

Name: \_\_\_\_\_

## Learning Goals:

- Elec 2- I can explain factors influencing current flow and how electrons flow through components in a circuit
- Elec 3- I can describe different types of circuits and draw schematic diagrams showing components and electron flow

## Electricity – 1) Current, Circuits & Schematic Diagrams

Electrical Current Explained (video): [https://www.youtube.com/watch?v=kcL2\\_D33k3o](https://www.youtube.com/watch?v=kcL2_D33k3o)

### Types of Electricity

- Static electricity forms when \_\_\_\_\_
- Current electricity forms when \_\_\_\_\_

### What is Current Electricity?

The flow of \_\_\_\_\_ called electrons in a complete circuit.

### Electric current (I) – flow of charge

- ▶ Amount of \_\_\_\_\_ passing through a set point every second
- ▶ Higher the current, the \_\_\_\_\_ the electrons move
- ▶ Unit of measure = \_\_\_\_\_ (A) or \_\_\_\_\_ (mA);
- ▶ 1.0 A = \_\_\_\_\_ mA
- ▶ 1 A = \_\_\_\_\_ (1 Coulomb is  $6.241 \times 10^{18}$  electrons)
- ▶ Measured with a device called an \_\_\_\_\_ **Analogy:**

### Electric Circuit

A \_\_\_\_\_ pathway that allows \_\_\_\_\_ to flow \_\_\_\_\_

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### Alternating vs Direct Current

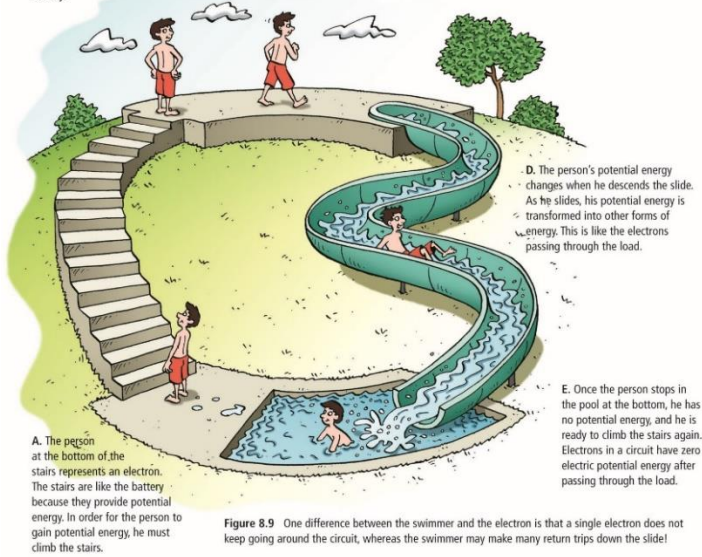
*Record your own notes while viewing videos on Alternating Current vs Direct Current*

Intro: <https://www.youtube.com/watch?v=g17f9J1-r-k>; AC and DC Basics - <https://www.youtube.com/watch?v=2jqJZxxX6gQ>

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B. Once the person is at the top of the stairs, he has potential energy. The number of stairs he climbed represents the voltage of the battery.

C. As the person walks horizontally along the top platform, he is not changing his potential energy. This is similar to the electrons passing through the conducting wire.



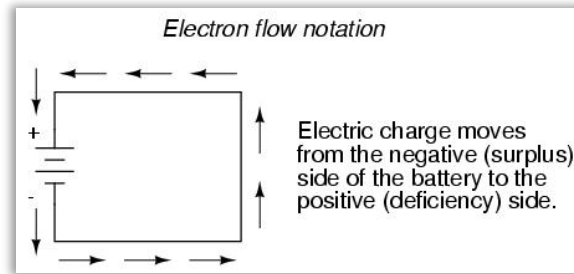
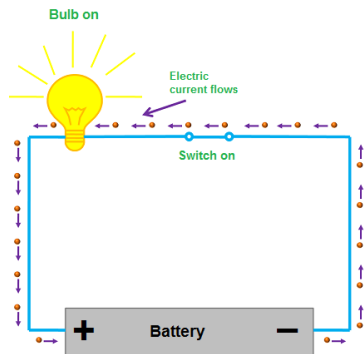
### Waterslide Electric Circuit Analogy

