PHYS 452: Quantum Mechanics II,   Quiz #5

Instruction: use additional sheets if you find it necessary

Consider a two-state system whose Hamiltonian in some basis $|1\rangle$ and $|2\rangle$ is given by

$$H = A\sigma_x + B\sigma_z$$

1. Suppose A is a constant and $B(t)$ is a slowly varying function of time. The system is in state $|1\rangle$ at $t = -\infty$. Explain how would you choose function $B(t)$ so that at $t = +\infty$ the system is taken to state $|2\rangle$. Give an example of such function.

2. Give a condition on the parameters in your definition of $B(t)$ such that your transformation works (e.g. the adiabatic approximation remains applicable).

Appendix: Pauli matrices

$$\sigma_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \qquad \sigma_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix} \qquad \sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$$