- Task: Convolve using **np.convolve** or **MATLAB conv**, mode/shape = 'same', the following signal with the three Gaussian width parameters provided. The initial condition is not strictly real. Which Gaussian is sufficently small to maintain the initial condition's form after the convolution is applieed(just eyeball it from the graphs produced)? Do not worry about constant proportionalities.
- Question: For the Gaussian you chose, at what spatial frequency does its frequency spectrum fall to 5% of its maximum? Note the following useful Fourier transform pair for a Gaussian provided.

  A Gaussian function *f*, and its Fourier transform *F*:

  $$f(y) = e^{-\alpha y^2}$$

  $$F(f_{spatial}) \propto e^{-\frac{(\pi f_{spatial})^2}{\alpha}}$$

  The factor of $\boldsymbol{\pi}$ is present as this formulation of the Fourier transform is in spatial frequency rather than spatial angular velocity. A proportionality is all that is needed, since the question asks for a 5% fall off of relative to the maximum.

- Task: First: the following Fraunhofer propagation is deemed to have insufficent sample density at the far field. Modify the number of samples taken and the initial sample region size to double the final sampling density. Second: normalize the intensity of the resulting propagation so that the power is the same as that of the boundary condition.
  Hint: To normalize the intensity, calculate a value proportional to the power by taking the amplitude squared, and multiplying by the propagated y-domain width. This will give units of power, since a 1d intensity multiplied with a length yields a power.