- The person represents an \_\_\_\_\_ in a circuit
- Stairs are the battery – the source of potential energy (\_\_\_\_\_ of stairs is the voltage)
- Potential energy lost only when person slides down – like when electrical energy is \_\_\_\_\_ to other forms of energy by a \_\_\_\_\_ i.e. light bulb uses electricity to produce light and heat
- At bottom electron/person has \_\_\_\_\_ potential energy remaining

### Four Basic Components in a Circuit

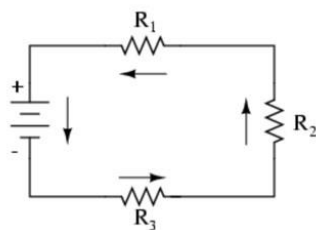
1. Source: \_\_\_\_\_
2. Conductor: \_\_\_\_\_
3. Load: \_\_\_\_\_
4. Switch: \_\_\_\_\_

### Electrons flow from -ve to +ve terminals if the circuit is “closed”

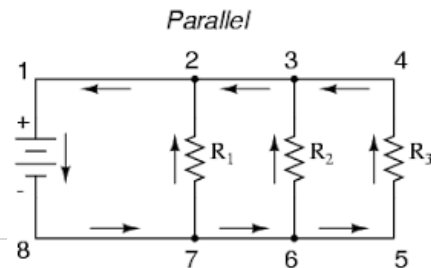


### Circuits can be arranged two ways:

➤ **In Series:** The current has only \_\_\_\_\_ through all parts of the circuit.


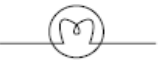
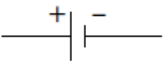
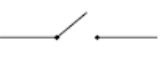
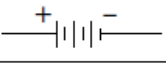
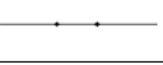
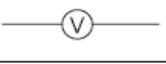
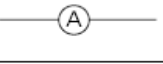


➤ **In Parallel:** Current can flow through \_\_\_\_\_ pathways in the circuit.



Name: \_\_\_\_\_

## Schematic Diagrams

 conducting wire	 bulb
 cell	 open switch
 battery	 closed switch
 voltmeter	 ammeter

Resistor:

Draw the *schematic diagram* next to the circuit shown:

1.



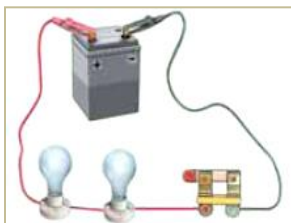
2.



3.



4.



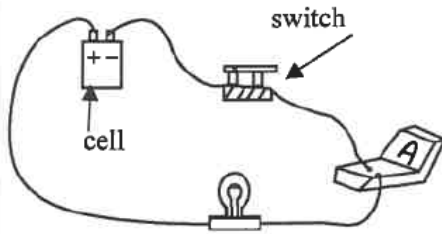
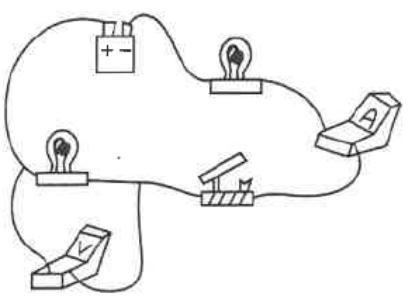
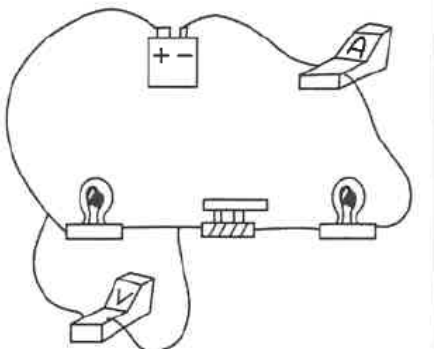
**Complete Schematic Diagram Handout next page!**

Name: \_\_\_\_\_

**Goal** • Practise drawing circuit diagrams.

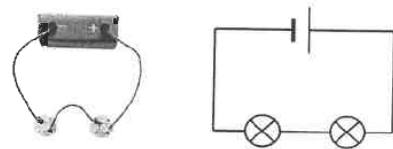
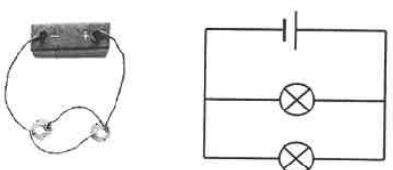
### What to Do

