Weekly Problem Set #5 – Week 5

PLEASE SHOW ALL YOUR WORK FOR FULL CREDIT. Showing your work includes writing out intermediate steps in ways that others can understand or writing sentences that help to communicate your assumptions and logic. If you utilize any software tools or apps (e.g. Mathematica, Desmos, ChatGTP, etc.), you must transparently acknowledge your use of them in your HW submission. A subset of these problems will be graded for correctness. The rest of the problems will be graded for effort.

Part 0: Tensor Products & Measurement of Multiple qubit systems

Question 1 (4 pts). (Wong E4.5, on 2-qubit states in matrices). Show your work.

Question 2 (4 pts). (Wong E4.6, on Completeness 2-qubit basis). Show your work.

Question 3 (4 pts). (Wong E4.7, on Measurement of multiple qubits). Show your work.

Question 4 (4 pts). (Wong E4.8, on State normalization). Show your work.

Question 5 (6 pts). (Wong E4.10, on measurement of 3-qubit system). Show your work.

Part 1: Recognizing Product States vs. Entangled States

Question 6 (6 pts). (Wong E4.11, on Product state vs. Entangled State). Show your work.

Question 7 (6 pts). (Wong E4.12, on Product state vs. Entangled State). Show your work.

Part 2: Quantum Gates for Multiple Qubit Systems

Question 8 (6 pts). (Wong E4.14, on Single Qubit Gates acting on a 2-qubit system). Show your work. If you use computer software for part (b), tell us what software you used and turn in you code (as Wong does on pages 151-152).

Question 9 (6 pts). (Wong E4.16, on 2 CNOT gates). Show your work.

Question 10 (9 pts). (Wong E4.18, on CNOT gate on 2-qubit system). Show your work.

Question 11 (6 pts). (Wong E4.22, on Mølmer-Sørensen (MS) gate). Show your work. Show your work. If you use computer software for part (b), tell us what software you used and turn in you code (as Wong does on pages 151-152).