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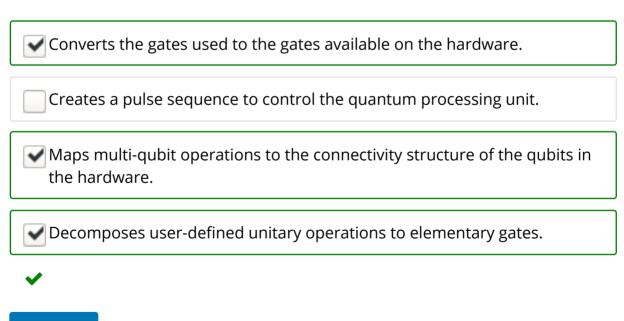
<u>Curso</u> > <u>Quantum Computation</u> > <u>End of Unit Exam</u> > Quantum Computation - Exam

## **Quantum Computation - Exam**

#### Checkboxes

1/1 point (graded)

A quantum compiler has a different role from a compiler on a classical computer for a language like C. A compiler on a classical computer translates a high-level language to machine code. A quantum programming language is already low-level, working at the level of quantum logical gates. So what does a quantum compiler actually do?



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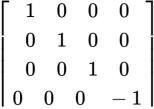
✓ Correcto (1/1 punto)

## Multiple Choice

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1/1 point (graded)

Imagine that you want to apply a CNOT where qubit 0 controls qubit 1. The hardware, however, can only implement the CZ gate defined as



. It can also implement any single-qubit gate. How would

you map CNOT to this quantum computer?

- Apply an X gate on qubit 1, apply CZ where qubit 0 controls qubit 1. Then apply X on qubit 1 again.
- Apply an X gate on qubit 0, apply CZ where qubit 0 controls qubit 1. Then apply X on qubit 1.
- Apply an H gate on qubit 1, apply CZ where qubit 0 controls qubit 1. Then apply H on qubit 1 again.
- Apply an Z gate on qubit 0, apply CZ where qubit 0 controls qubit 1. Then apply Z on qubit 0 again.



Enviar

✓ Correcto (1/1 punto)

## **Multiple Choice**

1/1 point (graded)

The Ry(heta) gate is defined as  $\begin{bmatrix} \cos{( heta/2)} & -\sin{( heta/2)} \\ \sin{( heta/2)} & \cos{( heta/2)} \end{bmatrix}$ . What is the outcome if we apply this gate with  $heta=\pi$  on  $|1\rangle$ 

- $\bigcirc \ket{0}$
- igcup |1
  angle
- $ledow{ledow} |0
  angle$
- $\bigcirc (\ket{0}\!+\!\ket{1})/\sqrt{2}$



Enviar

✓ Correcto (1/1 punto)

# **Multiple Choice**

1/1 point (graded)

We evolve the Hamiltonian  $H=\sigma^Z$  on a single qubit for some time t and we would like to reverse it. What's the corresponding  $U^\dagger$ ?

- $\bigcirc \exp{(-i\sigma^Z t)}$
- $ullet \exp{(i\sigma^Z t)}$
- $\bigcirc \exp{(-i\sigma^{Z\dagger}t)}$



Enviar

✓ Correcto (1/1 punto)

## **Numerical Input**

1/1 point (graded)

We perform annealing with a linear schedule and we know that the minimum gap for  $H\left(t\right)$  for any t during the transition is 0.2. What's the approximate speed limit?



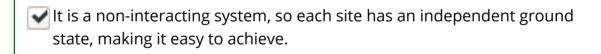
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✓ Correcto (1/1 punto)

