classmate

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$$\psi(x) = C_0 \, e^{-\frac{m\omega x^2}{2\hbar}}$$

$$\int_{-\infty}^{\infty} \psi^*(x)\psi(x)\,dx = 1$$

$$\Rightarrow \quad C_0^2 \underbrace{\int_{-\infty}^{\infty} e^{-\frac{2m\omega}{2\hbar}x^2}\,dx}_{\text{gaussian integral.}} = 1$$

$$\Rightarrow \quad C_0^2 \cdot \sqrt{\frac{\pi\hbar}{m\omega}} = 1$$

$$C_0 = \left(\frac{m\omega}{\pi\hbar}\right)^{1/4}$$

$$\Delta x = \sqrt{\langle x^2 \rangle - \langle x \rangle^2}$$

$$\boxed{\omega^2 m = k}$$

$$\psi(x) = \left(\frac{2\alpha}{\pi}\right)^{1/4} e^{-\alpha x^2}$$

$$\langle \psi^* | x^2 | \psi \rangle$$

$$= \left(\frac{2\alpha}{\pi}\right)^{1/2} \cdot \int_{-\infty}^{\infty} x^2 e^{-2\alpha x^2} \, dx$$

$$\cancel{\int x^2 \cdot \sqrt{\frac{\pi}{2\alpha}} - \int 2x}$$

→ using gamma function,

$$\Delta x = \sqrt{\frac{\hbar}{2m\omega} - 0^2}$$

$$= \sqrt{\frac{\hbar}{2m\omega}}$$

$$\Delta p = \sqrt{\frac{m\hbar\omega}{2}}$$

$$\therefore \Delta x \cdot \Delta p = \frac{1}{2}$$