# Week Thirteen PHY-480

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November 2025

## 1 Pre Quiz Questions

**Q24.1**
Quantum annealing solves optimization problems by starting in the ground state of a transverse field Hamiltonian and slowly turning on the problem Hamiltonian. If this is done slowly enough, the system stays in the ground state and ends in the solution. Simulated annealing instead uses temperature where it starts hot and cools down, escaping minima by thermal hopping rather than quantum tunneling.

**Q24.2**
The adiabatic theorem says that if a Hamiltonian changes slowly enough and the energy gap does not close, a system remains in its ground state. For quantum annealing this means the annealing must be slow compared to the minimum gap, otherwise the system may leave the ground state.

**Q24.3**
If you were writing some python code on this, define Pauli matrices, build operators for $X_i$ and $Z_iZ_j$, construct the SK Hamiltonian and the transverse field Hamiltonian, set a time grid, form $H(t) = at\,H_{\mathrm{NPC}} + (1-at)H_1$, evolve the wavefunction forward in time, and compare the final annealed state to the exact ground state.