Assignment 3

Byungjoon Min, Quantum Mechanics II
(due date: October 2, 2018)

1 Chuseok (Hangawi) [0 pt]

Have a happy Chuseok (Hangawi) with your family!

2 Neutrino Oscillations [40 pt]

2.1 Time evolution [20 pt]

Imagine a system in which there are just two linearly independent states:

$$|1\rangle = \begin{pmatrix} 1 \\ 0 \end{pmatrix}, \quad |2\rangle = \begin{pmatrix} 0 \\ 1 \end{pmatrix}.$$

The most general state is a normalized linear combination:

$$|S\rangle = a|1\rangle + b|2\rangle = \begin{pmatrix} a \\ b \end{pmatrix}, \tag{1}$$

with $|a|^2 + |b|^2 = 1$ for normalization. The Hamiltonian can be expressed as a (hermitian) matrix: suppose it has the specific form

$$H = \begin{pmatrix} h & g \\ g & h \end{pmatrix}, \tag{2}$$

where g and h are real constants. If the system starts out (at $t = 0$) in state $|1\rangle$, what is its state at time t? (Hint: see Example 3.8, Griffith)

2.2 Determinate State [10 pt]

If the system starts out (at $t = 0$) in state

$$\frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ 1 \end{pmatrix}, \tag{3}$$

what is its state at time t?

2.3 Diagonal Matrix [10 pt]

The Hamiltonian can be expressed as a (hermitian) matrix: suppose it has the specific form

$$H = \begin{pmatrix} g & 0 \\ 0 & h \end{pmatrix}, \tag{4}$$

where g and h are real constants. If the system starts out (at $t = 0$) in state $|1\rangle$, what is its state at time t?

3 Operator [20 pt]

Griffith Problem A. 28. (Hint: see the solution of Griffith that you have)