I.   THERE'S NO HOMEWORK WITHOUT AN ANHARMONIC OSCILLATOR

Consider an anharmonic oscillator in which the anharmonic part $\lambda \hat{x}^4$ is turned on at time $t = 0$ and turned of at time t'. The hamiltonian for the system is

$$\hat{H} = \frac{\hat{p}^2}{2m} + \frac{m\omega^2}{2}\hat{x}^2 + \theta(t)\theta(t' - t)\lambda\hat{x}^4. \tag{1}$$

Initially, the system is in the ground state. At $t > t'$ the energy of the system is measured. What are the possible outcomes of such a measurement and are their probabilities in the leading order in a λ expansion? If the system can from the ground state to an excited state, what happens to the conservation of energy?

II.   TWO BOSONS IN A BOX

Two identical, non-interacting spin-0 particles are in the ground state of a three-dimensional box of sides L. At time $t = 0$ a $\delta(x_1 - x_2)$ potential between them is turned on. What is the probability, in leading order of perturbation theory, for the particles to go tone of the first excited states (the 1st excited state of the unperturbed hamiltonian is degenerate so you have to sum over all of them)?