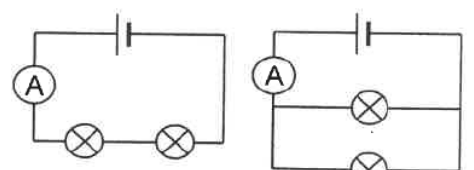
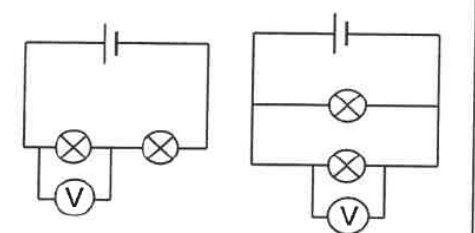
For each of the following circuit illustrations, draw its corresponding circuit diagram and answer the questions that follow.

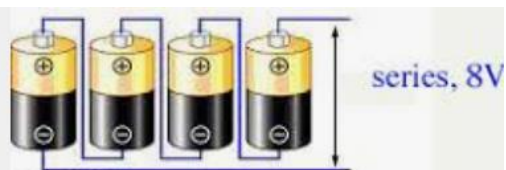
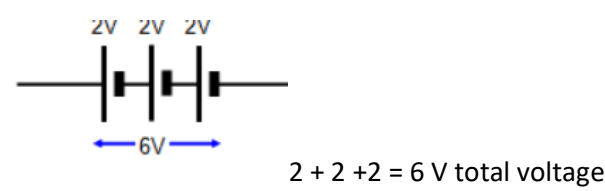
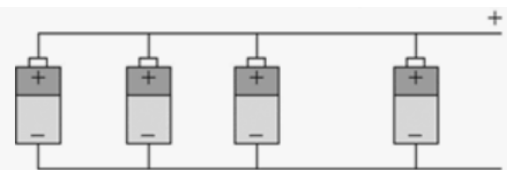
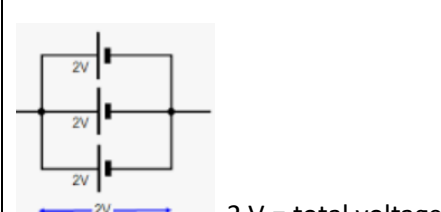
<p>1. Circuit A</p> 	<p>2. Circuit B</p> 	<p>3. Circuit C</p> 
<p>1. Circuit diagram</p>	<p>2. Circuit diagram</p>	<p>3. Circuit diagram</p>
<p>1. (a) Is this circuit open or closed? _____ (b) If this is a closed circuit, what is the source of the potential difference? _____ What is the load? _____</p>	<p>2. (a) Is this circuit open or closed? _____ (b) If this is a closed circuit, what is the source of the potential difference? _____ What is the load? _____</p>	<p>3. (a) Is this circuit open or closed? _____ (b) If this is a closed circuit, what is the source of the potential difference? _____ What is the load? _____</p>

Name: \_\_\_\_\_

## Drawing Schematic diagrams for parallel vs series circuits and placement of meters

<p style="text-align: center;"><b>SERIES CIRCUITS</b></p>  <p>The components are connected end-to-end, one after the other. There is only one pathway for current to flow</p>	<p style="text-align: center;"><b>PARALLEL CIRCUITS</b></p>  <p>The components are connected side by side. The current has a choice of routes.</p>
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<p style="text-align: center;">This is how we draw an ammeter in a circuit</p>  <p style="text-align: center;">SERIES CIRCUIT      PARALLEL CIRCUIT</p>	<p style="text-align: center;">This is how we draw a voltmeter in a circuit.</p>  <p style="text-align: center;">SERIES CIRCUIT      PARALLEL CIRCUIT</p>
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<p><b>Cells in Series</b> Battery ends are connected negative end to positive end, end to end</p>  <p>Voltage of each cell combines to give total voltage</p>  <p style="text-align: center;"><math>2 + 2 + 2 = 6 \text{ V total voltage}</math></p>	<p><b>Cells in Parallel</b> Battery ends connected negative end to negative end, and positive end to positive end</p>  <p>Total voltage is the voltage of one cell</p>  <p style="text-align: center;"><math>2 \text{ V} = \text{total voltage}</math></p>
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## Drawing Schematic Diagrams involving parallel and series components

