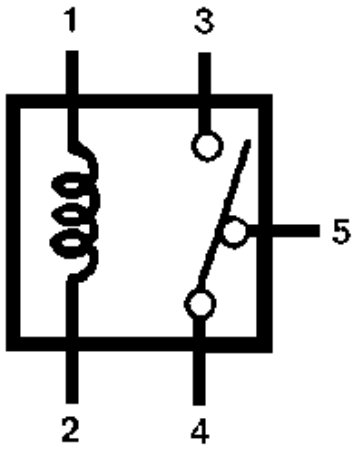
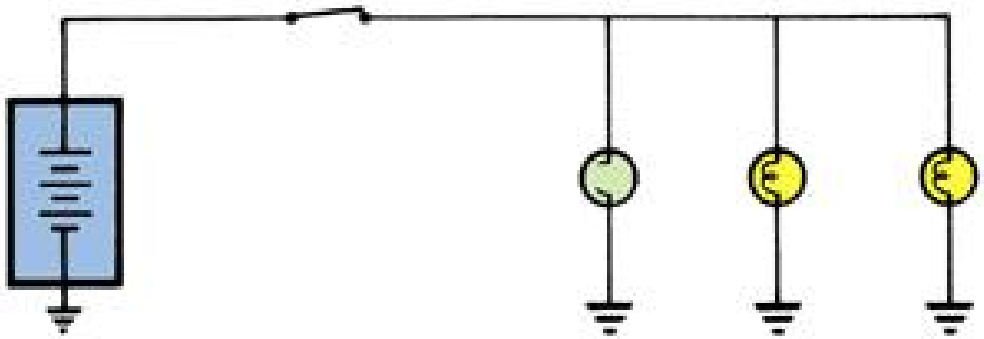
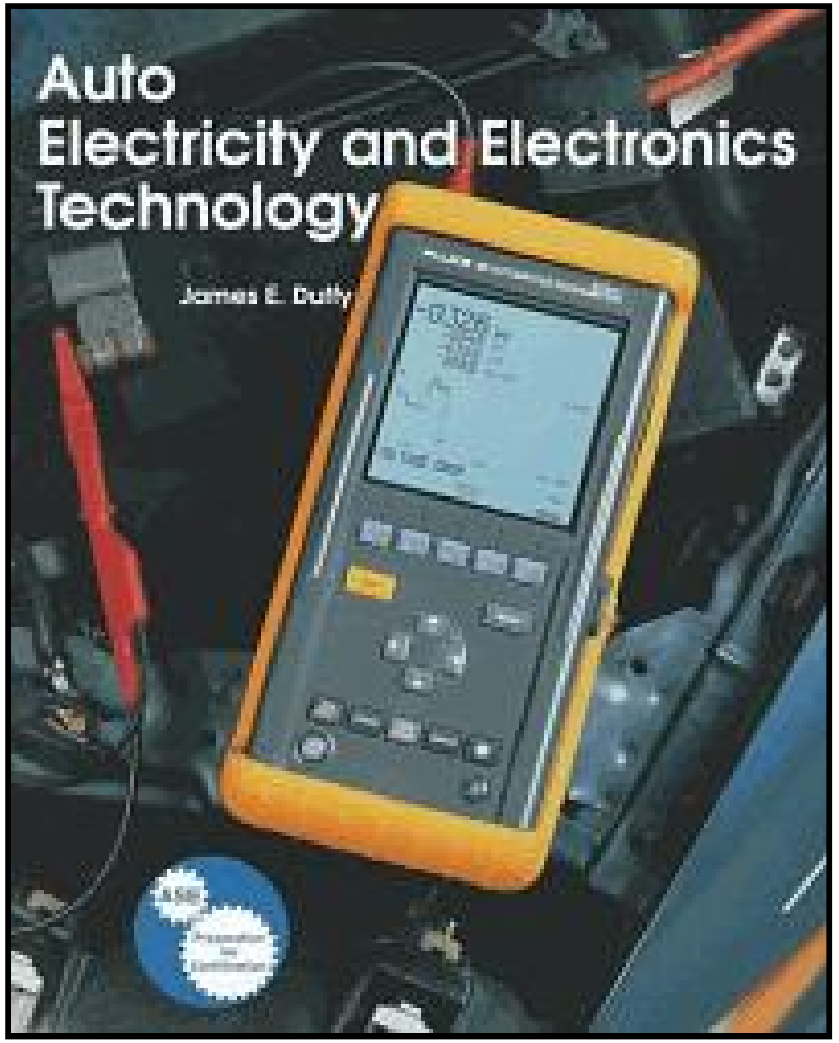
ATASA 5th Basics of Electrical Systems

ATASA 5TH Study Guide
Chapter 15 Pages 433-456
Basics of Electrical Systems
66 Points