#### Checkboxes

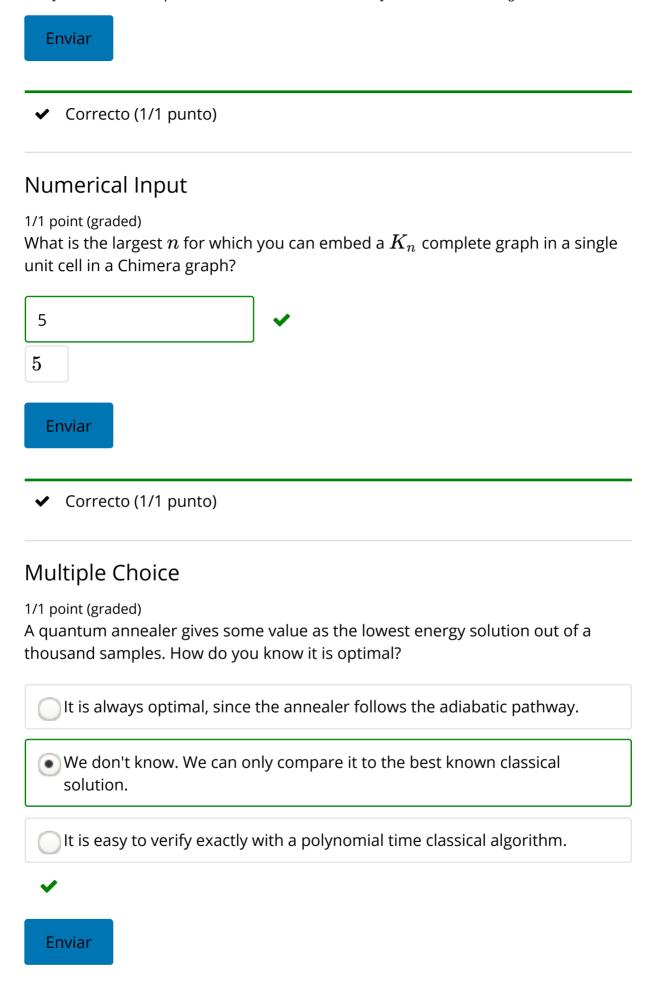
1/1 point (graded)

In adiabatic quantum computing and quantum annealing, we typically start annealing with the Hamiltonian  $H=\sum_i\sigma_i^X$ , which is just the transverse field on all sites. Why?



- The transverse field is easily switched to the external field in the classical Ising model.
- This Hamiltonian ensures a linear schedule for the adiabatic transition.
- The ground state is the uniform superposition, allowing the exploration of the solution space of the classical Ising model.

**~** 



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### Checkboxes

1/1 point (graded)

Superconducting architectures are...

The most popular target for implementations.

Use silicon-based fabrication.

Can have arbitrary connectivity between qubits.

Have a long coherence time.



Enviar

✓ Correcto (1/1 punto)

# **Multiple Choice**

1/1 point (graded)

In the Trotterization of the adiabatic transition, we alternate the time evolution between the mixer and target Hamiltonians, so the overall evolution is written as  $U \approx U\left(H_0, \beta_0\right) U\left(H_1, \gamma_0\right) \dots U\left(H_0, \beta_p\right) U\left(H_1, \gamma_p\right)$ . What is the role of  $\gamma_i$  and  $\beta_i$ ?

The coupling and field strengths of the target and the mixer Hamiltonians.

The length of time evolution for the two Hamiltonians at each step.

They are hyperparamater not affected by optimization.



✓ Correcto (1/	1 punto)
heckboxes	
/1 point (graded)	
he $p$ parameter	in QAOA
Is optimized	over.
<b>✓</b> Controls the	accuracy of the approximation.
✓ Controls the	depth of the circuit.
Controls the	depth of the circuit.
<b>✓</b>	depth of the circuit.
<b>✓</b>	
✓ Enviar ✓ Correcto (1/	1 punto)
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Enviar  Correcto (1/  Multiple Choi  /1 point (graded)  What's the tempe perform quantum	1 punto)  Ce  rature in the approximate Boltzmann distribution if you

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✓ Correcto (1/1 punto)

## **Multiple Choice**

1/1 point (graded)

You are preparing the thermal state of the mixer Hamiltonian in the quantum approximate thermalization protocol. The inverse temperature  $\beta$  is infinite. What's the starting state before you run QAOA?

$$igcup \psi 
angle = \sqrt{2\cosh 1/T} \sum_{z \in -,+} e^{-z/T} |z
angle \otimes |z
angle$$

- The uniform superposition.
- $\bigcirc$   $\mathbb{I}/2$ .



Enviar

✓ Correcto (1/1 punto)

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