\text{ms}^{-1}$$

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

BEFORE  
 A: 16J }  
 B: 2J } 18J

AFTER  
 A+B: 12J

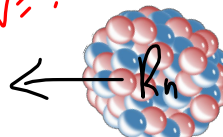
INELASTIC .... loss of 6J of kinetic energy (internal/sound)

**Example:**

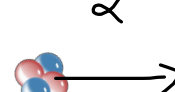
A stationary radon nucleus of mass  $3.6 \times 10^{-25}$  kg emits an alpha particle with a kinetic energy of  $1.1 \times 10^{-12}$  J. Calculate the kinetic energy of the recoiling nucleus. Mass of an alpha particle is  $6.7 \times 10^{-27}$  kg.

includes  $\alpha$  particle

$\vec{P}_{\text{total (before)}} = \vec{P}_{\text{total (after)}} \quad v = ?$   
 $0 = \vec{P}_{\alpha} + \vec{P}_{Rn}$   
 $\vec{P}_{Rn} = -\vec{P}_{\alpha}$   
 $m_{Rn} \vec{V}_{Rn} = -m_{\alpha} \vec{V}_{\alpha}$   
 $\vec{V}_{Rn} = \frac{-(6.7 \times 10^{-27} \text{ kg})(1.8 \times 10^7 \text{ m s}^{-1})}{3.533 \times 10^{-25} \text{ kg}} = -3.4 \times 10^5 \text{ m s}^{-1}$



$3.6 \times 10^{-25} \text{ kg}$   
 $- 6.7 \times 10^{-27} \text{ kg}$   
 $3.533 \times 10^{-25} \text{ kg}$



$1.1 \times 10^{-12} \text{ J}$   
 $6.7 \times 10^{-27} \text{ kg}$   
 $1.8 \times 10^7 \text{ m s}^{-1}$   
 $(E_k = \frac{1}{2} m v^2)$

**Example:**

When a radioactive nucleus decays by emitting a particle with a mass which is very small compared to the mass of the nucleus, nuclear potential energy is converted into kinetic energy of both the particle and the recoiling nucleus.

Show that almost all the energy released is carried by the small mass particle while very little of the kinetic energy is carried by the recoiling nucleus.

$\frac{1}{2} (3.533 \times 10^{-25} \text{ kg}) (3.4 \times 10^5 \text{ m s}^{-1})^2$   
 $2.1 \times 10^{-14} \text{ J}$

let  $m$  be small particle mass  
 $M$  be nucleus ( $M \gg \gg m$ )  
 $v$  be the velocity of small particle  
 $V$  be the velocity of the recoiling nucleus.

magnitude:  $mv = MV$   
 $V = \frac{mv}{M}$

Since  $M$  is very very large,  $V$  will be very very small

$\therefore E_k$  will also be very very small