Quantum Supremacy Division C
Washington State 2026-2027 Rules

DESCRIPTION: Teams will answer questions related to quantum effects and applications in science, instrumentation, and with an emphasis on quantum computing.

A TEAM OF UP TO: 2 APPROXIMATE TIME: 50 minutes

2. EVENT PARAMETERS:
   a. Each team may bring one three-ring binder containing information in any form and from any source. The three-ring binder may be of any size and the information contained should be attached using the available rings. The information or pages may be removed during the event.
   b. Each team may bring two stand-alone calculators of any type as allowed in the national rule manual.
   c. A sheet of relevant constants, if math is required, may be given as part of the exam.

3. THE COMPETITION:
   The written test covers quantum effects, applications, and programming. It can be in any form including interpretation of data, charts, circuit diagrams or graphs, or simple calculations. Questions on the test will use the following mathematical content:
      1. Algebraic manipulations of multiple steps
      2. Basic trigonometry and vectors
      3. *Basic level of linear algebra, complex numbers, and statistics distribution concepts*
      4. No questions may require the use of calculus.

   a. Quantum Mechanics - Fundamental concepts
      i. Wave and particles: e.g. wavefunctions, the Born rule, superposition
      ii. Probability and uncertainty principle
      iii. Foundational experiments (e.g. double-slit) and paradoxes (e.g. Einstein–Podolsky–Rosen)
   b. Quantum Applications
      i. Quantum Instrumentation; Sensitivity and noise in Quantum sensors
      ii. Physical realization of Quantum computers, e.g. NV-diamond (5.K)
      iii. Electron transfer in protein, enzyme, and intermolecular forces
   c. Programing
      i. Qubits, difference between quantum and classical computing
      ii. Identification of Quantum circuit elements and Quantum gates, e.g. CNOT, CCNOT, H gates
      iii. Comparison and conversion of Digital logic to Quantum Circuit (written or activity-based)

4. SCORING:
   All questions will have been assigned a predetermined number of points. The highest score wins.

5. RECOMMENDED RESOURCES
   a. *Physics (any edition)*, Resnick, Halliday, Krane, John Wiley & Sons.
   b. Quantum Physics, A Beginner's Guide, Alastair Rae (2008)
   c. *Quantum Computation and Quantum Information*, Michael Nielsen & Isaac Chuang (2010)
   d. https://bio.libretexts.org/Bookshelves/Biochemistry/Fundamentals_of_Biochemistry_(Jakubowski_and_Flatt)/Unit_IV_-_Special_Topics/31%3A__Quantum_Biochemistry
   e. MIT OpenCourseWare (https://ocw.mit.edu/) on Statistical Physics, Quantum Physics
   f. Quantum for high school: https://chicagoquantum.org/education-and-training/quick-quantum
   g. Quantum Computing intro: https://youtu.be/-5fKVn1GR9Y?si=bNpbeoGTPA4q_my_
   h. Quantum Computing course: https://learning.quantum.ibm.com/ https://youtu.be/42OiBzfdE2o?si=g23g3QWAF_F6GKi8
   i. Quantum Computing: https://youtu.be/F_Riqjdh2oM?si=9mWgrsvOqI7uEJzj
   j. https://quantum.cloud.ibm.com/learning/courses/fundamentals-of-quantum-algorithms
   k. NV diamond with point defect https://www.youtube.com/watch?v=VCT0wDLyvSs