Linear momentum

Variation of momentum. The time variation of momentum of a system is equal with the total external force applied on the system

One body. $\frac{d\vec{p}}{dt} = \vec{F}$ (2^{nd} law)

n bodies. $\vec{P} = \sum_{i=1}^{n} \vec{p}_i$. $\frac{d\vec{P}}{dt} = \sum_{i=1}^{n} \frac{d\vec{p}_i}{dt} = \sum_{i=1}^{n} \vec{F}_i = \sum_{i=1}^{n} (\vec{F}_i + \vec{F}_{iext}) = \sum_{i=1}^{n} \vec{F}_i$ (D12)

(using the 3^{rd} law).

Definition: Center of mass. A point in the position

$$\vec{R} = \frac{\sum_{i=1}^{n} m_i \vec{r}_i}{\sum_{i=1}^{n} m_i} \quad \text{(D13)}$$

with mass

$$M = \sum_{i=1}^{n} m_i \ . \quad \text{(D14)}$$

What is its velocity ? Show that the momentum is zero in the CM frame.