# CIRCUIT LAB

**See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.**

1. **DESCRIPTION:** Participants must complete tasks and answer questions about electricity and magnetism.

   **A TEAM OF UP TO:** 2 **EYE PROTECTION:** None **APPROXIMATE TIME:** 50 minutes

2. **EVENT PARAMETERS:**
   a. Each team may bring one three-ring binder of any size containing information in any form and from any source attached using the available rings. **Sheet protectors, lamination, tabs and labels are permitted.** Participants may remove information or pages for their use during the event.
   b. Each team may also bring writing utensils and two stand-alone calculators of any type for use during any part of the event.
   c. Event Supervisors must provide any material & measurement devices required for the hands-on tasks.
   d. Participants may bring their own basic multimeters for use in place of provided ones at the discretion of the Event Supervisor.

3. **THE COMPETITION:**

   **Part I: Written Test**
   a. The written test consisting of multiple choice, true-false, completion, or calculation questions/problems will assess the team's knowledge of electricity and magnetism.
   b. Unless otherwise requested, answers must be in metric units with appropriate significant figures.
   c. The test will consist of at least one question from each of the following areas:
      i. Historical perspective of the electricity discoveries made by **Ampere, Coulomb, Kirchhoff,** Volta, Ohm, Tesla, & Faraday
      ii. Properties of electric charges/fields, sources/hazards of static electricity, Coulomb's Law, capacitance
      iii. Direct current (DC) characteristics, sources, uses, simple circuit diagrams, DC hazards
      iv. Alternating current (AC) characteristics, sources, uses, AC hazards
      v. Concepts and units of current, voltage, resistance, power, energy, and using Ohm's law
      vi. Magnetic poles/fields, electromagnets, transformers, motors/generators, right-hand rule
      vii. Electrical control devices including 3-way light switch circuits
      viii. Simple **calculations**, constructions, and configurations of a circuit and individual components
      ix. Fundamental characteristics and operation of a light emitting diode (LED)
      x. Simple circuit analysis using Kirchhoff's Voltage & Current Laws
      xi. **Division C only** - Basic digital logic and digital logic operations
      xii. **Division C only - Basic e**lectrical characteristics of silicon PN junctions **(e.g., Diodes, PNP, NPN)**
      xiii. **Division C only** - Basics and applications of Operational Amplifiers (OpAmps)
   d. Topics not included in the competition are: semiconductors **(beyond those listed above)**, AC circuit theory, inductance, calculations involving direct use of calculus and/or differential equations, non-linear devices, three-state logic gates, sequential logic, **3 Phase** Power, and oscilloscopes.

   **Part II: Hands-On Tasks**
   a. The hands-on portion will consist of at least one task at a station(s) for the teams to complete.
   b. Participants must be familiar with the operation of breadboards and how to use them.
   c. The hands-on tasks, or stations, may include but are not limited to:
      i. Determine the value of a mystery resistor in a circuit using only voltage measurements.
      ii. Calculate the power supplied to a circuit.
      iii. Given some wires, batteries, resistors, and 2 LEDs, hook them up so the LEDs are equally bright.
      iv. Construct an electromagnet using some wire, a bolt and battery.

4. **SCORING:**
   a. High score wins.
   b. Points will be awarded for correct answers, measurements, calculations, and data analysis. Supervisors are encouraged to provide a standard form for competitors to show measurements/calculations.
   c. The written portion of the competition will account for 50-75% of each team's score. No single question will count for more than 10% of the total points possible on the written test.
   d. The hands-on portion of the competition will account for the remaining 25-50% of each team's score.
   e. Ties will be broken using pre-selected task(s)/question(s) that will be noted on the written test.

**Recommended Resources:** The Science Olympiad Store (store.soinc.org) carries the Chem/Phy Science CD; other resources are on the event page at soinc.org.

**This event is sponsored by Institute of Electrical and Electronics Engineers (IEEE)**