Quantum Mechanics I - HW3

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1. A charged particle (charge q) us out in a constant electric field $E_0\hat{\mathbf{x}}$. In addition it experiences a harmonic force in the same direction. Determine the energy eigenvalues and the eigenfunctions. To do so define a new variable

$$\xi \equiv x - \frac{qE_0}{k} \tag{1}$$

2. Find the eigenfunctions $\Psi(x, y)$ and the eigenvalues E of a two dimensional harmonic oscillator with the Hamiltonian

$$\hat{H} = \hat{H}_x + \hat{H_y} = \frac{\hat{P}_x^2}{2m} + \frac{1}{2}m\omega x^2 + \frac{\hat{P}_y^2}{2m} + \frac{1}{2}m\omega y^2 \tag{2}$$

Try a separation ansatz: $\Psi(x, y) = \Psi_x(x)\Psi_y(y)$.

3. Consider a particle with a charge $q > 0$ moving under the three dimensional harmonic potential $V(r) = \frac{1}{2}m\omega r^2$ in an electric field $\vec{E} = E_0\hat{\mathbf{x}}$. Find the eigenvalues by making a separation ansatz $\Psi(x, y, z) = \Psi_x(x)\Psi_y(y)\Psi_z(z)$.