Physics 215C
Take-home Exam II
Spring, 2000

A spin $\frac{1}{2}$ system with a magnetic moment is located at the origin and interacts with a magnetic field

$$H = \mu\sigma \cdot \left(\mathbf{B}^{\rm ext} + \mathbf{B}^{\rm quant}\right).$$

The magnetic field has been separated into a constant external one, $\mathbf{B}^{\rm ext}$, which may be taken to be along the z direction, and the quantized magnetic field, $\mathbf{B}^{\rm quant} = \nabla \times \mathbf{A}$ expressed in terms of the creation and annihilation operators. The higher energy state can decay into the lower one by emitting a photon.

[a.] Find the decay rate as a function of the photon direction and polarization.

[b.] What is the lifetime of the higher energy state?