Recitation #1
Quantum 521

---

1. Given a matrix A with eigenvalues a_i

   prove that $\mathrm{Tr\,(A)} = \sum \mathrm{a_i}$

2. Consider a classical collection of masses m_i and positions $\vec{r}_i$ rotating with about a fixed axis with angular velocity $\vec{\omega}$. The velocites are therefore $\vec{v}_i = \vec{\omega} \times \vec{r}_i$.

   In general, will the angular momentum be parallel to $\vec{\omega}$?

   Argue that in general there will be three directions for $\vec{\omega}$ that if chosen will have the angular momentum be parallel to this direction. How do you find these directions?

3. Prove that, given a function $f(x)$ which has a zero $f(x_0) = 0$,

$$\delta\left(f(x)\right) = \frac{\delta(x_0 - x)}{\left|\frac{df}{dx}|_{x_0}\right|}$$

   Hint: On hw 1 you prove that $\delta(ax) = \delta(x)/|a|$.

4. Prove that

$$\delta(x - x') = \frac{d}{dx}\theta(x - x')$$

   where θ is the unit step function.