Fundamental Postulate of Classical Mechanics

Consider a system of N particles with total kinetic energy T and interacting via the potential V. We define the **Lagrangian** $\mathcal{L}$ to be

$$\mathcal{L} = T - V.$$

That is,

$$\boxed{\mathcal{L} = \frac{1}{2}\sum_{\alpha=1}^{N} m_\alpha |\dot{\mathbf{r}}^{(\alpha)}|^2 - V(\mathbf{r}^{(1)}, \mathbf{r}^{(2)}, \ldots, \mathbf{r}^{(N)})}. \tag{1}$$

The equations of motion are given by the **Euler-Lagrange** equations,

$$\boxed{\frac{\partial \mathcal{L}}{\partial \mathbf{r}_i^\alpha} = \frac{d}{dt}\frac{\partial \mathcal{L}}{\partial \dot{\mathbf{r}}_i^\alpha}} \tag{2}$$

for each α, i, where α labels the particle and i labels the vector components of $\mathbf{r}$.