

PHY 341 HW Ch.4a

Do problem 4.1 plus the following.

q4.1

A certain operator in given 2D Hilbert basis takes on the form $\sigma = \begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$. (a) Show that σ is Hermitian (transpose + conjugate, aka adjoint). (b) Find the eigenstates of σ (eigenvalues and eigenvectors).

q4.2

The Hamiltonian in a 3D Hilbert space is given by

$$H = \begin{pmatrix} a & 0 & d \\ 0 & b & 0 \\ d & 0 & c \end{pmatrix}.$$

Find the eigenstates of H and show the eigenvectors are orthogonal to each other. Symbolic computation is recommended.

q4.3

Verify that Y_{10} and Y_{20} are orthogonal.

q4.4

The angular wave function of a particle is given by $Y_{11}(\theta, \varphi)$. Calculate the probability of finding the particle in the solid angle $0 \leq \theta \leq \pi/4$ and $0 \leq \varphi \leq \pi/2$.