Before we begin:

- We want to know who is here! Please introduce yourself in the chat: Name. School.
- Please mute your microphone to reduce background noise.
- We will leave time for Q & A. Please submit your questions via the Google form that will be shared in the chat.
- This presentation, along with the questions and answers, will be posted on the WESO website.

wesoscience.org

Circuit Wizardry

WESO 2025

Event Supervisors:
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Goals for this event:

01

CIRCUITS BASICS

Learn the basics on electrical components and circuits.

02

TEAMWORK

Encourage positive interactions and good sportsmanship!

03

FUN

Reintroduce a popular and fun event!

General Event Info

GRADES: 4 and 5

TEAM SIZE: 3 participants max (per grade)

DURATION: 45 minutes

DETAILED EVENT DESCRIPTION:
https://wesoscience.org/circuit-wizardry

Event Format Overview

- **Part I:** (10 points) multiple-choice questions
  - Components: function, symbols, etc
  - Circuit concepts: what is an electric circuit, Ohm's law, resistor network (series and parallel), etc.

- **Part II:** (20 points) Questions about circuits or networks, including logic gates and logic gates' function represented by a circuit with basic elements.

- **Part III:** (30 points) Design and build a circuit
  - Teams will demonstrate operation to event supervisor.
  - 5th grade will report and show measurements.

Event Format Overview

- Materials provided during competition: competition booklet, one circuit kit per team, pencils, scratch paper, masking tape
- Tables with circuit element symbols or logic gates will **not** be provided
- Multimeters will **not** be provided
- 5th grade teams **must** bring a multimeter.
- 4th grade teams may bring a multimeter if they want to.
- Teams should **not** bring their circuit kits to the event room.
- Teams should **not** bring calculators.

Part I: Multiple-Choice Questions

- 5 multiple choice questions on electrical circuit concepts and components
- Questions will have varying degrees of difficulty
- May include a simple calculation involving Ohm’s Law. No calculators.
- Suggested time: no more than 5 minutes

Part II: Analysis of Circuits and Networks

- 2-3 circuits or networks presented in schematic form
- Questions about the circuit or network function and operation
- Circuits will have at least one tricky aspect.
  - Examples of “tricky” include (but are not limited to) inverted polarity and short circuit conditions
- Suggested time: 10 - 15 minutes

Part III: Design and build a circuit

One question only. Given a functional description of a circuit

- Design a circuit (draw a schematic of a circuit)
- Build the circuit
- 5th grade only: make and record a measurement of the circuit using a multimeter
- Suggested time: no more than 20 - 25 minutes

Notes:

➔ Label all components, include + and - on battery
➔ The circuit schematic can be drawn before or after building the circuit.
➔ Circuit and schematic should agree (correct polarity, component order).
➔ Circuit measurements (5th grade teams only) will involve one of current, resistance and/or voltage.

Coaching Advice

- Read the event description
- Let the kids play with the components and try out different designs
- Don’t over coach your team!
- Make sure they support each other
- Most importantly, make it fun!

Coaching Tips

- Wires and components can get entangled during a build. Use masking tape to secure wires to the table.
- Remove screws from switches, so that hook leads can attach easily.
- Experiment with the components to learn their limitations.
- Challenge teams to build circuits with fewest possible elements.
- Instruct students to label all electronic components and logic gates, include + and - on battery.
- Always list units!

Suggested Materials

- Slides with basic concepts at https://wesoscience.org/circuit-wizardry/
- Electronics Club study resources: https://electronicsclub.info/study.htm
- Phet circuit simulator: https://phet.colorado.edu/en/simulations/circuit-construction-kit-dc
- Logic Gates simulator: https://academo.org/demos/logic-gate-simulator/
- Note: WESO Circuit Wizardry 2025 materials (electronic components) will be distributed to schools early February - check with you school's head coach

Questions after tonight?

New for 2025!

