FINAL EXAM (con't.)

2. A spin-$\frac{1}{2}$ particle has a magnetic moment $\vec{\mu} = \gamma \vec{S}$ and is in a uniform magnetic field oriented in the z direction, $\vec{B} = \hat{z}B_0$. At time $t = 0$ the spin state of the particle is $|\psi\rangle = \frac{1}{\sqrt{2}}[|+\rangle + |-\rangle]$, where $|+\rangle$ and $|-\rangle$ are up and down eigenfunctions of S_z.

   (a) At time $t = 0$ what is the probability that a measurement of S_x will yield the value $\frac{\hbar}{2}$?

   (b) At time $t = 0$ what is the probability that a measurement of S_x will yield the value $\frac{\hbar}{2}$?

   (c) What are the eigenstates and eigenvalues associated with the potential energy $W = -\vec{\mu} \cdot \vec{B}$?