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1. For a harmonic oscillator with Hamiltonian being

$$\hat{H} = \frac{\hat{p}^2}{2m} + \frac{m\omega^2\hat{x}^2}{2}, \tag{1}$$

calculate $\langle m|\hat{x}|n\rangle$, $\langle m|\hat{p}|n\rangle$, $\langle m|\hat{x}^2|n\rangle$, and $\langle m|\hat{p}^2|n\rangle$, where $|n\rangle$ is the nth eigen-vector of $\hat{H}$. Based on your result, check the uncertainty relation.