1. Draw two cells in series.

2. Draw two cells in parallel

Name: \_\_\_\_\_

3. Draw two lamps in series connected to one cell.

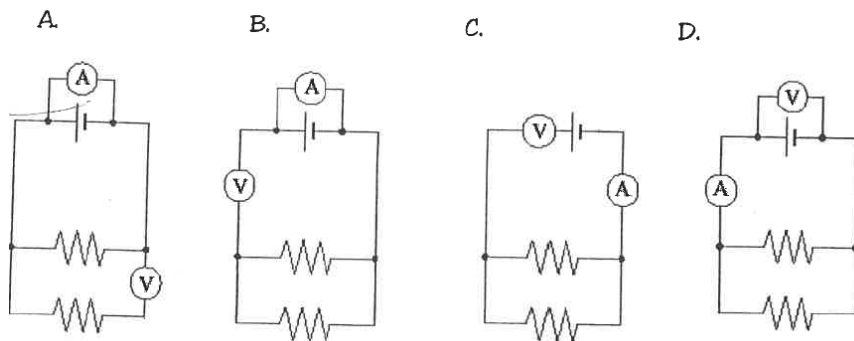
4. Draw two lamps in parallel connected to one cell.

5. a) Draw a battery leading to a closed switch and a lamp.

b) Is this circuit open or closed? \_\_\_\_\_

c) Will the light bulbs light up? Yes or No, Explain.

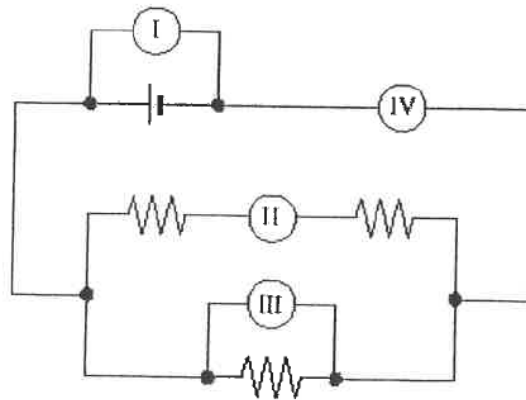
6. Which of the following diagrams shows an ammeter correctly placed to measure the circuit current and a voltmeter correctly placed to measure the potential difference across the battery?



Name: \_\_\_\_\_

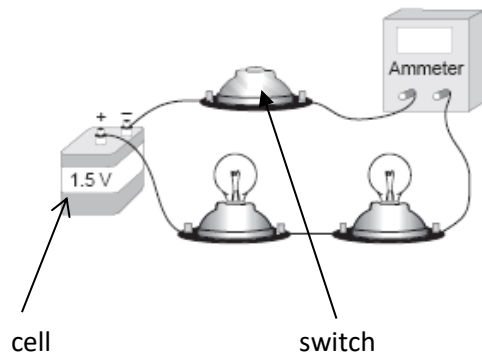
7. Identify the correct placement of ammeters and voltmeters in the following circuit.

- I \_\_\_\_\_
  - II \_\_\_\_\_
  - III \_\_\_\_\_
  - IV \_\_\_\_\_
- 2V + 1V = 3V*



8. Draw four cells in series connected to a voltmeter to measure the potential difference across one lamp.

9. a) Draw a schematic diagram for the diagram given (note position of the terminals (+ vs - on the cell matters!). **The switch is open.**



b) Will the light bulbs light up? Yes or No, Explain.

