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\}\}, \{\(|+_x\rangle, |-_x\rangle\}\}, and \{\(|+_y\rangle, |-_y\rangle\}\} 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,

\[ S_x|\pm\rangle_x = \pm \frac{\hbar}{2} |\pm\rangle_x, \quad S_y|\pm\rangle_y = \pm \frac{\hbar}{2} |\pm\rangle_y, \quad S_z|\pm\rangle = \pm \frac{\hbar}{2} |\pm\rangle, \]

\[ |\pm\rangle_x = \pm \frac{1}{\sqrt{2}} |+\rangle + \frac{1}{\sqrt{2}} |-\rangle, \quad |\pm\rangle_y = \frac{1}{\sqrt{2}} |+\rangle \pm i \frac{1}{\sqrt{2}} |-\rangle, \]

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.