An important quantum mechanical problem is a 2 state problem with the Hamiltonian matrix given by

$$\begin{pmatrix} 0 & U^* \\ U & 0 \end{pmatrix}$$

where U is some matrix element coupling the two basis states $|1>$ and $|2>$. (a) What are the eigenvalues? (b) What are the eigenvectors (in terms of $|1>$ and $|2>$)? (c) Of the two vertical lines shown below (A and B), which one corresponds to this problem, if any?