Consider the 1-D harmonic oscillator, with Hamiltonian $H = p^2/2m + \frac{1}{2}m\omega^2x^2 = \hbar\omega(a^\dagger a + 1/2)$, and with energy eigenstates $H|n\rangle = E_n|n\rangle = \hbar\omega(n+1/2)|n\rangle$. The eigenvectors of the annihilation operator a are known as *coherent states*: $a|z\rangle = z|z\rangle$, where z is in general a complex number (a is not Hermitian, so z is not necessarily real). Take $|z\rangle$ to be normalized: $\langle z|z\rangle = 1$.

a) Find an expression for $|z\rangle$ as a linear combination of the energy eigenstates $|n\rangle$. Make sure it is normalized. Calculate $\langle z_1|z_2\rangle$.

b) If the oscillator is in the state $|z\rangle$ at the instant that the oscillator energy is measured, what is the probability of obtaining the result E_n? What is the expectation value for the measured energy, $\langle z|H|z\rangle$?

c) Show that for this state, $\Delta x \Delta p = \hbar/2$, so that the state is a minimum uncertainty wave packet.