

Name: \_\_\_\_\_

**Do NOT simply write an answer. Give a calculation and/or reasoning that supports your answer. Circle or clearly delineate all relevant work.**

1) A spin-1/2 particle is placed in a magnetic field pointing in the z-direction, so that  $\hat{H} = \hbar\omega\sigma_z$ . At  $t = 0$  the y-component of its spin is measured and found to be  $\hbar/2$ . At time  $t = t_1$ , the x-component of its spin is measured. What are the possible results and what are the probabilities for each of these results?

2) Light with wavelength  $\lambda$  shines on particles of unknown mass,  $M$ . The wavelength of light scattered backwards is found to be  $2\lambda$ . What is  $M$ ? Find the answer in terms of  $\lambda$ ,  $c$  and  $\hbar$  or  $h$ . Assume that  $M$  is large enough that it can be treated non-relativistically. [Hint: Set up the scattering problem as if you know  $M$ , then treat it as the only unknown.]