Discord

WESO Discord Server

- **Every WESO event will have its own channel**
- **Join the WESO server to submit your questions in the event chat**
- **Event supervisors or WESO board members will monitor the discussion and answer questions**
- **Event coaches can use the chat to exchange coaching ideas**
- **Go to** wesoscience.org/events/ **for details on how to join the WESO server and guidelines for its use**

QUESTIONS NOW?

- **Please submit your questions using the google form shared in the chat.**
- **We will answer live and post all questions and written answers to the website following the meeting.**

Thank you for serving as an event coach!

BACKUP SLIDES

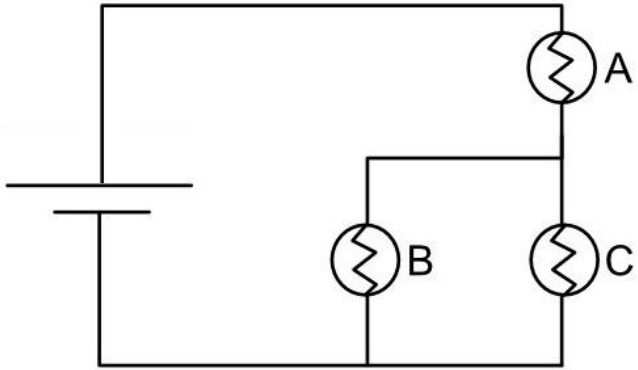
Additional Information

- Teams will have about 40 minutes to complete the tasks.
- The 4th and 5th grade exams will be different. There will be no common questions.
- Tie breaks: agreement between drawn and built circuit, fewest nodes for built circuit, a pre-determined tie-break question.
- Completion time is not a tie breaker. Correctness and completeness are important!

PART I EXAMPLES

1. What is the unit of measurement for electrical current?
2. In the circuit below, each light bulb has the same resistance. Which bulb is brightest?

a. A
b. B
c. C
d. B and C are the same brightness and brighter than A
e. A, B and C are all the same brightness.



PART I EXAMPLES

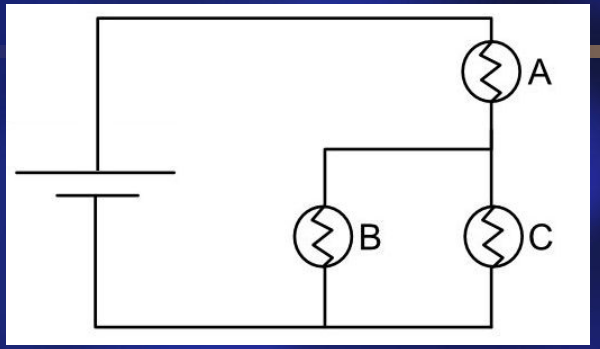
1. What is the unit of measurement for electrical current?

   Amperes or Amps are valid answers.

2. In the circuit below, each light bulb has the same resistance. Which bulb is brightest?

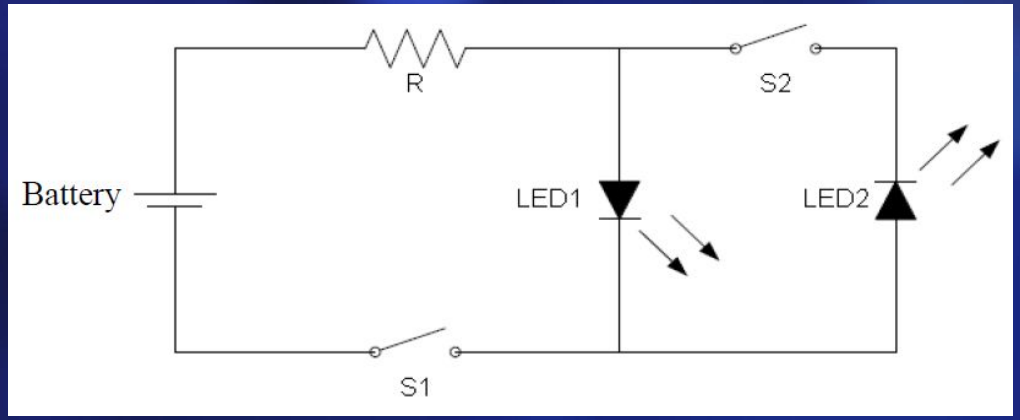
   There is more current going through lamp A, as it is split evenly for B and C in the parallel portion. So lamp A will be brighter.