Please Read The Summary







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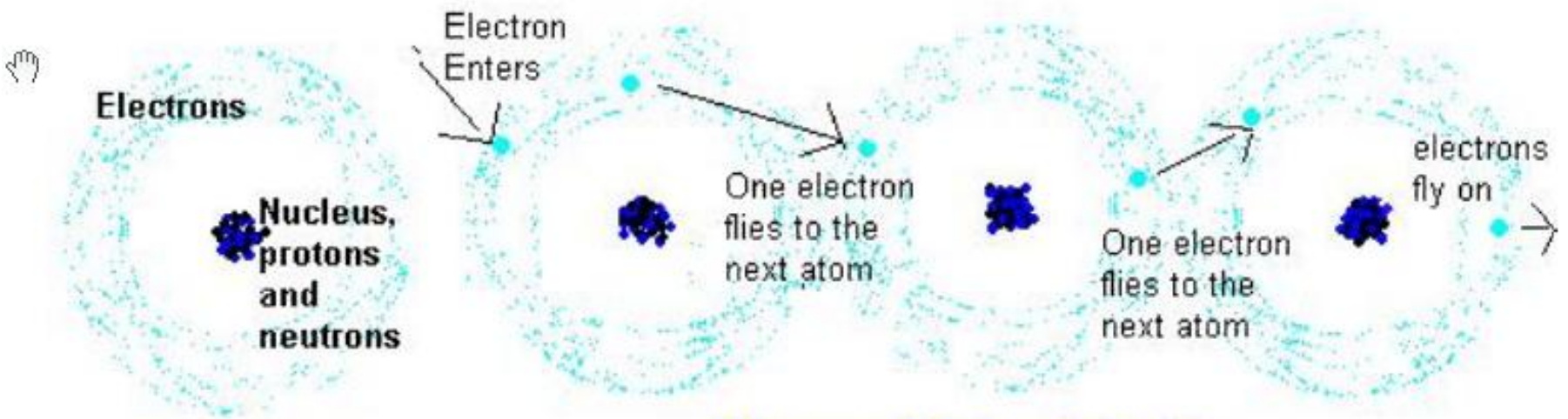
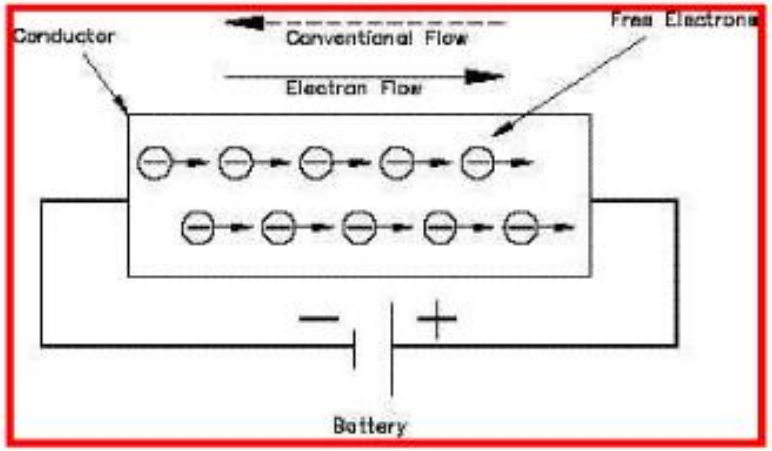
1. Electricity is the flow of _____ (-) from one atom to another.



An Atom

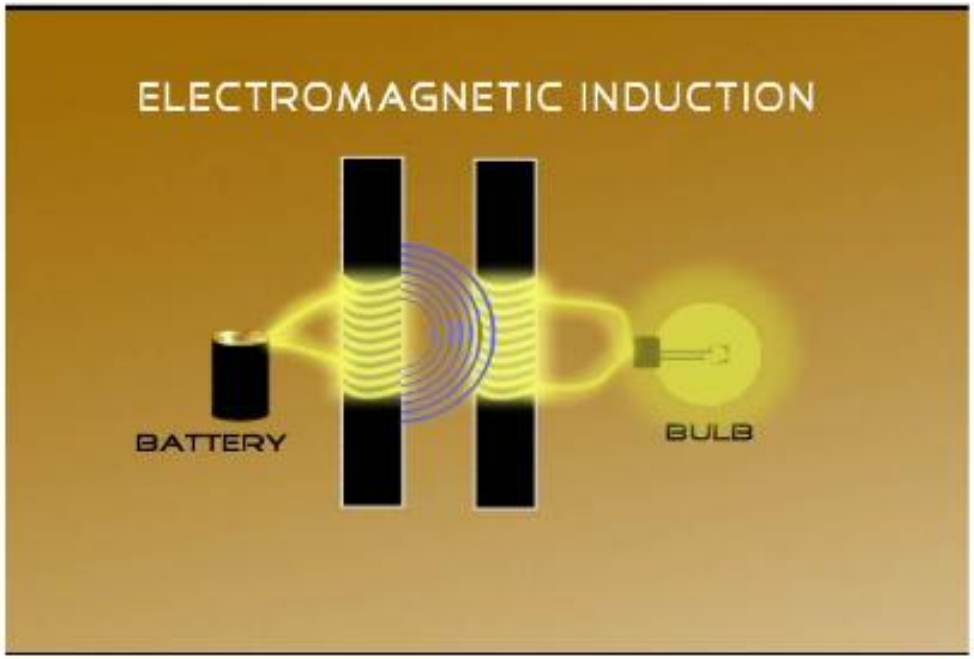
Flow of Electricity

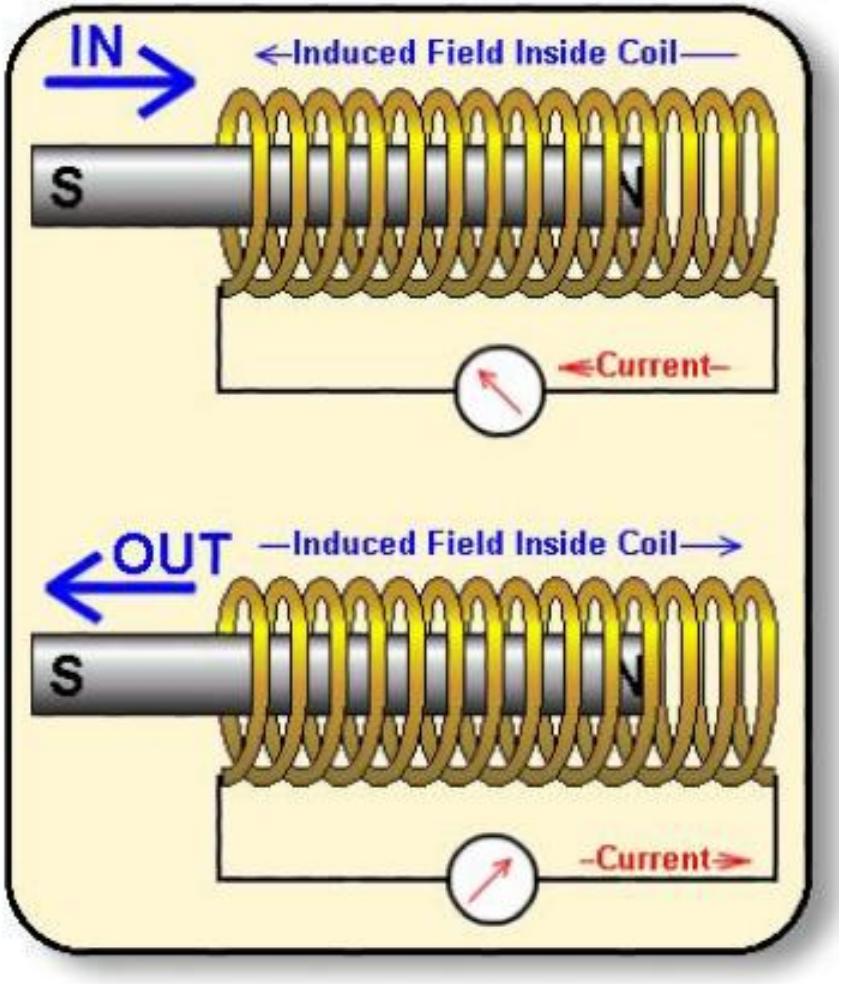


Protons
Neutrons
Electrons

2. _____ is moving coiled conductors through magnetic fields to produce electricity.

