For these questions, use the simulation "Energy corrections in a perturbed infinite well" in the QuVis HTML5 collection.
www.st-andrews.ac.uk/physics/quvis/simulations_html5/sims/perturbationGame/perturbationGame.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 energy corrections that you have found out.

2) Explain what is meant by a perturbed infinite well.

3) Consider the **ground state** of the infinite well.

a) In the simulation, how can you see the **energy correction** of the ground state for a given perturbation

i) in the left-hand energy level diagram and

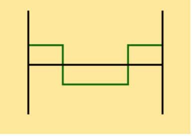
ii) in the bottom-right graph? Explain using sketches.

b) Explain using the left-hand energy level diagram the difference between $E_1^{(0)}, E_1^{(1)}$ and $E_1^{(0)} + E_1^{(1)}$.

c) Write down a formula for the energy correction of the ground state for a given perturbation.

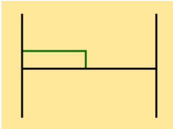
4) a) Are there perturbations in the simulation for which the **energy correction is always zero**, not only for the ground state but for all states? If so, explain how this comes about i) graphically and ii) with the help of the formula for the energy correction (consider symmetry!).

b) Sketch a perturbation different to the one shown in the simulation for which the energy correction for all states will be zero.

5) Consider the perturbation  with a positive slider value.

a) For the ground state, will the energy correction be positive, negative or zero? Explain your answer with the help of sketches.

b) For the first excited state, will the energy correction be positive, negative or zero? Explain your answer with the help of sketches.

6) Consider the perturbation  .

a) Calculate the energy correction with respect to the ground state (use the fact that the probability density is normalized over the *entire* well). Will your result change for a different state, e.g. one of the excited states?

b) Sketch a perturbation different to the one shown in the simulation for which the energy correction will be non-zero and the same for all states.

7) a) Sketch perturbations different to the ones shown in the simulation for which the energy correction of the ground state will be i) positive, ii) negative, iii) zero. No calculation is needed.

b) Sketch a perturbation different to the ones shown in the simulation for which the energy correction of the ground state is greater than the energy correction of the first excited state.