1) BD 13.1
2) BD 13.2
3) BD 13.3
4) BD 13.4
5) A certain atom has three energy levels \(a, b, c\), with energies \(0 < E_b < E_c\). The energy levels are coupled with a light wave of frequency \(\omega\), giving an interaction 
\[
V = \frac{\epsilon}{2} e^{-i\omega t} |a\rangle\langle b| + \frac{\epsilon}{2} e^{-i\omega t} |c\rangle\langle b| + h.c.
\]
Find a unitary transformation that makes the Hamiltonian time-independent and find the new effective Hamiltonian.

6) Suppose \(E_c = 2\omega\), and let \(\Delta = \omega - \frac{E_b}{\hbar} = 20\epsilon\). Assuming the atom starts in state \(a\), plot the probability of finding the atom in states \(b\) and \(c\) as a function of time. Comment on any similarities to the Rabi flopping problem; in particular find the effective Rabi frequency for the oscillations. How is it that the atom can go from state \(a\) to state \(c\) without being in state \(b\)?