1. Given that \( g(k) = \frac{N}{k^2 + \alpha^2} \), calculate the form of \( f(x) \) which is the Fourier transform of \( g \).
   Again, plot the two functions and show that \( \Delta k \Delta x > 1 \), independent of the choice of \( \alpha \).

2. Nuclei, typically of size \( 10^{-12} \) cm, frequently emit electrons, with energies of \( 1 \sim 10 \) MeV.
   Use the uncertainty principle \( \Delta x \cdot \Delta p \geq \frac{h}{2} \) to show that electrons of energy 1 MeV could not be contained in the nucleus before the decay.

3. In the last class, I have shown how to find a 2x2 matrix (operator) \( X \) if we know \( \langle \alpha | X | \alpha \rangle \)
   and \( \langle \alpha | X | \alpha \rangle \) for all \( |\alpha\rangle \). Please do the similar thing for a 3x3 matrix (operator) \( Y \).