Phys 448 HW 11 Due Nov 30

1) Use the variational principle with a trial Gaussian wavefunction to get an upper bound on the energy of a particle in the potential

$$V(x) = -V_0 e^{-\frac{x^2}{b^2}}$$

where $b = 10 \left(\frac{\hbar^2}{mV_0}\right)^{\frac{1}{2}}$. Express your answer in terms of V_0.

2) BD 10.1

3) BD 10.2

4) A system with angular momentum $j > \frac{1}{2}$ can have an electric quadrupole moment in addition to its magnetic dipole moment $\boldsymbol{\mu} = \gamma \boldsymbol{J}$. The Hamiltonian is then generally of the form

$$H = -\boldsymbol{\mu} \cdot \boldsymbol{B} + \boldsymbol{J}.\boldsymbol{Q}.\boldsymbol{J}$$

where $\boldsymbol{Q} = \sum_{i,j=1}^{3} Q_{ij} \hat{x}_i \hat{x}_j$. Assuming $\boldsymbol{B}$ points along the $\hat{x}_3$ direction, use perturbation theory to find the energy levels of H correct to first order in $\boldsymbol{Q}$.