

Chapter C4: Particles and Systems

Physics I

College of the Atlantic

Previously...

- Vectors are arrows. Represent with either components or magnitude/direction.
- Vector addition *must* be done with components.
- Interactions *change* motion.
- Accounting principle: Interactions exchange but do not create momentum.
- Reminder: The accounting is done with momentum (not velocity), and momentum is a vector.

C4.1: Systems of Particles

1. Particles are tiny.
2. A system is a collection of particles with a boundary.
3. Internal interactions are interactions between particles or objects in a systems.

C4.2: Conservation of Momentum

1. The total momentum of a system is just the sum of the momenta of the objects in the system. This is Eq. (C4.1).
2. If a system experiences no external interactions, then its total momentum is conserved; \vec{p}_{tot} does not change.

C4.3 Center of Mass

1. Eq. (C4.2), Eq. (C4.3) and Eqs. (C4.4a-c) are identical. They are different ways of writing the same thing.
2. The equation that defines the center of mass is the equation for a *weighted average*.

$$\text{average test score} = \frac{1}{N} (s_1 + s_2 + \cdots s_N) .$$

$$\text{average test score weighted by height} = \frac{1}{h_1 + h_2 + \cdots h_N} (h_1 s_1 + h_2 s_2 + \cdots h_N s_N) .$$

C4.4: How the Center of Mass Moves

1. A system's momentum can be found via the velocity of its center of mass: $\vec{p}_{\text{tot}} = M\vec{v}_{\text{CM}}$. This is Eq. (C4.14).
2. "A system's center of mass responds to its external interactions exactly as a point particle would respond to those interactions." (p. 71)

C4.5: Inertial Reference Frames

The main point here is that we should choose our reference frames such that they're non-accelerating. If some of the technical details seem a little strange, don't worry.

C4.6: Interactions with the Earth

The earth is way bigger than you.