   The symbol for battery is slightly different here; on the actual competition it will be as in the event description.



PART II EXAMPLES

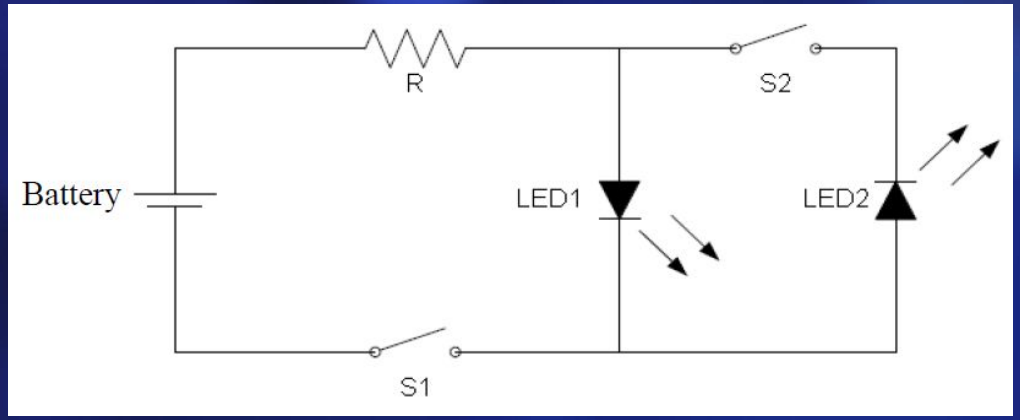
1. For the switch positions given in the table, determine the states of the LEDs.



S1	S2	LED1	LED2
closed	closed		
closed	open		
open	closed		

PART II EXAMPLES

1. For the switch positions given in the table, determine the states of the LEDs.

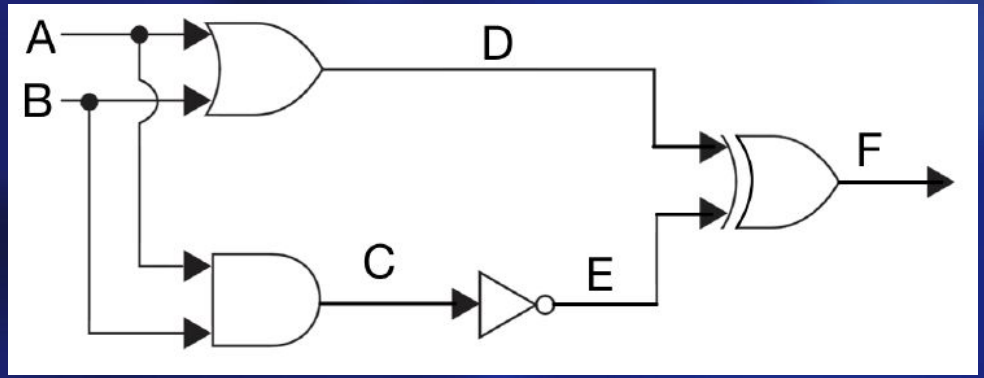


S1	S2	LED1	LED2
closed	closed	on	off
closed	open	on	off
open	closed	off	off

Notice the reversed polarity of LED2.

