Physics 5456 – Problem set 2

1. **Two bosons with weak contact interaction in infinite well.** Two identical bosons are placed in a one-dimensional infinite potential well of width a. They interact through the weak attractive contact potential

$$V(x_1, x_2) = -aV_0\delta(x_1 - x_2)$$

   (a) For $V_0 = 0$, list the ground and first excited states of this system, along with their energy eigenvalues.

   (b) Apply first-order perturbation theory to estimate the effects of the contact interaction on these energy levels.

   (c) How would your results above change if the system had identical fermions, instead of identical bosons?

2. Check Schwabl I equation (14.10), *i.e.* show that

$$\langle n, \ell + 1/2, m_j, \ell | J_z + S_z | n, \ell - 1/2, m_j, \ell \rangle = -\frac{\hbar}{2\ell + 1}\left[(\ell + 1/2)^2 - m_j^2\right]^{1/2}$$