

Physics 217
Problem Set 12
Due: Friday, Dec 7th, 2018

1. (10 points) Problem 28 from Chapter 8 of the Harris book.
2. (10 points) Using the completeness relation

$$1 = \sum_i |a_i\rangle \langle a_i| \quad (1)$$

demonstrate the operator identity for the operators A and B

$$(AB)^\dagger = B^\dagger A^\dagger. \quad (2)$$

3. (20 points) Use the expressions for the $|S_x; +\rangle$ and $|S_x; -\rangle$ as well as the $|S_y; +\rangle$ and $|S_y; -\rangle$ in terms of the spin states $|S_z; +\rangle$ and $|S_z; -\rangle$ to demonstrate that Eq. (1) is also fulfilled for the spin- x and spin- y states. Use these same expression to show that

- $S_x = \frac{\hbar}{2} (|+\rangle \langle -| + |-\rangle \langle +|)$
- $S_y = \frac{i\hbar}{2} (-|+\rangle \langle -| + |-\rangle \langle +|)$.

Note that we used the notation $|S_z; +\rangle = |+\rangle$ and $|S_z; -\rangle = |-\rangle$ here and also below.

4. (10 points) Using the orthonormality of $|+\rangle$ and $|-\rangle$ and the expression in the previous problem to prove

$$[S_x, S_y] = i\hbar S_z. \quad (3)$$