Koji od navedenih vektora nije normiran? // *Which of the following vectors is not normalized?*

Odaberite jedan odgovor:

- $\frac{2}{\sqrt{5}}\left(|0\rangle+\frac{1}{2}|1\rangle\right)$
- $\frac{\sqrt{3}}{2}\left(\mathrm{i}\,|0\rangle+\frac{1}{2}|1\rangle\right)$ ✔
- $\frac{3}{5}|0\rangle-\frac{4}{5}|1\rangle$
- $\frac{1}{3}|0\rangle+\frac{2\sqrt{2}}{3}|1\rangle$
- $\frac{1}{\sqrt{5}}(2\,|0\rangle+\mathrm{i}\,|1\rangle)$

Koja dva od navedenih stanja qubita čine ortonormiranu bazu u $\mathcal{H}^{(2)}$? / Which two of the following qubit states comprise a orthonormal basis in $\mathcal{H}^{(2)}$?

- $\frac{3}{5}|0\rangle+\frac{4\mathrm{i}}{5}|1\rangle$
- $\frac{4}{5}|0\rangle-\frac{3}{5}|1\rangle$ ✔
- $\frac{3}{5}|0\rangle+\frac{4}{5}|1\rangle$ ✔
- $-\frac{3}{5}|0\rangle-\frac{4\mathrm{i}}{5}|1\rangle$
- $\frac{3\mathrm{i}}{5}|0\rangle-\frac{4}{5}|1\rangle$

Koji od navedenih vektora predstavljaju isto stanje kvantnog bita? // *Which of the following kets represent the same qubit state?*

- $\frac{1}{\sqrt{5}}|0\rangle+\frac{2\mathrm{i}}{\sqrt{5}}|1\rangle$
- $-\frac{2}{\sqrt{5}}|0\rangle-\frac{1}{\sqrt{5}}|1\rangle$ ✔
- $\frac{2}{\sqrt{5}}|0\rangle-\frac{\mathrm{i}}{\sqrt{5}}|1\rangle$
- $\frac{2}{\sqrt{5}}|0\rangle+\frac{1}{\sqrt{5}}|1\rangle$ ✔
- $-\frac{2\mathrm{i}}{\sqrt{5}}|0\rangle-\frac{\mathrm{i}}{\sqrt{5}}|1\rangle$ ✔

Kvantni bit je pripremljen u stanju: // *Qubit is prepared in the state:*

$\frac{1}{\sqrt{2}}|0\rangle+\frac{1}{\sqrt{2}}|1\rangle$

Izračunaj vjerojatnost da taj kvantni bit bude izmjeren u stanju: // *Compute the probability that this qubit is measured in the state:*

$\frac{3}{5}|0\rangle+\frac{4}{5}|1\rangle$

Odaberite jedan odgovor:

- $\frac{7}{5\sqrt{2}}$
- $\frac{49}{50}$ ✔
- 0
- $\frac{1}{50}$
- 1

Operator // *Operator*

$\frac{1}{2}\left(|0\rangle\langle 0| - |0\rangle\langle 1| - |1\rangle\langle 0| + |1\rangle\langle 1|\right)$

je projektor na stanje: // *is a projector onto the state:*

Odaberite jedan odgovor:

- $|0\rangle$ ili $|1\rangle$
- $\frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$
- $\frac{1}{\sqrt{2}}|0\rangle + \frac{i}{\sqrt{2}}|1\rangle$
- $\frac{1}{\sqrt{2}}|0\rangle - \frac{1}{\sqrt{2}}|1\rangle$ ✔
- $\frac{1}{\sqrt{2}}|0\rangle - \frac{i}{\sqrt{2}}|1\rangle$

Izračunaj očekivanu vrijednost hermitskog operatora // *Compute the expectation value of the Hermitean operator*

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

u sustavu koji se nalazi u stanju // *in a system that is in the state*

$\frac{2}{\sqrt{13}}|0\rangle + \frac{3}{\sqrt{13}}|1\rangle$

Odaberite jedan odgovor:

- $\frac{5}{13}$
- $-\frac{3}{5}$
- $-\frac{5}{13}$ ✔
- 0
- $\frac{3}{5}$

Matrični prikaz // *Matrix representation*

$$\begin{pmatrix} \frac{1}{2} & -\frac{i}{2} \\ \frac{i}{2} & \frac{1}{2} \end{pmatrix}$$

odgovara operatoru // *corresponds to the operator*

Odaberite jedan odgovor:

- $\frac{1}{2}\left(|0\rangle\langle 0| + i|0\rangle\langle 1| - i|1\rangle\langle 0| + |1\rangle\langle 1|\right)$
- $\frac{1}{2}\left(|0\rangle\langle 0| + |0\rangle\langle 1| + |1\rangle\langle 0| + |1\rangle\langle 1|\right)$
- $\frac{1}{2}\left(|0\rangle\langle 0| + i|0\rangle\langle 1| + i|1\rangle\langle 0| + |1\rangle\langle 1|\right)$
- $\frac{1}{2}\left(|0\rangle\langle 0| - |0\rangle\langle 1| - |1\rangle\langle 0| + |1\rangle\langle 1|\right)$
- $\frac{1}{2}\left(|0\rangle\langle 0| - i|0\rangle\langle 1| + i|1\rangle\langle 0| + |1\rangle\langle 1|\right)$ ✔

Ako je energija kvantnog bita opisana hamiltonijanom // *If qubit energy is described by the Hamiltonian*

$H = \hbar\omega|0\rangle\langle 0|, \qquad \omega > 0,$

i ako je početno stanje kvantnog bita // *and if the initial state of the qubit is*

$\frac{1}{\sqrt{2}}|0\rangle + \frac{i}{\sqrt{2}}|1\rangle,$

nakon $\Delta t = \frac{\pi}{2\omega}$ sustav će biti u stanju // *after* $\Delta t = \frac{\pi}{2\omega}$ *the state of the qubit will be*

Odaberite jedan odgovor:

- $\frac{1}{\sqrt{2}}|0\rangle - \frac{i}{\sqrt{2}}|1\rangle$
- $\frac{1}{\sqrt{2}}|0\rangle - \frac{1}{\sqrt{2}}|1\rangle$ ✔
- $|1\rangle$
- $\frac{1}{\sqrt{2}}|0\rangle + \frac{i}{\sqrt{2}}|1\rangle$
- $|0\rangle$
- $\frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$

Alice i Bob uspostavljaju tajni enkripcijski ključ korištenjem protokola BB84. Alice odabire bazu $\otimes$ i odašilje foton u stanju 1. Kolika je vjerojatnost da Bob izmjeri vrijednost 0 ako on odabere bazu $\oplus$, a Eve prisluškuje komunikaciju?

Alice and Bob are establishing a secret encryption key using the BB84 protocol. Alice chooses base $\otimes$ and sends a foton in the state 1. What is the probability that Bob measures 0 if he chooses base $\oplus$, and if Eve is eavesdropping the communication?

Odaberite jedan odgovor:

- ○ $1/4$
- ○ $3/8$
- ◉ $1/2$ ✔
- ○ $5/8$
- ○ $3/4$

U kojima od navedenih stanja sustava dvaju kvantnih bitova su stanja samih bitova spregnuta? // In which of the following states of the 2-qubit system are the states of the individual qubits entangled?

- ☐ $\frac{1}{2}(|00\rangle - |01\rangle + |10\rangle - |11\rangle)$
- ☑ $\frac{1}{2}(|00\rangle - |01\rangle + |10\rangle + \mathrm{i}|11\rangle)$ ✔
- ☑ $\frac{1}{2}(|00\rangle + \mathrm{i}|01\rangle + \mathrm{i}|10\rangle - \mathrm{i}|11\rangle)$ ✔
- ☑ $\frac{1}{2}(|00\rangle + \mathrm{i}|01\rangle + \mathrm{i}|10\rangle - \mathrm{i}|11\rangle)$ ✔
- ☐ $\frac{1}{2}(|00\rangle - \mathrm{i}|01\rangle - \mathrm{i}|10\rangle - |11\rangle)$