**Bonus:** Draw two cells in parallel connected to two lamps in parallel.

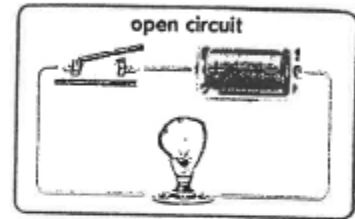
Name: \_\_\_\_\_

### Warm-up

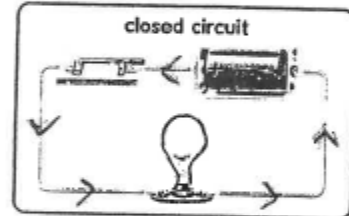
#### TRUE OR FALSE:

- \_\_\_\_\_ 1. Current electricity can travel around a closed circuit.
- \_\_\_\_\_ 2. Conventional current flow is from positive to negative, and electron flow is from negative to positive.
- \_\_\_\_\_ 3. Current electricity cannot flow through an open circuit.
- \_\_\_\_\_ 4. Copper wires allow electric current to flow.

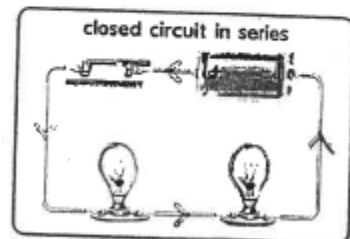
5. What will happen to the current when the circuit is open?



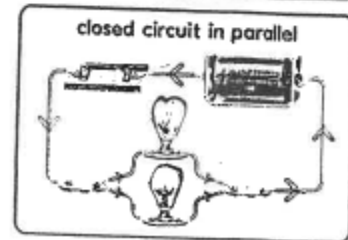
6. What will happen to the current when the circuit is closed?



7. What will happen if one of the bulbs in this series circuit stops working?



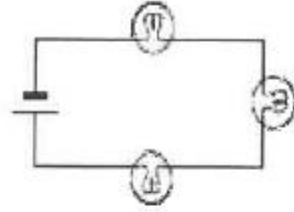
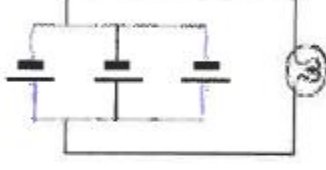
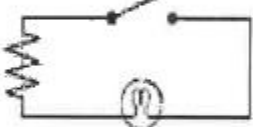


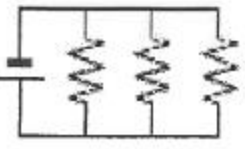
8. What will happen if one of the bulbs in this parallel circuit stops working?





Name: \_\_\_\_\_

Match each Description on the left with the Circuit on the right.  
Each Circuit may be used as often as necessary.

Description	Circuit
71. Three cells in series.	<p>A. </p>
72. Three cells in parallel.	<p>B. </p>
73. Three resistors in series.	<p>C. </p>
74. Three resistors in parallel.	<p>D. </p>
75. A circuit in which no current is flowing.	<p>E. </p>
	<p>F. </p>

Name: \_\_\_\_\_

Elec 5- I can describe the relationship between current, voltage and resistance in circuits and use Ohm's law to solve problems.

## Voltage, Cells and Batteries

**Voltage ( )** - The \_\_\_\_\_ that pushes electrons in a conducting material through a circuit

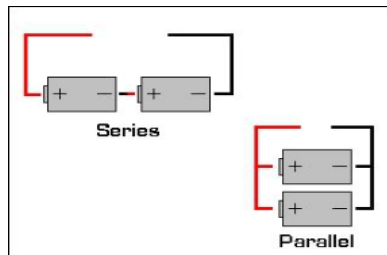
- This push is called \_\_\_\_\_ or \_\_\_\_\_
- Measured in \_\_\_\_\_ with a \_\_\_\_\_
- Analogy:

### Voltage is often referred to as Potential Difference

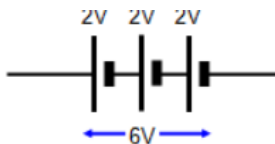
- Defined as the difference in potential energy, per unit charge, between \_\_\_\_\_ points in a circuit. Sometimes called voltage drop!

## Batteries

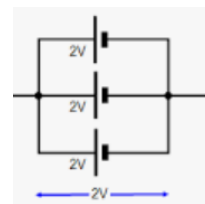
A **battery** is defined as one or more \_\_\_\_\_ cells connected together in series or parallel.



Cells in series are connected  
+ to - terminals (ends)



Cells in parallel are connected  
- to - terminal and + to + end



An electrochemical cell converts \_\_\_\_\_ energy into \_\_\_\_\_ energy.

