Consider 1D harmonic oscillator and use variational method to calculate the energy of the ground state. As we derived in class, with the trial function \( \psi_a(x) = \frac{1}{x^2 + a} \), the mean value of the Hamiltonian as a function of Ritz parameter \( a \) is:

\[
\langle H \rangle(a) = \frac{\hbar^2}{4m} \frac{1}{a} + \frac{maa}{2}
\]

Find the approximate value of the ground state energy and compare it with the exact value. What is the error (calculated as the approximate value minus the exact value divided by the exact value)?