

2007 Paper 12 Question 9

Quantum Computing

- (a) Give a schematic circuit diagram for Grover's algorithm. [4 marks]
- (b) Suppose we apply Grover's algorithm to a four-qubit register in which exactly one of the states is marked.
- (i) Writing O for the oracle matrix, write out the Grover iterate in matrix form. [4 marks]
- (ii) What are the probabilities of measuring the marked state after applying the Grover iterate *once*, *twice* and *three* times? [3 marks each]
- (iii) If you continue to increase the number of times the Grover iterate is applied, will the probability continue to increase? Justify your answer. [3 marks]