8.5 – Center of Mass

Point at which an object's mass may be considered to be concentrated - also called the balance point.

CM is often erroneously called "center of gravity (CG)," which accounts for the gravitational field around the object (or system). Usually, CM = CG.

Center of Mass

For a system of n masses on the x-axis, the center is:

$$\vec{X}_{cm} = \frac{m_1\vec{x}_1 + m_2\vec{x}_2 \ldots + m_n\vec{x}_n}{m_1 + m_2 \ldots + m_n}$$

m = mass (kg)
x = position (m) (+ or -)

Or, in Greek terms:

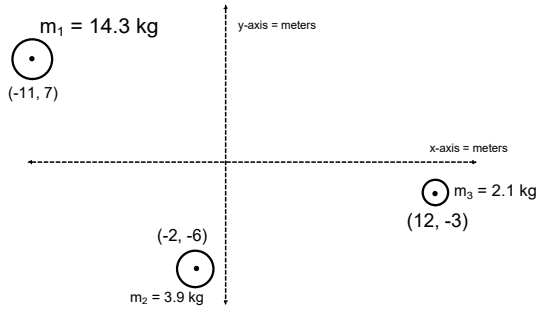
$$X_{cm} = \frac{\sum m_i x_i}{M}$$

i = individual items
M = Sum of Masses

For the y-axis: $Y_{cm} = \frac{\sum m_i \vec{y}_i}{M}$

1. Example

Where is the center of mass of this system (x, y)?



1. Example

x-axis:

$$x_{cm} = \frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3}$$

$$= \frac{14.3\text{ kg}\cdot -11\text{ m} + 3.9\text{ kg}\cdot -2\text{ m} + 2.1\text{kg}\bullet 12\text{m}}{14.3\text{ kg} + 3.9\text{ kg} + 2.1\text{ kg}}$$

$$= \frac{-139.9\,kg\bullet m}{20.3\,kg} = -6.9\text{ m}$$

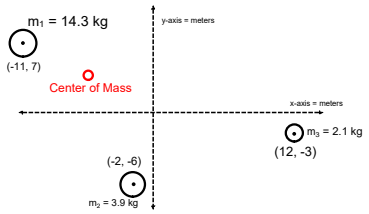
1. Example

Y-axis:

$$y_{cm} = \frac{m_1y_1 + m_2y_2 + m_3y_3}{m_1 + m_2 + m_3}$$

$$\frac{14.3\text{ kg}\bullet 7\text{m} + 3.9\text{ kg}\bullet -6\text{m} + 2.1\text{ kg}\bullet -3\text{m}}{14.3\text{ kg} + 3.9\text{ kg} + 2.1\text{ kg}} = \frac{70.4\text{ kg}\bullet\text{m}}{20.3\text{ kg}} = 3.5\text{ m}$$

The center of mass is at (-6.9 , 3.5 m).



Homework

8.5 Problems in your Booklet
Due: next class
Finish Unit 8 Review Problems