Homework 3

Due Nov 11 at 3:59am **Points** 100 **Questions** 10
Available until Nov 11 at 3:59am **Time Limit** 60 Minutes
Allowed Attempts 3

Instructions

We use the **conventions in the QBook101**.

The default programming language for coding is Python. You may write pieces of code during this exercise.

Take the Quiz Again

Attempt History

	Attempt	Time	Score
KEPT	Attempt 2	3 minutes	80 out of 100
LATEST	Attempt 2	3 minutes	80 out of 100
	Attempt 1	60 minutes	0 out of 100

Last Attempt Details:

Time:	3 minutes
Current Score:	80 out of 100
Kept Score:	80 out of 100

2 Attempts so far
View Previous Attempts
1 More Attempt available

Take the Quiz Again

(Will keep the highest of all your scores)

Correct answers are hidden.

Score for this attempt: **80** out of 100
Submitted Oct 9 at 12:41am
This attempt took 3 minutes.

Question 1 — 10 / 10 pts

We have a three state quantum system. If the system is in the quantum state

$$|u\rangle = \begin{pmatrix} x \\ \frac{1}{\sqrt{7}} \\ \frac{2}{\sqrt{7}} \end{pmatrix} \in \mathbb{R}^3 \quad ,$$

what is the probability of being in the first state?

- $\frac{1}{7}$
- $\frac{2}{\sqrt{7}}$
- $\sqrt{\frac{2}{7}}$
- $\frac{2}{7}$

Question 2

10 / 10 pts

If $|u\rangle \in \mathbb{R}^2$ is a quantum state on the unit circle with angle $\frac{5\pi}{6}$, what is $|u\rangle$?

- $\begin{pmatrix} \frac{1}{2} \\ \frac{\sqrt{3}}{2} \end{pmatrix}$
- $\begin{pmatrix} -\frac{\sqrt{3}}{2} \\ -\frac{1}{2} \end{pmatrix}$
- $\begin{pmatrix} \frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{pmatrix}$
- $\begin{pmatrix} -\frac{\sqrt{3}}{2} \\ \frac{1}{2} \end{pmatrix}$

Question 3

10 / 10 pts

We have a qubit in state $|1\rangle$, We apply the operators $X, H, X, H,$ in order,

where H and X are the Hadamard and NOT operators, respectively.

What is the final state?

- $-|1\rangle$
- $|1\rangle$
- $|0\rangle$
- $|-\rangle$

Question 4

10 / 10 pts

When a qubit is in the quantum state $|u\rangle = \begin{pmatrix} \frac{1}{\sqrt{3}} \\ -\sqrt{\frac{2}{3}} \end{pmatrix}$,

the Hadamard operator is applied: $|u'\rangle = H|u\rangle$

What is the probability of being in state $|0\rangle$ in the new quantum state $|u'\rangle$?

- 0.0286

0.9714

0.5

1

Incorrect

Question 5

0 / 10 pts

We apply a series of quantum operators to a single qubit that is in state $|1\rangle$ at the beginning.

If we observe the state 0 at the end with probability 1, then which one of the following combinations is possible,

where M stands for a measurement, and we apply the operators from the left to the right?

- H, X, H, M
- H, H, M
- M, X, M, X, M
- X, H, X, H, M
- X, H, X, M

Question 6

10 / 10 pts

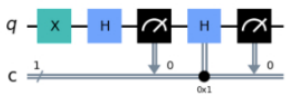
$XHHHHXXXHHHHHX|+\rangle$

- $|+\rangle$
- $|1\rangle$
- $|-\rangle$
- $|0\rangle$

Incorrect

Question 7

0 / 10 pts



If we execute the above program 500 times, what is the most likely count of observing '0'?

125

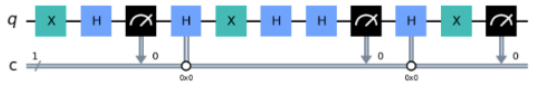
375

250

400

Question 8

10 / 10 pts



If we execute the above program 1000 times, what is the most likely count of observing '0'?

625

125

250

375

Question 9

10 / 10 pts

If we execute the following quantum program with a single qubit and a single classical bit 1000 times,

which one of the following outcomes is more likely?

Hint: *You could write a code in python* similar to the tasks in the notebooks.

```
start in |1>
apply the Hadamard operator
make a measurement
for i in range(9)
    x  = i mod 3
    if the classical bit is x:
        apply a Hadamard operator
    make a measurement
```

{'0': 511, '1': 489}

{'0': 392, '1': 608}

{'0': 367, '1': 633}

{'0': 442, '1': 558}

{'0': 274, '1': 726}

Question 10

10 / 10 pts

We have four qubits, say $q_0, \ldots, q_3$ initially in zero states.

We apply the X operators to both qubits q_0 and q_2.

For the rest of qubits, we apply either identity operator or X operator.

After making a measurement, we read the values from the qubits $q_0, \ldots, q_3$ as $b_0, \ldots, b_3$ respectively.

If $b = b_3 \cdots b_0$ a binary number, which one of the following decimal numbers is not possible for the value of b?

- 15
- 7
- 13
- 5
- 11

Quiz Score: **80** out of 100

◂ Previous