Name

5.73

Quiz 24

November 1, 2002

Pauli Matrices: $\mathbf{I} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \boldsymbol{\sigma}_x = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

$\boldsymbol{\sigma}_y = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}, \boldsymbol{\sigma}_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

A. What are the eigenvalues of $\boldsymbol{\sigma}_x$, $\boldsymbol{\sigma}_y$, and $\boldsymbol{\sigma}_z$?.

B. Let $M = \begin{pmatrix} 1 & 3\cos\omega t \\ 3\cos\omega t & 4 \end{pmatrix}$. Find the trace of

(i) $\mathbf{MI}$

(ii) $\mathbf{M}\boldsymbol{\sigma}_x$

(iii) $\mathbf{M}\boldsymbol{\sigma}_y$

(iv) $\mathbf{M}\boldsymbol{\sigma}_z$

(over)

C. Let $\boldsymbol{\rho}(t) = \frac{1}{5}\mathbf{M}$. Consider the vector

$$a_x = \frac{1}{2}\mathrm{Tr}(\boldsymbol{\rho}\boldsymbol{\sigma}_x)$$
$$a_y = \frac{1}{2}\mathrm{Tr}(\boldsymbol{\rho}\boldsymbol{\sigma}_y)$$
$$a_z = \frac{1}{2}\mathrm{Tr}(\boldsymbol{\rho}\boldsymbol{\sigma}_z).$$

Where is the vector $\vec{a}$ pointing at $t = 0$ and at $t = \pi/2\omega$?