Exercise 2B

Due No due date **Points** 100 **Questions** 10 **Time Limit** 75 Minutes
Allowed Attempts 3

Instructions

We use the conventions in Bronze-Qiskit.

The default programming language for coding is python.

You may write pieces of code during the exam.

Take the Quiz Again

Attempt History

	Attempt	Time	Score
KEPT	Attempt 2	4 minutes	100 out of 100
LATEST	Attempt 2	4 minutes	100 out of 100
	Attempt 1	21 minutes	80 out of 100

ⓘ Correct answers are hidden.

Score for this attempt: **100** out of 100
Submitted Sep 19 at 12:12pm
This attempt took 4 minutes.

Question 1 — 10 / 10 pts

If $|u\rangle = \begin{pmatrix} \frac{1}{2} \\ x \\ y \end{pmatrix} \in \mathbb{R}^3$ is a quantum state, which one of the following equations is definitely wrong.

- [x] $x^2 + y^2 = \frac{1}{2}$
- [ ] $x + y = \frac{1}{2}$
- [ ] $x + y = \frac{3}{4}$
- [ ] $x^2 + y^2 = \frac{3}{4}$
- [ ] $x - y = 0$

Question 2

5 / 5 pts

What is H^7 , where H is the Hadamard operator?

- [ ] $\begin{pmatrix} \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & -\frac{1}{2} \end{pmatrix}$
- [ ] $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$
- [ ] $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$
- [x] $\begin{pmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \end{pmatrix}$
- [ ] $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

Question 3

10 / 10 pts

We have a qubit in state $|0\rangle$. We apply the operators X, H, X, H, X in order,

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

What is the final state?

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

Question 4

10 / 10 pts

When a qubit is in the quantum state $|u\rangle = \begin{pmatrix} \frac{3}{5} \\ \\ -\frac{4}{5} \end{pmatrix}$,

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

What is the probability of being in state $|1\rangle$ in the new quantum state $|u'\rangle$?

- 0.36
- 0.64
- 0.98
- 0.02
- 0.50

Question 5

5 / 5 pts

What is XH?

- (selected) $\begin{pmatrix} \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{pmatrix}$
- $\begin{pmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \end{pmatrix}$
- $\begin{pmatrix} -\frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{pmatrix}$
- $\begin{pmatrix} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{pmatrix}$
- $\begin{pmatrix} -\frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{pmatrix}$

Question 6

5 / 5 pts

If $|u\rangle = \begin{pmatrix} x \\ 3x \end{pmatrix} \in \mathbb{R}^2$ is the quantum state of a qubit,

what is the probability of being state $|0\rangle$?

- 0.90
- 0.50
- 0.75
- (selected) 0.10

0.25

Question 7

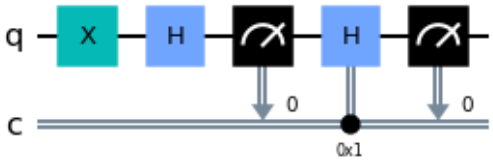
5 / 5 pts

$XHHHHXXXHHHHHX|0\rangle$ =?

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

Question 8

10 / 10 pts



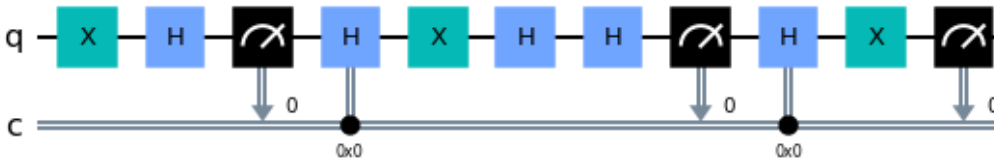
If we execute the above program 500 times, what is the expected value of observing '0'?

- 125
- 100
- 250

- 375
- 400

Question 9

20 / 20 pts



If we execute the above program 1000 times, what is the expected value of observing '1'?

- 0
- 125
- 250
- 375
- 500

Question 10

20 / 20 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?

```
start in |1>
apply the Hadamard operator
make a measurement
for i in range(4)
    x  = i mod 2
    if the classical bit is x:
        apply a Hadamard operator
    make a measurement
```

- {'0': 367, '1': 633}
- {'0': 768, '1': 232}
- {'0': 665, '1': 335}
- {'0': 511, '1': 489}
- {'0': 442, '1': 558}

Quiz Score: **100** out of 100