Quantum Systems - Exam

Numerical Input

1/1 point (graded)

Calculate the normalization factor to make the vector $\begin{bmatrix} 3 \\ 2 \end{bmatrix}$ a stochastic vector.

This is the value you have to divide the vector by to normalize it.

5 ✔

5

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)

You are given a linear combination $a \begin{bmatrix} 1 \\ 0 \end{bmatrix} + 0.3 \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. What choice of a would make this a stochastic vector?

0.7 ✔

0.7

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)

What's the entropy of the probability distribution described by the stochastic vector $\begin{bmatrix} 0.2 \\ 0.8 \end{bmatrix}$?

0.72 ✔

0.72

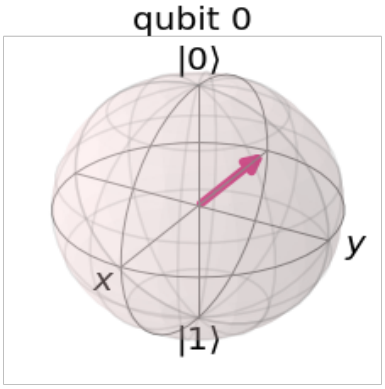
Enviar

✔ Correcto (1/1 punto)

Multiple Choice

1/1 point (graded)

Which state does the following point on the surface of the Bloch sphere correspond to?



- (selected) $(|0\rangle - |1\rangle)/\sqrt{2}$
- $|0\rangle$
- $|1\rangle$
- $(|0\rangle + |1\rangle)/\sqrt{2}$

✔

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)

Calculate the probability amplitude a in the superposition $a|0\rangle - i/2|1\rangle$.

sqrt(3/4) ✔

$\sqrt{\frac{3}{4}}$

Enviar

✔ Correcto (1/1 punto)

Multiple Choice

1/1 point (graded)

You are given a product state $0.5(|00\rangle + |01\rangle + |10\rangle + |11\rangle)$. What is a possible formulation for this tensor product?

- $0.5|0\rangle \otimes 0.5|1\rangle$
- $(1/\sqrt{2}(|0\rangle + |1\rangle)) \otimes (1/\sqrt{2}(|0\rangle + |1\rangle))$
- $0.5(|00\rangle + |01\rangle) \otimes 0.5(|10\rangle + |11\rangle)$

✔

Enviar

✔ Correcto (1/1 punto)

Checkboxes

1/1 point (graded)

An entangled state...

- [x] is not a product state.
- [ ] is a product state.
- [x] can show strong correlations.
- [ ] has maximum entropy.

Enviar

✔ Correcto (1/1 punto)

Checkboxes

1/1 point (graded)

The complex conjugate of the bra $\langle 0|$, that is, $\langle 0|^\dagger$, is

- [x] $|0\rangle$.
- [x] a column vector.
- [ ] a row vector
- [ ] a matrix.

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)

You are given a source of an unknown qubit state. You make measurements in the computational basis, that is, your measurement is $\{|0\rangle\langle 0|, |1\rangle\langle 1|\}$. You observe that you see the outcome zero 30 times and the outcome one 70 times out of a hundred measurements. What is your estimate of the absolute value of the probability amplitude of $|0\rangle$ in the superposition?

sqrt(0.3) ✔

$\sqrt{0.3}$

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)

What's the trace of a density matrix?

1 ✔

1

Enviar

✔ Correcto (1/1 punto)

Multiple Choice

1/1 point (graded)

You make a single-qubit measurement on the first qubit of the state $(|00\rangle - |11\rangle)/\sqrt{2}$. You get the output one. What's the state after the measurement?

- $|00\rangle$.
- ● $|11\rangle$. ✔
- $-|11\rangle$.
- $(|00\rangle - |11\rangle)/\sqrt{2}$.

Enviar

✔ Correcto (1/1 punto)

Text Input

1/1 point (graded)
Reverse this unitary circuit: XH

HX ✔

Enviar

✔ Correcto (1/1 punto)

Multiple Choice

1/1 point (graded)
Unitary operations also preserve the l_1-norm.

- ○ True.
- ● False. ✔

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)
A two-qubit pure state $(|00\rangle+|11\rangle)/\sqrt{2}$ is in an open system and we model

decoherence by mixing it with random noise $\mathbb{I}/4$ with a visibility parameter v. What's the top-right element of the density matrix at $v = 0.7$?

0.35 ✔

0.35

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)

A system is in equilibrium at zero temperature. What's the probability of observing the ground state energy?

1 ✔

1

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)

What's the energy of the spin system given by the Hamiltonian $H = -0.5\sigma_1\sigma_2 + \sigma_1 + \sigma_2$ with $\sigma_1 = 1$ and $\sigma_2 = -1$?

0.5 ✔

0.5

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)

What's the optimal value of this QUBO? $\min 5x_1x_2 + 6x_1 + 3x_2$

0 ✔

0

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)

A single-qubit system is described by a Hamiltonian $H = -\sigma^X$. What is the energy expectation value in the state $|0\rangle$?

0 ✔

0

Enviar

✔ Correcto (1/1 punto)

Numerical Input

1/1 point (graded)

Given the same Hamiltonian, what is the energy expectation value in the state $|0\rangle+|1\rangle)/\sqrt{2}$?

-1 ✔

-1

Enviar

✔ Correcto (1/1 punto)

Multiple Choice

1/1 point (graded)

Do the matrices $X = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ and $H = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$ commute?

- Yes.
- ✔ No.

Enviar

✔ Correcto (1/1 punto)