Name: \_\_\_\_\_

## Producing Voltage

An **electrochemical cell** works by producing a potential energy difference between the +ve and -ve terminals.

There are 2 types of **electrochemical cells**: \_\_\_\_\_ cells and \_\_\_\_\_ cells.

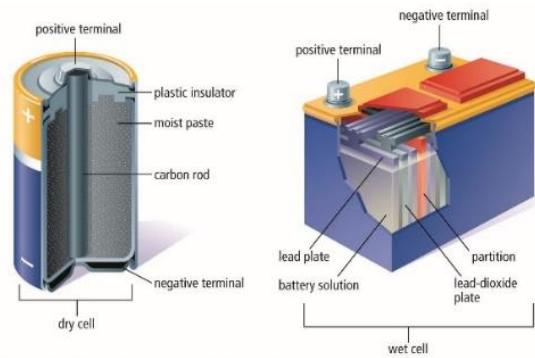


Figure 8.5 Chemical reactions in batteries produce a voltage across the positive and negative terminals.

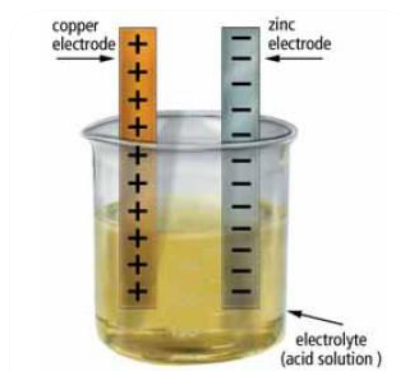


Figure 8.6 An electrochemical cell requires two different electrodes (usually metals) and an electrolyte.

## How do electrochemical cells produce voltage?

Battery terminals- \_\_\_\_\_ (usually two different metals) sit in a substance (paste or fluid) called \_\_\_\_\_ that conducts electricity.

**Activities: Lemon Cell Lab Activity and/or Phet Activity investigating voltage in a series circuit.**

Name: \_\_\_\_\_

## Resistance (R) in a Circuit-

➤ Created by any device that slows the passage of the electrons  
Such as: \_\_\_\_\_

➤ The current slows down because the electrons are \_\_\_\_\_  
\_\_\_\_\_

### Analogies:

- The amount of resistance depends on:
  - Type of \_\_\_\_\_ the device is made of e.g. \_\_\_\_\_
  - The path length: path = resistance
  - Good conductors have \_\_\_\_\_ resistance e.g. \_\_\_\_\_
  - Good resistors \_\_\_\_\_ the current or \_\_\_\_\_ completely. i.e. \_\_\_\_\_  
e.g. Light bulb – \_\_\_\_\_ current flow allowing electrical energy to change to \_\_\_\_\_  
\_\_\_\_\_
  - Measured in \_\_\_\_\_ ( $\Omega$ ) by an \_\_\_\_\_

## Water Pump house Circuit Analogy

TO KEEP ALL THESE CONCEPTS IN MIND, IT HELPS TO HAVE A MECHANICAL ANALOGY:

YES, PLEASE.

PUMP HOUSE

IMAGINE THAT ELECTRIC CURRENT IS LIKE WATER FLOWING THROUGH A PIPE. THEN WE HAVE THESE CORRESPONDENCES:

ELECTRICITY	WATER
COULOMB OF CHARGE	LITER OF WATER
AMPERE	ONE LITER/SEC FLOW
BATTERY	PUMP
VOLTAGE	PUMP PRESSURE
WIRE	PIPE

THE LAMP FILAMENT IS LIKE A SECTION OF PIPE FILLED WITH GRAVEL THAT **RESISTS** THE FLOW OF WATER. IN FACT, THE FRICTION OF FLOWING WATER EVEN HEATS THE GRAVEL!

Name: \_\_\_\_\_

**Respond to the following Questions Relating Current, Voltage and Resistance**

1. What is the definition of *electric current* and what unit is current measured in?
2. What is the difference between a closed and an open circuit?
3. Use the charge of electrons to explain why electrons flow from negative to positive.
4. What type of devices use direct current? What is a disadvantage of using direct current?
5. What is an advantage of using alternating current? Where is it used?
6. How is pressure in a water hose like voltage in a circuit?

