

Center of Mass Encyclopedia Article

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Contents

| | |
|--|-------------------|
| Center of Mass Encyclopedia Article..... | 1 |
| Contents..... | 2 |
| Center of Mass..... | 3 |

Center of Mass

The center of **mass** of an object is a point where, for purposes of measurements, all of the object's mass is imagined to be concentrated. It is also the point at which an object will balance on a single support or spin around if thrown into the air.

Knowing where the center of mass is located becomes particularly useful when calculating the **motion** of a body as it is acted upon by external forces. A perfectly symmetrical ball thrown through the air will travel in an arc, or parabola. This motion can be easily tracked with the naked eye or mathematically. But, for instance, if we throw a hammer into the air, it will wobble and spin, and appear not to travel in a parabolic motion. If we track the end of the hammer on its journey, it will be mathematically very complicated. There is, however, a location (the center of mass) that follows a smooth parabolic path.

In a perfectly symmetrical object, such as a barbell with equal weights on each end, the center of mass is easy to find: it is in the middle of the bar, at the exact midpoint between the two weights.

If we replace the **weight** on one side with one twice as heavy, the center of mass shifts towards the more massive end of the barbell. The new center of mass is $\frac{2}{3}$ of the way from the **light** end to the heavy end. This is the point at which the barbell would balance on a sawhorse. To calculate the center of mass in the lopsided barbell, we find the sum of all the segments of mass of the object multiplied by the position of each segment of mass, divided by the entire mass of the object. The center of mass may not even reside inside the object: It is between the legs of a chair and in the center of a hoop.