1 | **Position of** m_i

In a rigid body consisting of N point masses, the vector to the position of m_i is defined as $\vec{r_i(t)}$, which is defined as follows:

$$\vec{r_i(t)} = \vec{R_{CM}}(t) + \vec{r_i}'(t) \tag{1}$$

whereas, $\vec{R_{CM}}(t)$ is the position vector of the center of mass of the rigid body as a whole, and $\vec{r_i}'(t)$ the vector from the center of mass to m_i.

2 | **Velocity of** m_i

The velocity of m_i is simply determined by the first derivative of the position equation as per above. Namely, that:

$$\vec{v_i(t)} = \vec{V_{CM}}(t) + \vec{v_i}'(t) \tag{2}$$

where, $\vec{v_i(t)}$ is the velocity vector of m_i, and $\vec{V_{CM}}(t)$ is the velocity vector of the center of mass of the rigid body, and $\vec{v_i}'(t)$ is the velocity vector from center of mass to m_i.

3 | **Deriving** KE_{total}

From definition of KE_{total} itself, KE_{total} is the sum of all energies of each point mass in the rigid body.

$$\sum_{i=1}^{N} \frac{1}{2} m_i v_i^2 \tag{3}$$

Expanding this equation and replacing