Reduction
Induction
Conduction





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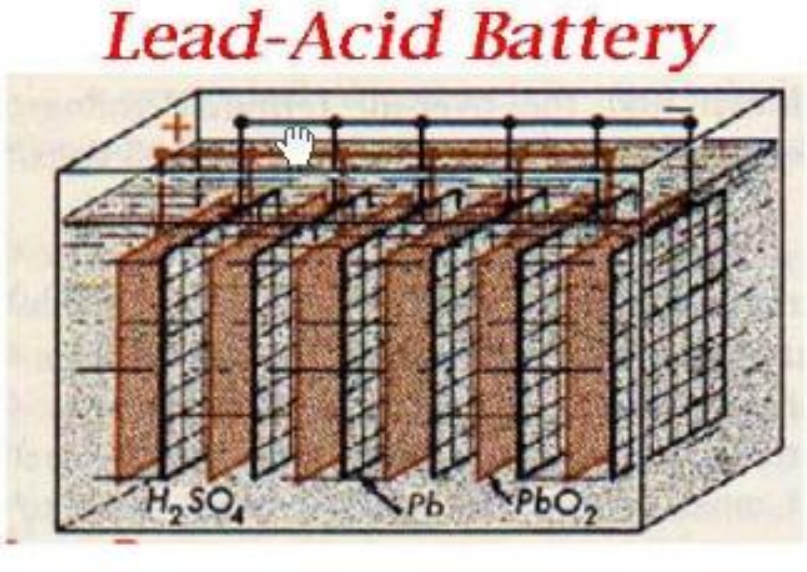
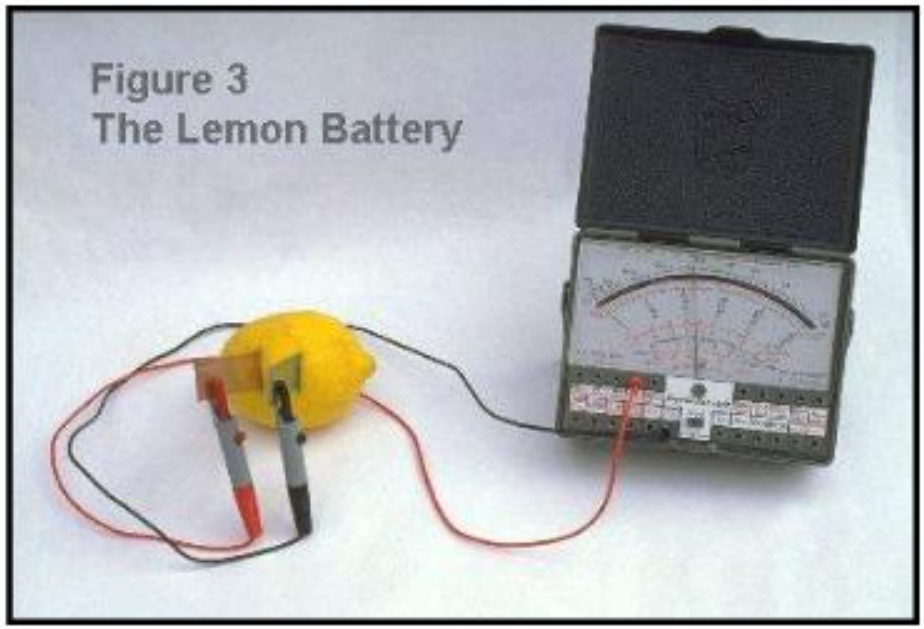
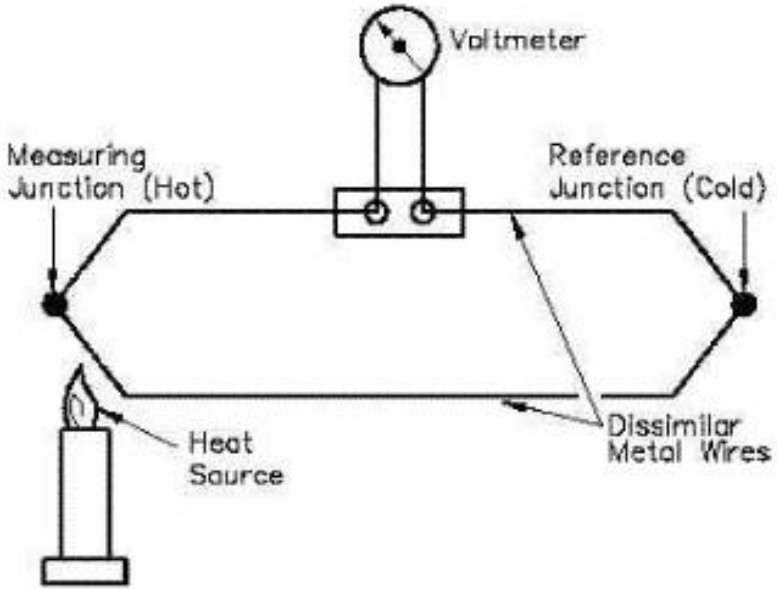
3. Electricity is also produced through _____, thermal, photoelectrical & piezoelectrical means.

