

Problem set -7, due Tuesday, Oct 21, 2003

25. A displacement of an object by a vector $\vec{\rho}$ is represented by a unitary operator $U_r(\vec{\rho})$. We have said in the class that this gives

$$U_r^+(\vec{\rho})\vec{r}U_r(\vec{\rho}) = \vec{r} + \vec{\rho}$$

Show this relation mathematically. Just consider the displacement is in the x-direction.

Hint: Show $\vec{r}U_r(\vec{\rho}) = U_r(\vec{\rho})(\vec{r} + \vec{\rho})$ instead of the expression above.

26. This is a very simple exercise, but just want to make sure that you know how to do the simple problems. For any angular momentum, in the representation where \vec{J}^2 and J_z are diagonal, what are the matrix representation of J_x and J_y ? Work out the explicit matrices

for $J=1/2, 1, 3/2$ and compare your results, for example, (27.26) of Schiff. Note that in this representation the matrices J_x and J_z are real while J_y is purely imaginary.