HW Quiz 9

Work one of the following problems (show your work):

1. For a system of two spin-1/2 particles, show that the spin singlet state $|00\rangle$ is an eigenstate of $\hat{S}^2$ with eigenvalue 0.

$$\hat{S}^2 = S_x^2 + S_y^2 + S_z^2$$

2. For two identical fermions in a SHO potential, write an integral expression for $\langle (x_1 - x_2)^2 \rangle - \langle x^2 \rangle_{n=0} - \langle x^2 \rangle_{n=1} + 2\langle x \rangle_{n=0}\langle x \rangle_{n=1}$ if the $n=0$ and $n=1$ wavefunctions are given by:

$$\psi_0(x) = \left(\frac{m\omega}{\pi\hbar}\right)^{1/4} e^{-\frac{m\omega}{2\hbar}x^2}$$

$$\psi_1(x) = \left(\frac{m\omega}{\pi\hbar}\right)^{1/4} \sqrt{\frac{2m\omega}{\hbar}} xe^{-\frac{m\omega}{2\hbar}x^2}$$

**NOTE:** Your answer should involve only one integral and you do not have to evaluate it!