PART II EXAMPLES

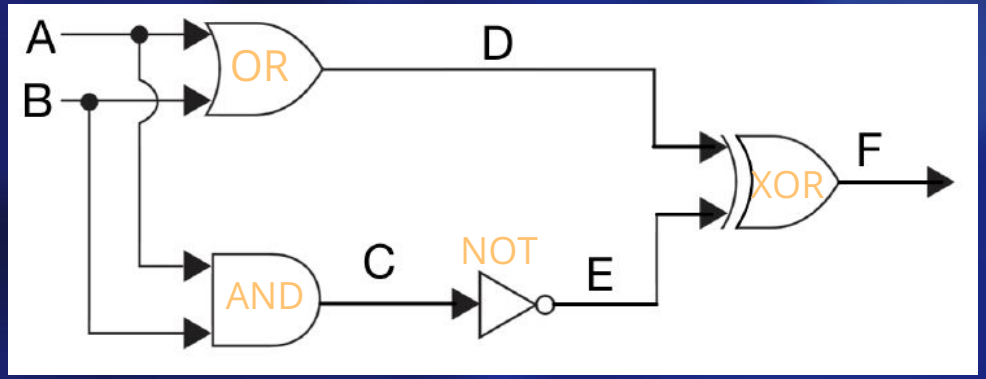
2. Find the combinations of input values A and B for which the output F equals 1.



A	B	C	D	E	F
0	0				
0	1				
1	0				
1	1				

PART II EXAMPLES

2. Find the combinations of input values A and B for which the output F equals 1.



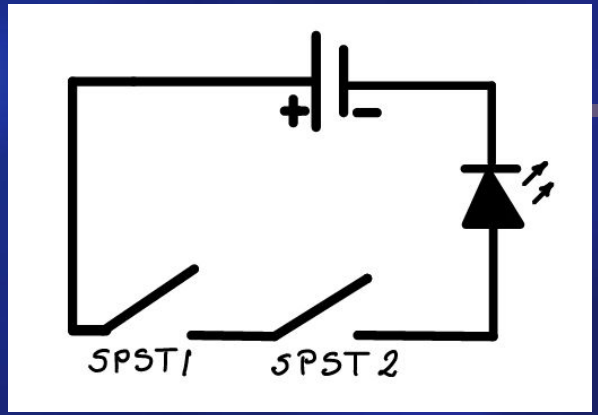
A	B	C	D	E	F
0	0	0	0	1	1
0	1	0	1	1	0
1	0	0	1	1	0
1	1	1	1	0	1

Answer: The combination of values are A = 0, B = 0 and A = 1, B=1.

PART II EXAMPLES

3. The circuit below represents the action of a logic gate. A switch in the “ON” position corresponds to 1, and “OFF” corresponds to 0. The LED being “ON”, represents 1, and it being “OFF”represents 0. Which logic gate is represented by this circuit?

a) AND
b) OR
c) XOR
d) NOT
e) None of the above



PART II EXAMPLES

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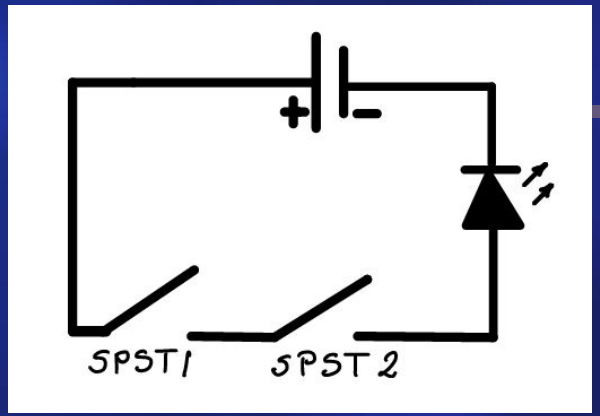
a) AND
b) OR
c) XOR
d) NOT
e) None of the above

The LED lights up only when both switches are closed.



PART III EXAMPLE

Design and build a circuit that switches one lamp between off, low and high intensity. Switching may be done using any combination of switches.

Measure the current through the lamp when it is at high intensity (5th grade only).

Note: Solve this question without a potentiometer.

PART III EXAMPLE

Design and build a circuit that switches one lamp between off, low and high intensity. Switching may be done using any combination of switches.

One possible solution