



# CIRCUIT LAB

See General Rules, Eye Protection & other Policies on [www.soinc.org](http://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, Kirchoff, 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 Kirchoff's Voltage & Current Laws
  - xi. **Division C only** - Basic digital logic and digital logic operations
  - xii. **Division C only** - **Basic** electrical 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](http://store.soinc.org)) carries the Chem/Phy Science CD; other resources are on the event page at [soinc.org](http://soinc.org).

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