For these questions, use the simulation "The expanding infinite square well" and work through the simulation, including the step-by-step exploration.

1) For a symmetric infinite square well with impenetrable walls at $+a$ and $-a$, the spatial part of the ground state energy eigenfunction inside the well is $u_1(x) = \frac{1}{\sqrt{a}} \cos\left(\frac{\pi}{2a} x\right)$.

a) Write down an expression for the spatial part of the wave function shown in the simulation before the well is expanded. Is this an energy eigenfunction of the initial square well?

b) Assume the well is suddenly expanded to a total width of $2L$ at time $t = 0$. What is the wavefunction directly after this expansion? Is this an energy eigenfunction of the expanded well? Explain why the wavefunction changes its shape with time after the well is expanded.

c) Using the expansion theorem, write down a general expression for the wave function $\psi(x, t)$ after the well is expanded. You do not need to calculate the expansion coefficients.

2) a) Calculate the expansion coefficient c_1 for the cases that
i) the well is expanded to a total width of $2L$,
ii) the well is expanded to a total width of $4L$.
You may use $2\cos(x)\cos(y) = \cos(x - y) + \cos(x + y)$.

Compare your results with those shown in the simulation. Explain how you are carrying out this comparison.

b) Explain qualitatively the difference in magnitude of your two expansion coefficients calculated in part a). Which one is larger and why?

c) Which expansion coefficients are zero? Explain why this is.