For these questions, use the simulation “Wavefunction and energy levels of a particle in a one-dimensional box” and work through the simulation, including the step-by-step exploration.

a) Explain what is shown in the simulation graphs.

b) Investigate how the graphs shown in the simulation change as you choose different energy levels. Describe your observations.

c) What are the most likely positions to find the quantum particle for i) $n = 3$ and for ii) $n = 6$? How does the number of most likely positions change as the quantum number gets larger and larger? Reconcile your answer with the classical limit for the same system.

d) What is the energy of the ground state? Why is it not zero?

e) How does the spacing between adjacent energy levels change as you increase the quantum number n? Calculate $E_{n+1} - E_n$ explicitly and interpret your result.

f) Consider a particle in the ground state. Find a region of the well $[x_1, x_2]$ (smaller than the total well width) for which the quantum probability of finding the particle in this region is identical to the classical probability of finding the particle in this region.

g) For $n = 5$, what is the probability of finding the quantum particle in the region between $x = 0$ and $x = L/5$? You should not need to do any calculation to give your answer. Compare with the classical probability of finding the particle in this region.

h) Whithout the need for any calculation, state if the probability of finding the quantum particle in the interval $[0, L/4]$ for $n = 5$ is greater or smaller than the classical probability. Justify your answer.

i) By examining the plots of $\psi(x)$ as you increase the quantum number n, determine the wavenumber k as a function of n.