1/16/15

QUANTUM MECHANICS II (524)
PROBLEM SET 1 (hand in January 23)

1) (10 points) Diagonalize $\boldsymbol{S}^2$ for a system of two spin $\frac{1}{2}$ particles and generate the basis transformation to states with good total spin that way. Compare with the results obtained in class for this system.

2) (20 points) Find **all** nonvanishing Clebsch-Gordan coefficients that describe the coupling of two states with angular momentum 1 to a total angular momentum of 2, 1, and 0. (Having successfully done this once, you can look Clebsch-Gordan coefficients up in a table or download code to calculate them from now on.)

3) (10 points) Consider a system made up of two spin-$\frac{1}{2}$ particles in a spin-singlet state (meaning the total spin $S = 0$). Observer A measures spin components of particle 1 while B does the same for particle 2.

   a) Determine the probability for A to obtain the spin up in the y-direction when B makes no measurement. Same for the $\hat{\boldsymbol{n}}$-direction, where this unit vector lies in the xz-plane and makes a 45 degree angle with the z-axis.

   b) Observer B obtains the spin of particle 2 to be up in the $\hat{\boldsymbol{n}}$-direction. What can be concluded about the outcome of observer A's measurement if (i) A measures S_{1y}, and (ii) A measures S_{1x}?