SC1.310 Assignment 1

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Question 1.

Prove Reverse triangle inequality using Schwarz inequality.

Question 2.

Using Uncertainty principle, prove that electron cannot reside in nucleus.
Info: radius of nuclues $\approx 10^{-15}m$. Maximum energy of electron coming out of nucleus $\approx 4MeV$ $(1eV = 1.6 * 10^{-19}J$.

Question 3.

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a) The Hamiltonian(energy) operator for a two state system is given by

$$H = a(|1\rangle\langle 1| - |2\rangle\langle 2| + |1\rangle\langle 2| + |2\rangle\langle 1|)$$

Find the energy eigenvalues and the corresponding energy eigenkets.

b) Can the operator $A = |1\rangle\langle 2| - |2\rangle\langle 1|$ be the Hamiltonian?

c)Under what conditions, the following operator can be Hamiltonian?

$$B = a|1\rangle\langle 1| + b|2\rangle\langle 2| + c(|1\rangle\langle 2| - |2\rangle\langle 1|)$$

d) Find(under appropriate conditions) the energy eigenkets and eigenvalue of B.

Question 4.

A certain observable in quantum mechanics, has a matrix representation as

$$\frac{1}{\sqrt(2)}\begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix}$$

Find the normalised eigenvector and eigenvalues. Is there any degeneracy?

Question 5.

Two hermitian operators anti-commute *i.e* $\{A, B\} = AB + BA = 0$. Is it possible to have simultaneous eigenkets of A and B ? Explain your assertion.