Wednesday Warm Up: Unit 5: Momentum II

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1 Memory Bank

- $\vec{p} = m\vec{v}$ ... Definition of momentum.
- $\vec{p}_{\rm total} = \vec{p}_1 + \vec{p}_2$ ... Total momentum.
- $\vec{p}_{\rm total,i} = \vec{p}_{\rm total,f}$ ... Momentum is conserved.
- $\vec{F}_{\rm Net} = \frac{d\vec{p}}{dt}$ ... Force and momentum
- Let M be the total mass of a system, and let m_j and $\vec{r}_j$ $(j = 1, ..., N)$ be the masses and positions of the constituent parts of the system. The position of the center of mass is

$$\vec{r}_{\rm CM} = \frac{1}{M}\sum_{j=1}^{N} m_j \vec{r}_j \tag{1}$$

- The momentum of the center of mass $\vec{P}_{\rm CM}$ is

$$\vec{P}_{\rm CM} = \sum_{j=1}^{N} \vec{p}_j \tag{2}$$

- The net external force on a system obeys

$$\vec{F} = \frac{d\vec{P}_{\rm CM}}{dt} \tag{3}$$

2 Momentum II

1. An alpha particle (4 amu) undergoes an elastic collision with a stationary uranium nucleus (235 amu). What percent of the kinetic energy of the alpha particle is transferred to the uranium nucleus? Assume the collision is one-dimensional.

2. Three point masses are placed at the corners of a triangle as shown in Fig. 1. Find the center of mass of the three-mass system.

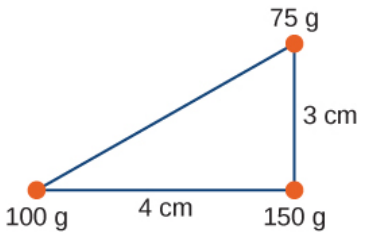

Figure 1: Triangle of masses.

3. Two objects of equal mass m approach each other with equal speed v. The undergo a totally inelastic collision. Determine the location of the center of mass versus time, before and after the collision.