Test ID: TESTID Name: _____

MAT 399 Quiz 5 Fall 2026

1. Let $f : \{0,1\}^2 \longrightarrow \{0,1\}^2$, with $f(00) = 01$, $f(01) = 10$, $f(10) = 10$ and $f(11) = 01$. For f to satisfy the requirement of Simon's algorithm, what is the secret string $s \in \{0,1\}^2$? (If none of these work, then f does not satisfy the requirement.)

   a) 00 b) 01 c) 10 d) 11 e) none of these

   Correct Answer: 11

2. Let f be the same function as in the previous problem, and let U_f be the oracle for Simon's circuit. What is $U_f \left|00\right\rangle \left|11\right\rangle$?

   a) $\left|01\right\rangle \left|00\right\rangle$ b) $\left|10\right\rangle \left|11\right\rangle$ c) $\left|00\right\rangle \left|11\right\rangle$ d) $\left|11\right\rangle \left|00\right\rangle$ e) $\left|00\right\rangle \left|10\right\rangle$

   Correct Answer: $\left|00\right\rangle \left|10\right\rangle$

3. Same f and U_f as in the previous problems. In Simon's circuit, U_f is preceeded by Hadamard gates on each of the first two wires. If we use input to Simon's circuit $\left|0\right\rangle$ on each of the four wires, and we measure the state of the four wires after the U_f gate, what is the probability that we get 1 (the eigenvalue associated with the bit string 0001)?

   a) $\frac{1}{2}$ b) $\frac{1}{\sqrt{2}}$ c) $\frac{1}{4}$ d) 0 e) 1

   Correct Answer: $\frac{1}{4}$

4. Same f and circuit and input and measurement as in the previous problem. What is the probability that we get 2 (the eigenvalue associated with the bit string 0010)?

   a) $\frac{1}{2}$ b) $\frac{1}{\sqrt{2}}$ c) $\frac{1}{4}$ d) 0 e) 1

   Correct Answer: 0

5. Same f and U_f and inputs to Simon's circuit as in the previous problem. If we run the full Simon's circuit 3 times and measure the first two wires only (as in Simon's algorithm) with output strings $\mathbf{w} \in \{0,1\}^2$, and we form a 2×3 matrix of columns W, then what is the probability that this matrix has rank 1?

   a) $\frac{2}{3}$ b) $\frac{1}{2}$ c) $\frac{5}{8}$ d) $\frac{3}{4}$ e) $\frac{7}{8}$

   Correct Answer: $\frac{7}{8}$