Homework IX - PHYS652

1. Given following Hamilton operator (in matrix form) with three linearly independent states. V_0 a constant and $\epsilon << 1$ represents a perturbation.

$$H = V_0 \begin{pmatrix} 1-\epsilon & 0 & 0 \\ 0 & 1 & \epsilon \\ 0 & \epsilon & 2 \end{pmatrix}$$

   a) determine eigenvalues and eigenstates for the unperturbed Hamiltonian ($\epsilon = 0$)
   b) calculate the exact eigenvalues of H. Expand them as a power series in ϵ to second order
   c) Calculate first and second order energy corrections for each eigenvalue and compare them with the b). [hint: be careful with degeneracies]

2. Determine the Schroedinger equation for a moving charged particle in the constant magnetic field $\mathbf{B} = B\hat{z}$. Use that $\mathbf{A}$ and $\mathbf{p}$ commute in Coulomb gauge. With a separation ansatz split the motion of the particle in the z-direction from the motion in a plane perpendicular to $\hat{z}$. Discuss energy eigenvalues and eigenstates of $\hat{H}$ in analogy to the harmonic oscillator.

3. shankar: 18.5.2

4. shankar: proof equation 18.5.24

5. shankar: 19.3.1

6. shankar: 19.3.2