Exercise 5

Consider a rigid structure composed of point particles joined by massless rods. The particles are numbered 1, 2, 3, \ldots, N, and the particle masses are \( m_v \) \((v = 1, 2, \ldots, N)\). The locations of the particles with respect to the center of mass are \( R_v \). The entire structure rotates on an axis passing through the center of mass with an angular velocity \( W \). Show that the angular momentum with respect to the center of mass is

\[
L = \sum_v m_v [R_v \times (W \times R_v)]
\]

Then show that the latter expression may be rewritten as

\[
L = [\Phi \cdot W]
\]

where

\[
\Phi = \sum_v m_v \{(R_v \cdot R_v)\delta - R_v R_v\}
\]

is the moment-of-inertia tensor.