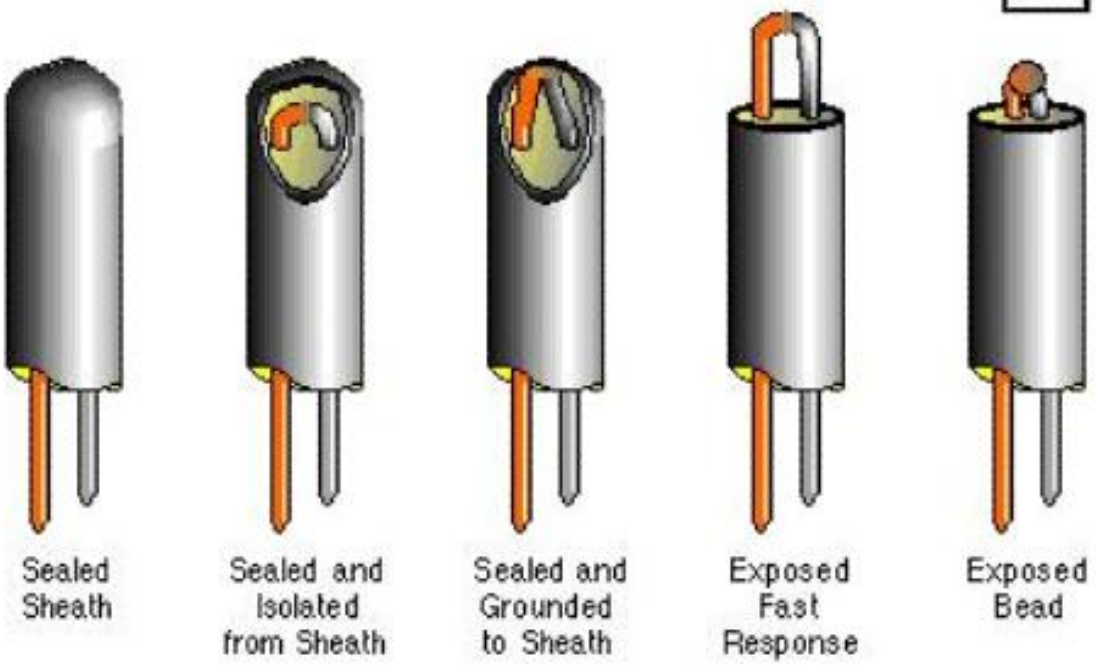




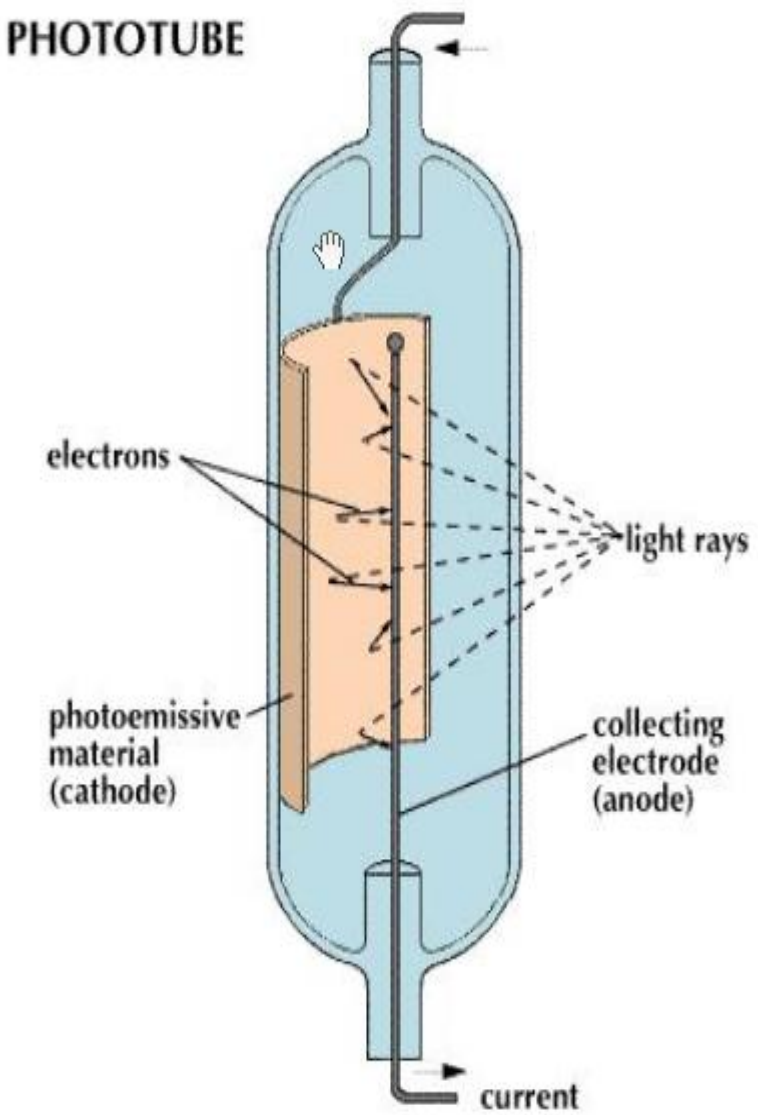
$$PbO_2 + Pb + 2H_2SO_4$$
$$\text{charge} \uparrow \quad \downarrow \text{discharge}$$
$$2PbSO_4 + 2H_2O$$

