# MA2341 - Advanced Mechanics 1
# Michelmas Term - 2015-2016
# Homework 8 - Due Dec. 8th, 2015

1. Determine the principal moments of inertia of a homogeneous cone with height $h$ and mass $M$ for rotations about
   (a) the origin at the point of the cone.
   (b) the origin at the center of mass of the cone.

2. Prove the identity:
$$\epsilon_{ijk}\lambda_{jj'}\lambda_{kk'} = \lambda_{ii'}\epsilon_{i'j'k'}$$
   where $\lambda_{ij}$ is a rotation matrix. Hint: you may need the identity
$$\epsilon_{ijk}A_{ii'}A_{jj'}A_{kk'} = (\det A)\,\epsilon_{i'j'k'},$$
   where A is a $3 \times 3$ matrix. Use this result to demonstrate that the angular momentum transforms like an axial vector, i.e. like a vector under rotations but invariant under the parity transformation.

3. Prove the following by explicitly demonstrating transformation properties under rotations and parity:
   (a) $\det I$ is a scalar.
   (b) $\mathrm{Tr}\, I$ is a scalar.
   (c) $s = (\vec{A} \times \vec{B}) \cdot \vec{C}$, where $\vec{A}$, $\vec{B}$, and $\vec{C}$ are vectors, is a pseudoscalar.