1 Frequency

Consider a two-state quantum system (i.e., a system with a two-dimensional Hilbert space) with a Hamiltonian

$$\hat{H} \doteq \begin{pmatrix} E_1 & 0 \\ 0 & E_2 \end{pmatrix} \tag{1}$$

Another physical observable M is represented by the operator

$$\hat{M} \doteq \begin{pmatrix} 0 & c \\ c & 0 \end{pmatrix} \tag{2}$$

where c is real and positive. Note: Both matrices are written in the same basis.
The initial state of the system is $|\psi(t=0)\rangle = |m_1\rangle$, where $|m_1\rangle$ is the eigenstate of $\hat{M}$ corresponding to the larger of the two eigenvalues of $\hat{M}$.

(a) What is the expectation value of M as a function of time?

(b) What is the frequency of oscillation of the expectation value of M?