Chemical
Electrical
Subliminal





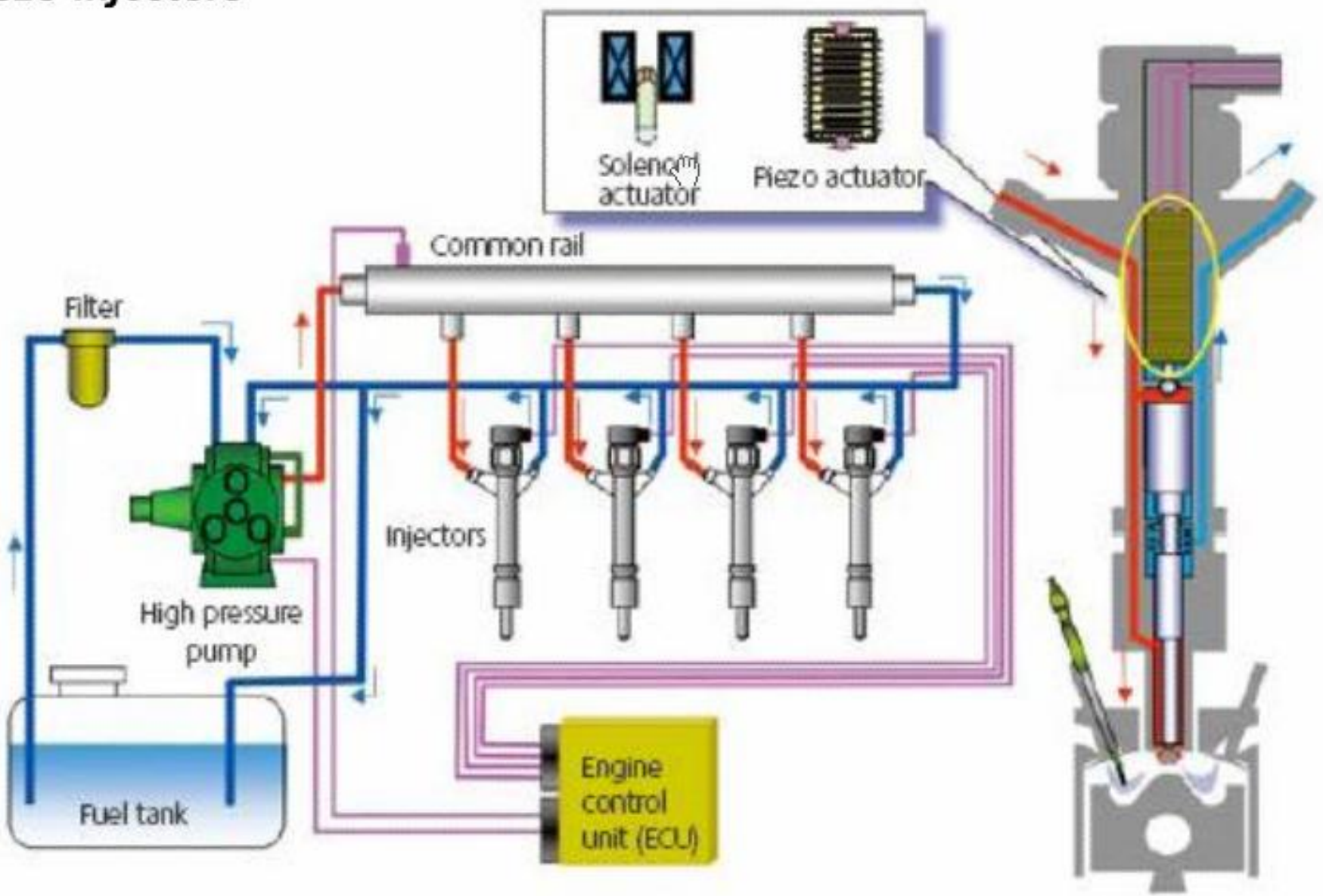
Thermocouple Sheath Options

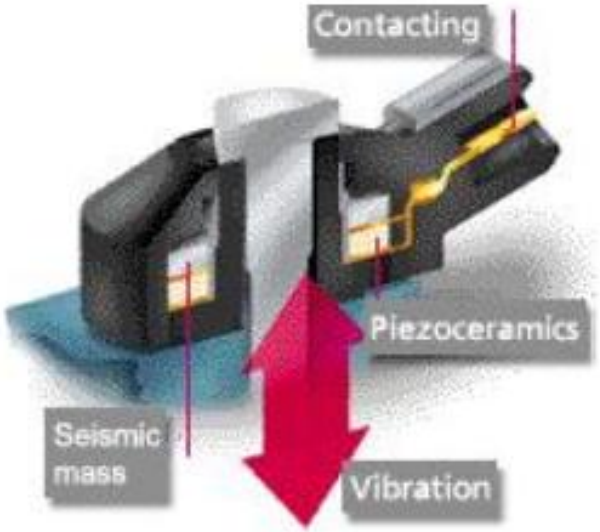

PHOTOTUBE
electrons
light rays
photoemissive material (cathode)
collecting electrode (anode)
current

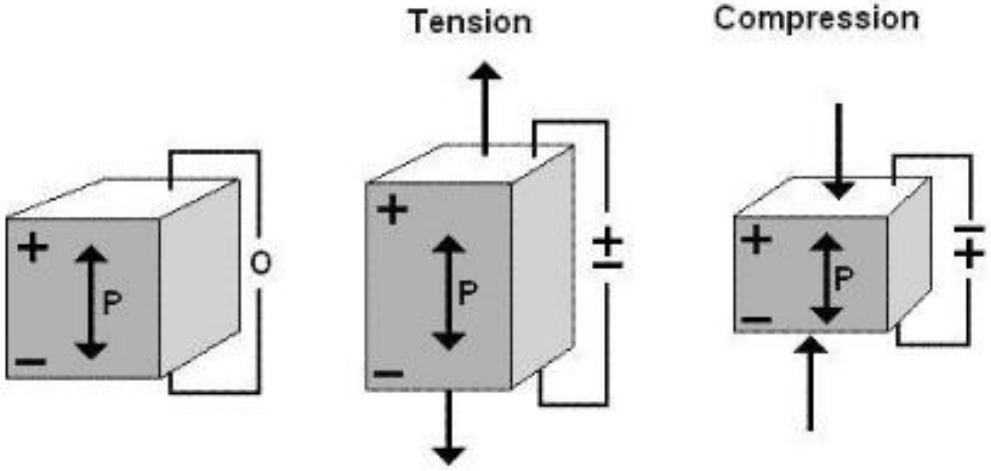
Piezoelectricity is the ability of crystals and certain ceramic materials to generate a voltage in response to applied mechanical stress. Piezoelectricity was discovered by Pierre Curie and the word is derived from the Greek piezein, which means to squeeze or press.

