Homework 3

Quantum Mechanics

February 7, 2023   C SEITZ

Problem 1. *Problem 2.48*

Solution.   ■

Problem 2. *Problem 2.49*

Solution.   ■

Problem 3. *Problem 2.50*

Solution.   ■

Problem 4. *Problem 2.51*

Solution.   The Hadamard gate H is unitary if $H^\dagger = H^{-1}$. It is easy to see that

$$H^\dagger = H = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$$

It's inverse is

$$H^{-1} = -\frac{1}{\sqrt{2}} \begin{pmatrix} -1 & -1 \\ -1 & 1 \end{pmatrix} = H$$

■

Problem 5. *Problem 2.52*

Solution.
$$H^2 = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} \frac{1}{\sqrt{2}} \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

■

Problem 6. *Problem 2.53*

Solution.   Writing out the characteristic equation gives that the eigenvalues are $\lambda = \pm\sqrt{2}$. ■

Problem 7. *Problem 2.54*

Solution. ■

Problem 8. *Problem 2.55*

Solution. ■

Problem 9. *Problem 2.56*

Solution. ■

Problem 10. *Problem 2.57*

Solution. ■

Problem 11. *Problem 2.58*

Solution. ■

Problem 12. *Problem 2.59*

Solution. ■

Problem 13. *Problem 2.60*

Solution. ■

Problem 14. *Problem 2.61*

Solution. ■