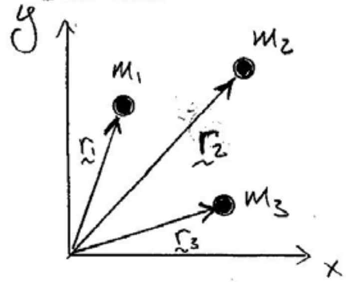
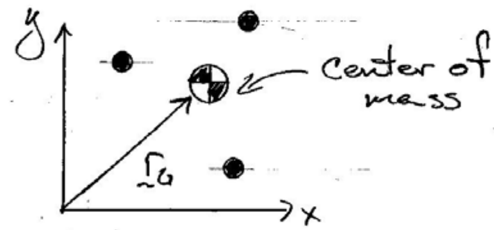
Review of Center of mass





Suppose we have a collection of three particles that have masses

m_1, m_2, m_3

And suppose that the positions of the particles are

$$\underset{\sim}{r}_1 = x_1\hat{i} + y_1\hat{j}$$

$$\underset{\sim}{r}_2 = x_2\hat{i} + y_2\hat{j}$$

$$\underset{\sim}{r}_3 = x_3\hat{i} + y_3\hat{j}$$

The center of mass is defined as

$$\underset{\sim}{r}_G = \frac{m_1\underset{\sim}{r}_1 + m_2\underset{\sim}{r}_2 + m_3\underset{\sim}{r}_3}{m_1 + m_2 + m_3}$$

Or in components if $\underset{\sim}{r}_G = x_G\hat{i} + y_G\hat{j}$

$$x_G = \frac{1}{m_T}\left(m_1 x_1 + m_2 x_2 + m_3 x_3\right)$$

$$y_G = \frac{1}{m_T}\left(m_1 y_1 + m_2 y_2 + m_3 y_3\right)$$

where $m_T = m_1 + m_2 + m_3$
Total mass

The center of mass is a "weighted average" of the positions of the particles

Of course, our definition can be generalized.

- If the particles reside in 3-dimensional space the

$$\underset{\sim}{r}_G = x_G \hat{i} + y_G \hat{j} + z_G \hat{k}$$

where x_G & y_G are given earlier, and

$$z_G = \frac{1}{m_T}\left(m_1 z_1 + m_2 z_2 + m_3 z_3\right)$$

- We can generalize it to any number of particles, say N particles

$$\underset{\sim}{r}_G = \frac{1}{m_T}\sum_{j=1}^{N} m_j \underset{\sim}{r}_j$$

where $m_T = \sum_{j=1}^{N} m_j$