Physics 5645
Quantum Mechanics A
Problem Set I

Due: Thursday, Sep 5, 2019, DEADLINE EXTENDED TO **TUESDAY, SEP 10.**

1.1 Consider a spin-1/2 particle in a state described by the (unnormalized) ket

$$|\psi\rangle = |+\rangle + (3+i)|-\rangle.$$

(a) Normalize $|\psi\rangle$ and expand it in the $\{|+\rangle, |-\rangle\}$, $\{|+\rangle_x, |-\rangle_x\}$, and $\{|+\rangle_y, |-\rangle_y\}$ bases, (i.e., the S_z, S_x, and S_y bases).

(b) Determine the probabilities for the possible results of measuring S_z, S_x, or S_y for a particle in the state $|\psi\rangle$.

1.2 Given the following,

$$S_x|\pm\rangle_x = \pm\frac{\hbar}{2}|\pm\rangle_x, \qquad S_y|\pm\rangle_y = \pm\frac{\hbar}{2}|\pm\rangle_y, \qquad S_z|\pm\rangle = \pm\frac{\hbar}{2}|\pm\rangle,$$
$$|\pm\rangle_x = \pm\frac{1}{\sqrt{2}}|+\rangle + \frac{1}{\sqrt{2}}|-\rangle, \qquad |\pm\rangle_y = \frac{1}{\sqrt{2}}|+\rangle \pm i\frac{1}{\sqrt{2}}|-\rangle,$$

obtain the matrix representations of S_x, S_y, and S_z in the S_z basis.

1.3 Problem 1.8, Sakurai and Napolitano, Pg. 59.

1.4 Problem 1.9, Sakurai and Napolitano, Pg. 59.

1.5 Problem 1.13, Sakurai and Napolitano, Pg. 61.