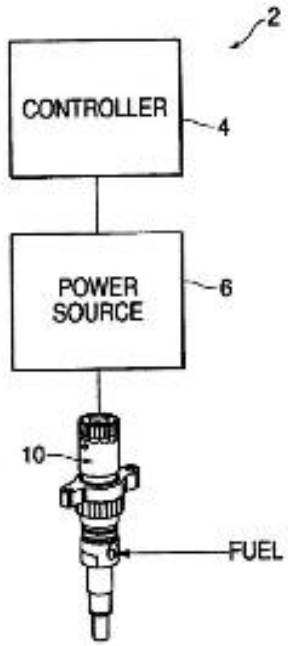
The piezoelectric effect is reversible in that piezoelectric crystals, when subjected to an externally applied voltage, can change shape by a small amount (for example, deformation of about 0.1% of the original dimension in lead zirconate titanate). The effect finds useful applications such as the production and detection of sound, generation of high voltages, electronic frequency generation, microbalances, ultra-fine focusing of optical assemblies, and piezo electronic fuel injectors.

Piezo-injectors




Contacting
Piezoceramics
Seismic mass
Vibration


Tension
Compression
P
O
±
∓


2
CONTROLLER
4
POWER SOURCE
6
10
FUEL

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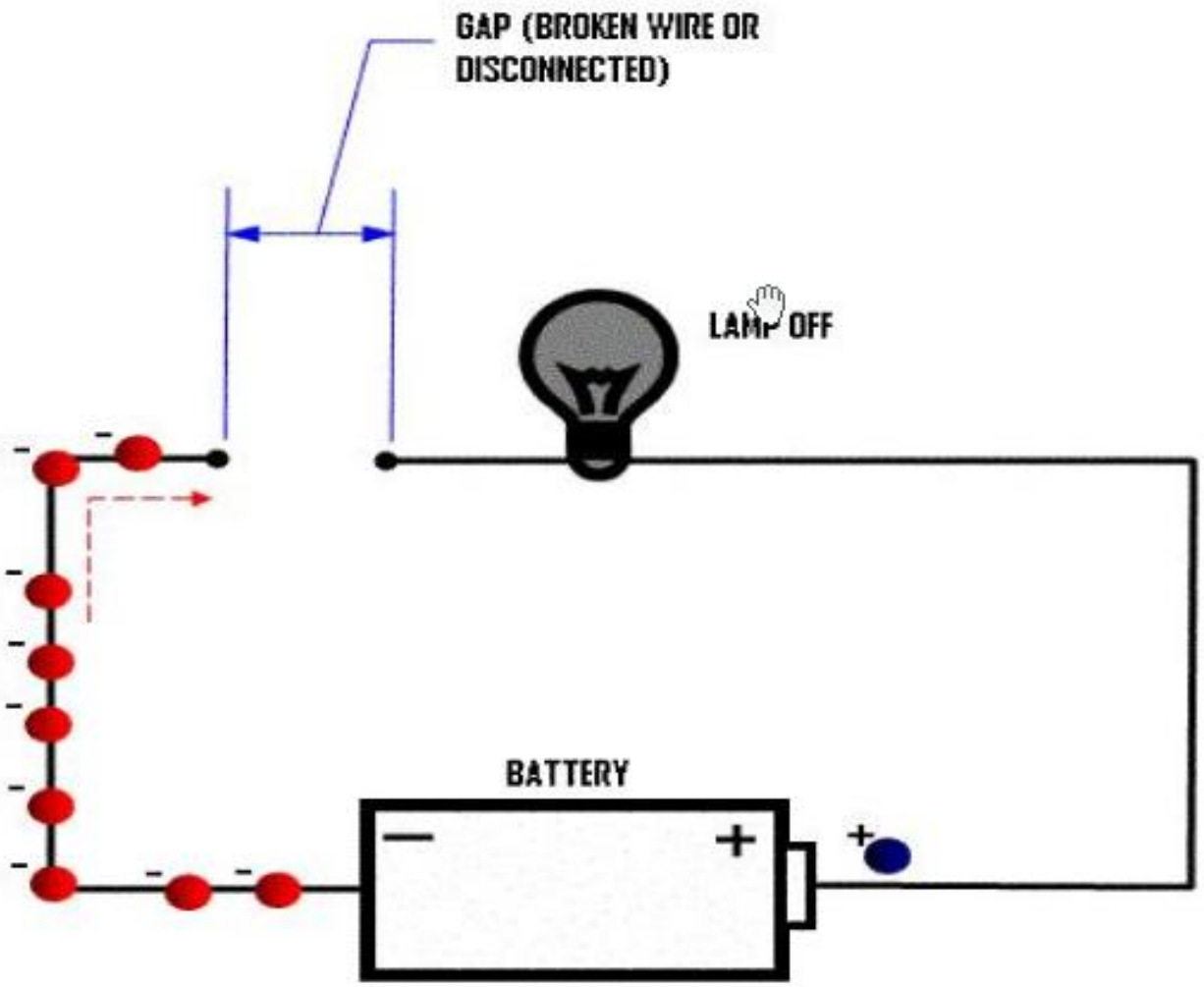
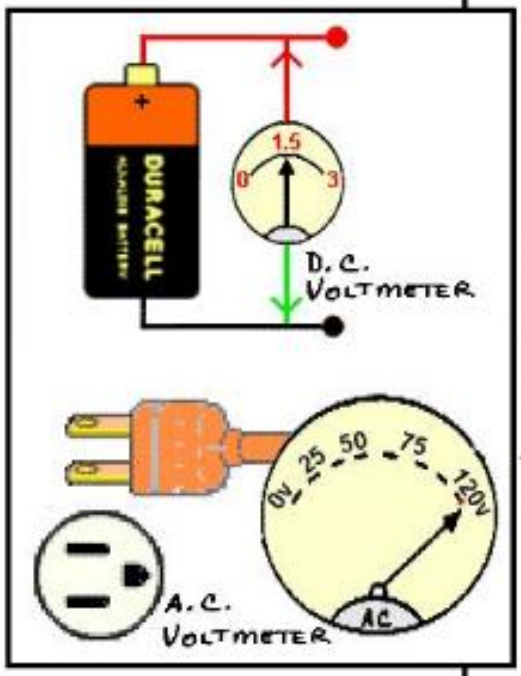
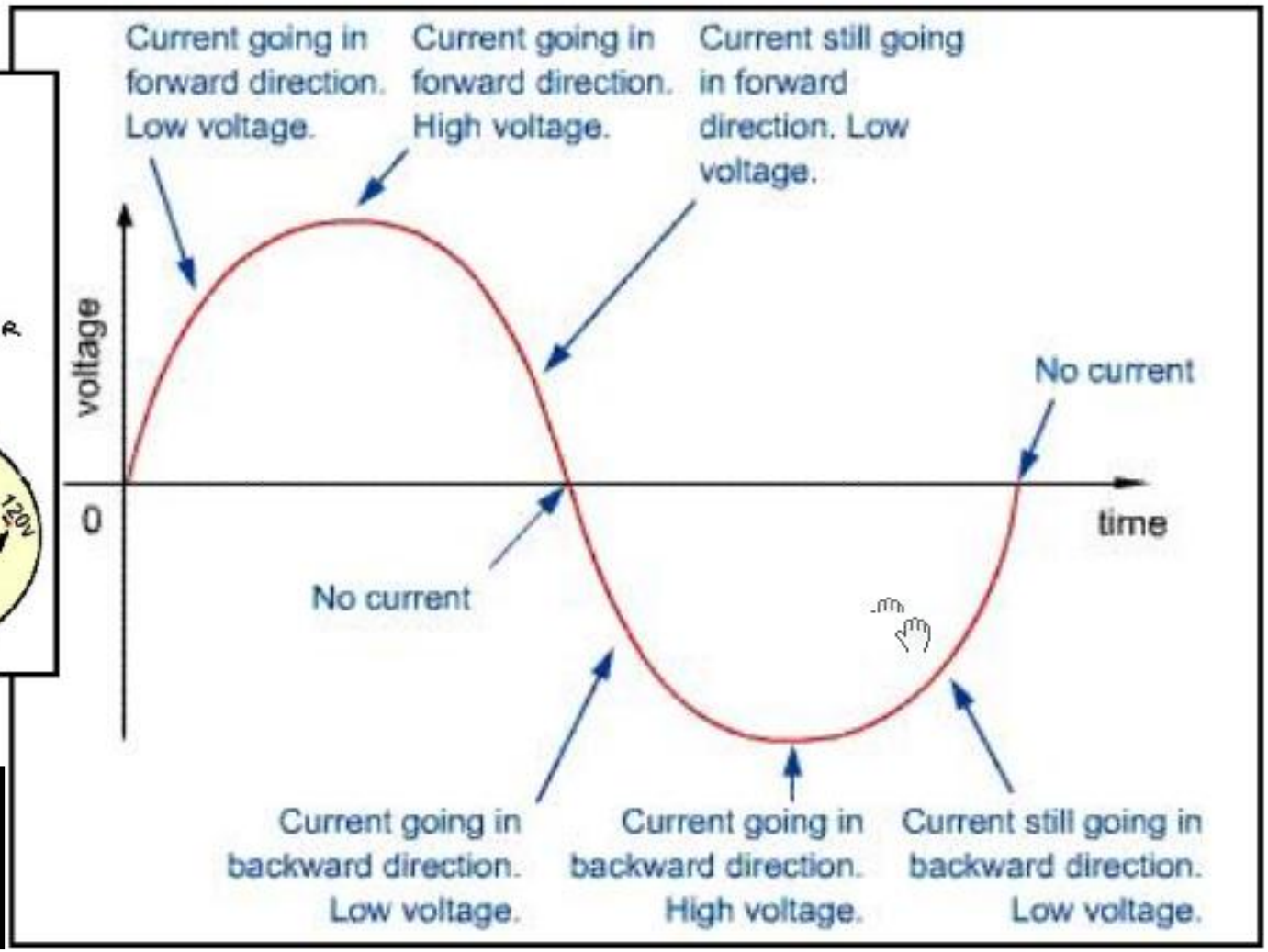
4. The unit for measuring <u>electrical current flow</u> is the _____.
(6.24 x 10^{18} electrons/sec = 1 amp)



