TASK: Implement the *lens* function which should create and return a phasor field with the quadratic phase of a thin lens. It may be assumed the provided coordinates are zero-centered. Note that taking the focal length to be positive or negative immediately provides a defocusing or focusing lens.

$exp(\frac{\pi i r^2}{\lambda f}) = exp(\frac{\pi i [x^2 + y^2]}{\lambda f})$

QUESTION: Propose a lens phasor if there is some manufacturing error in the lens thickness in addition to the correct lens geometry, quantified by the spatially varying error $\epsilon(x, y)$.

TASK: Use your implemented lens function to focus a Gaussian beam of SIZE, with 64x64 samples, to L = 0.1m, with lenses of focal lengths 5mm, 2.5cm, and 12.5cm, calculating the single Fourier transform Fresnel propagation. Plot the intensity profile.

QUESTION: Does the Fresnel approximation fail? For what focal length does your simulation fail to predict the Gaussian beam propagating with Gaussian intensity? Lack of a Gaussian profile for the Gaussian beam (even after a lens) in the Fresnel region indicates that the simulation has clearly failed.

TASK: Plot the 2d transverse phase of the lens phasors used in the above task.

QUESTION: Explain what indicates serious aliasing (high frequency details being incorrectly represented as a lower frequency signal by sampling) in these phase plots.

TASK: Tophat beam, propagate the approximately square shaped beam to 0.1m, after a focusing lens of focal length 0.1m. Plot the 2d intensity profile.

QUESTION: Given that the Fourier transform of a tophat function is a *sinc* function, explain the intensity pattern of the focused tophat beam.