For these questions, use the simulation "The one-dimensional particle in a box" in the QuVis HTML5 collection.
www.st-andrews.ac.uk/physics/quvis/simulations_html5/sims/infwell1d/infwell1d.html

1) Have a play with the simulation for a few minutes, getting to understand the controls and displays. Note down three things about the displayed quantities that you have found out.

2) What is shown in the left-hand simulation graphs? Investigate how the graphs change as you choose different energy levels. Describe your observations.

3) a) Investigate how the graphs of the wavefunction and the probability density shown in the simulation change as you make the well wider. Describe your observations.

b) Explain the change in amplitude of the wave function by considering the normalization condition on the probability density.

4) a) What is/are the most likely positions to find the quantum particle for i) $n = 3$ and for ii) $n = 6$?

b) 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.

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

6) 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.

7) 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.

8) a) 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.

b) Without 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.

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

10) Which of the Challenges did you find most difficult and why? Explain how you solved the challenge. If none of the Challenges were difficult, choose the one you found most interesting and explain how you solved it.