Physics 214A
Problem Set 1
Fall 1997

Problem 1

At $t = 0$ a spin particle has a probability p of having $s_x = +1/2$ and probability $(1-p)$ of $s_x = -1/2$. A magnetic field B is applied along the $\hat{z}$ direction. The interaction Hamiltonian is

$$H = -\mu \sigma_z B$$

What is the density matrix as a function of time? Interpret the result.

Problem 2

Two $\ell = 1$ particles are in the following pure state.

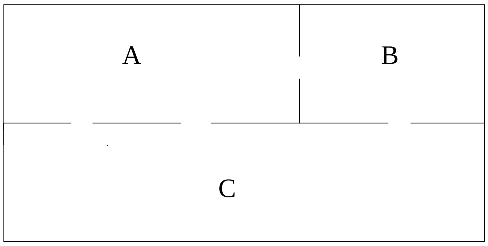
$$\frac{1}{\sqrt{3}} \left[\, |0,0\rangle + |1,0\rangle + |1,1\rangle \,\right] .$$

(The notation is $|m_\ell^{(1)}, m_\ell^{(2)}\rangle$)

You are allowed to measure only operators that are diagonal in the second spin. What is the effective density matrix for the first spin? Diagonalize this effective density matrix and interpret the eigenvalues.

Problem 3 (20 pts.)

Three rooms, whose volumes are V_A, V_B, V_C, are connected by doors as shown in the figure. The rooms are filled with a gas. The probability that in time δt a molecule will go



from a room with volume V through any door available to it is $\frac{p}{V}\delta t$. At $t = 0$ all the gas is in room A. What is the distribution at a time t later? What is the distribution for $t \to \infty$?