For these questions, use the simulation "The Heisenberg Uncertainty Principle" and work through the simulation, including the step-by-step exploration.

a) Explain what is shown in the simulation plots.

b) For the 1D wave packet, investigate the effect of moving the position uncertainty slider on the two plots shown in the simulation. Describe your observations. Explain the change in amplitude seen in the plots.

c) Consider the 2D wave packet:
   i) Investigate the effect of moving the position uncertainty sliders on the two plots shown in the simulation. Describe your observations.
   ii) What is the effect of measuring very precisely the position of a particle along the *x*-axis on its momentum uncertainty along *y*?

d) What is the minimum value for the product of position and momentum uncertainties along the same axis? What is the minimum value for the product of position and momentum uncertainties along different axes, such as $\Delta x\ \Delta p_y$ or $\Delta y\ \Delta p_x$?

e) Calculate the minimum uncertainty allowed by the uncertainty principle on the *x*-position of a conduction electron in a copper wire whose velocity along *x* has been measured with an uncertainty $\Delta v_x = 1.0\ mm/s$. Use $m_e = 9.1 \times 10^{-31}$ kg for the electron's mass, and $h = 6.63 \times 10^{-34}$ Js for Planck's constant.