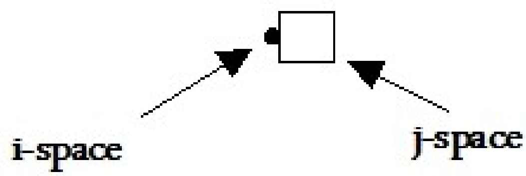

Q1. In CQC, what is the role of the boundary vs. bulk?

Q2. Please explain in your own words: What does it mean that a computation is a “cobordism between boundary Hilbert spaces”?

Q3. Why is topology preferred over standard quantum circuits in CQC?

Q4. Please use the black hole analogy from the blog to explain CQC.

Q5. In the following table please fill the missing concept:

Standard QC	CQC
Time evolution	?

Q6. If two boundary Hilbert spaces are H_0 and H_1, what does the cobordism represent mathematically?

Q7. Why is cobordism similar to a path integral?

Q8. Why does CQC avoid the “noise accumulation problem” of NISQ systems?

Q9. What is lost when we describe computation only as gate sequences?

Q10. Why is CQC closer to GR than standard quantum computing?

Q11. If we define Ω_5 as a higher-order connector between the measurement circuits in j-space, and Cobordism as the geometric bridge between boundaries, are these two equivalent to each other?

Q12. Given two boundary states: Initial $|\psi_0>$ and Final $|\psi_1>$, instead of applying gates, please describe the computation in CQC terms?

ANSWERS

Q1. In CQC, what is the role of the boundary vs. Bulk?

A1. • Boundary: where observable states live (data, measurements)

• Bulk: the hidden geometric structure that enforces how states evolve

• Boundary constrains admissible bulk geometries (like GR constraints)

Q2. Please explain in your own words: What does it mean that a computation is a "cobordism between boundary Hilbert spaces"?

A2. It means:

• The input and output quantum states are treated as boundaries

• The computation itself is not a sequence of steps, but a geometric object (bulk) connecting them

• This bulk encodes the transformation globally, rather than step-by-step

Q3. Why is topology preferred over standard quantum circuits in CQC?

A3. Because topology:

• Is robust to noise

• Depends only on global structure, not small perturbations

• Naturally avoids NISQ limitations (error accumulation)

Q4. Please use the black hole analogy from the blog to explain CQC.

A4. • Bulk = information inside black hole (3D)

• Boundary = event horizon (2D surface)

• All bulk information is encoded on the boundary

→ Similarly, computation is encoded as a relation between boundary states

Q5. In the following table please fill the missing concept:

Standard QC	CQC
Time evolution	?

A5.

Standard QC	CQC
Time evolution	**Geometric transformation (cobordism)**

Q6. If two boundary Hilbert spaces are H_0 and H_1, what does the cobordism represent mathematically?

A6. $Z(M): H_0 \rightarrow H_1$, where M = cobordism (bulk geometry) and $Z(M)$ = induced transformation

Q7. Why is cobordism similar to a path integral?

A7. Because:

• Multiple possible bulk geometries can connect the same boundaries

• Each contributes to the final transformation

• Similar to summing over all paths in quantum mechanics

Q8. Why does CQC avoid the "noise accumulation problem" of NISQ systems?

A8. Because:

• Computation depends on global topology, not local operations

• Small errors do not change topology

• No long gate sequences → less error buildup

Q9. What is lost when we describe computation only as gate sequences?

A9. • Global structure

• Geometric constraints

• Robustness

• Relationship between input/output as a whole

Q10. Why is CQC closer to GR than standard quantum computing?

A10. Because:

- Evolution is determined by global constraints
- Geometry dictates dynamics
- Similar to:

– GR: geometry $\rightarrow$ motion

– CQC: geometry $\rightarrow$ computation

Q11. If we define Ω_5 as a higher-order connector between the measurement circuits in j-space, and Cobordism as the geometric bridge between boundaries, are these two equivalent to each other?

A11. Yes, Cobordism ~ Ω_5 (in j-space)

Q12. Given two boundary states: Initial $|\psi_0>$ and Final $|\psi_1>$, instead of applying gates, please describe the computation in CQC terms?

A12. Find a manifold *M* such that: $\partial M = \psi_0$ uplus ψ_1,

then the computation is $Z(M) : |\psi_0\rangle \rightarrow |\psi_1\rangle$.