Volt
Ampere
Ohm

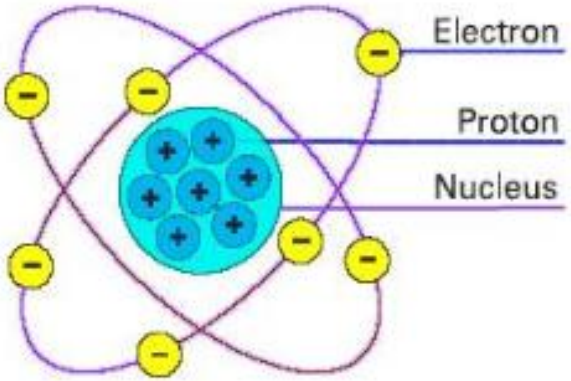
5. _____ current flows in one direction while _____ current changes direction.

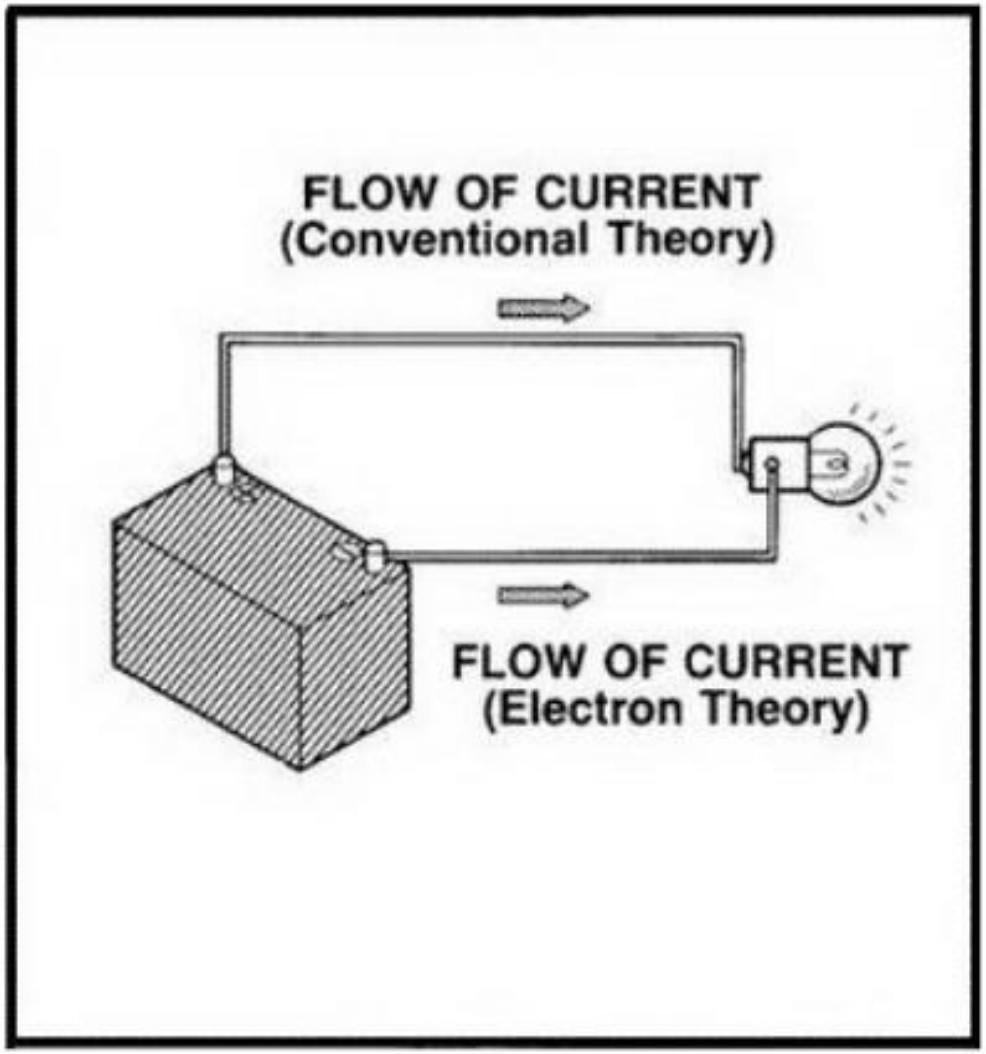




Alternating, Direct
Direct, Alternating
Wavy & Straight

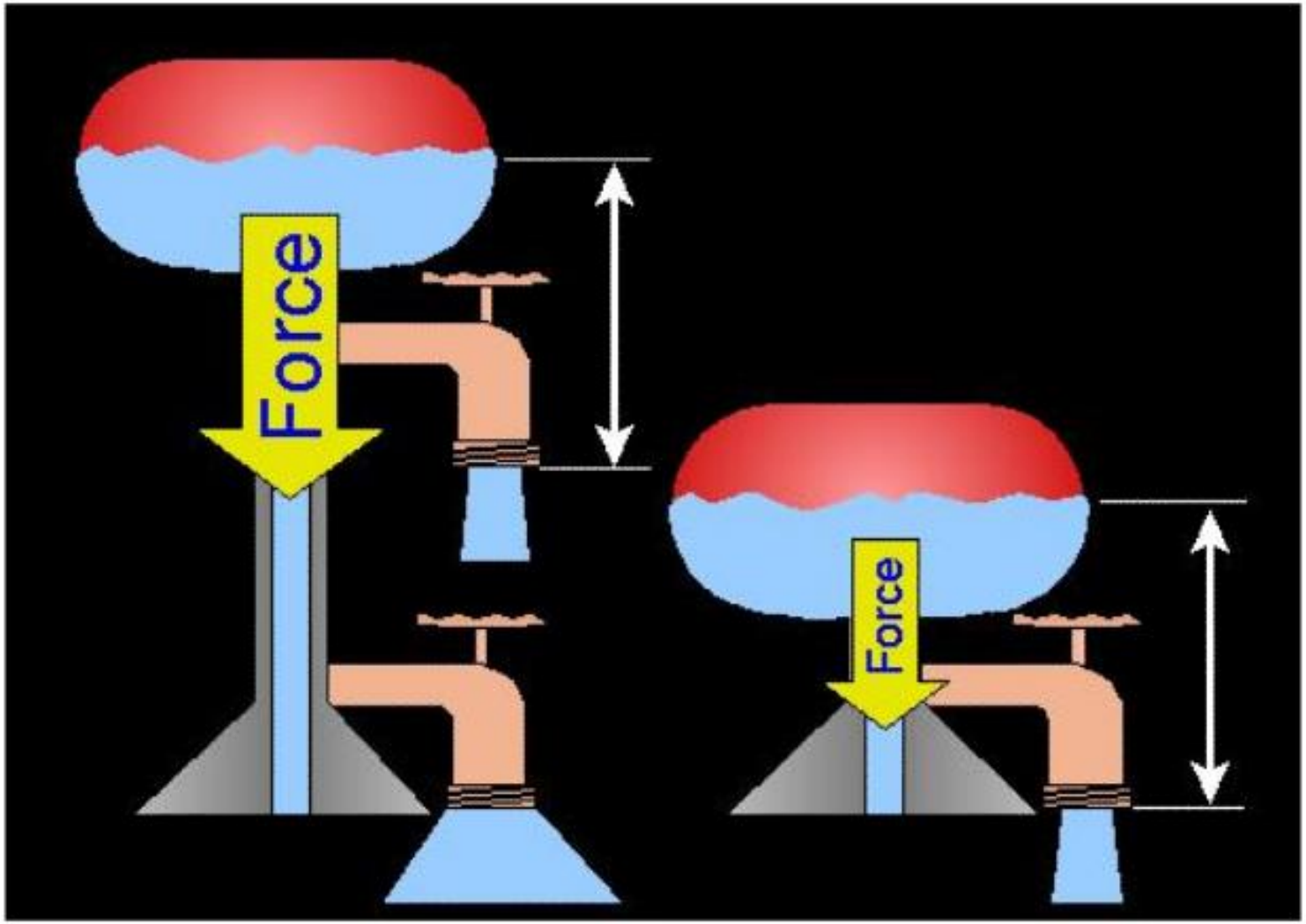
6. _____ *theory states that current flows from + to -.*
_____ *says its from – to +.*





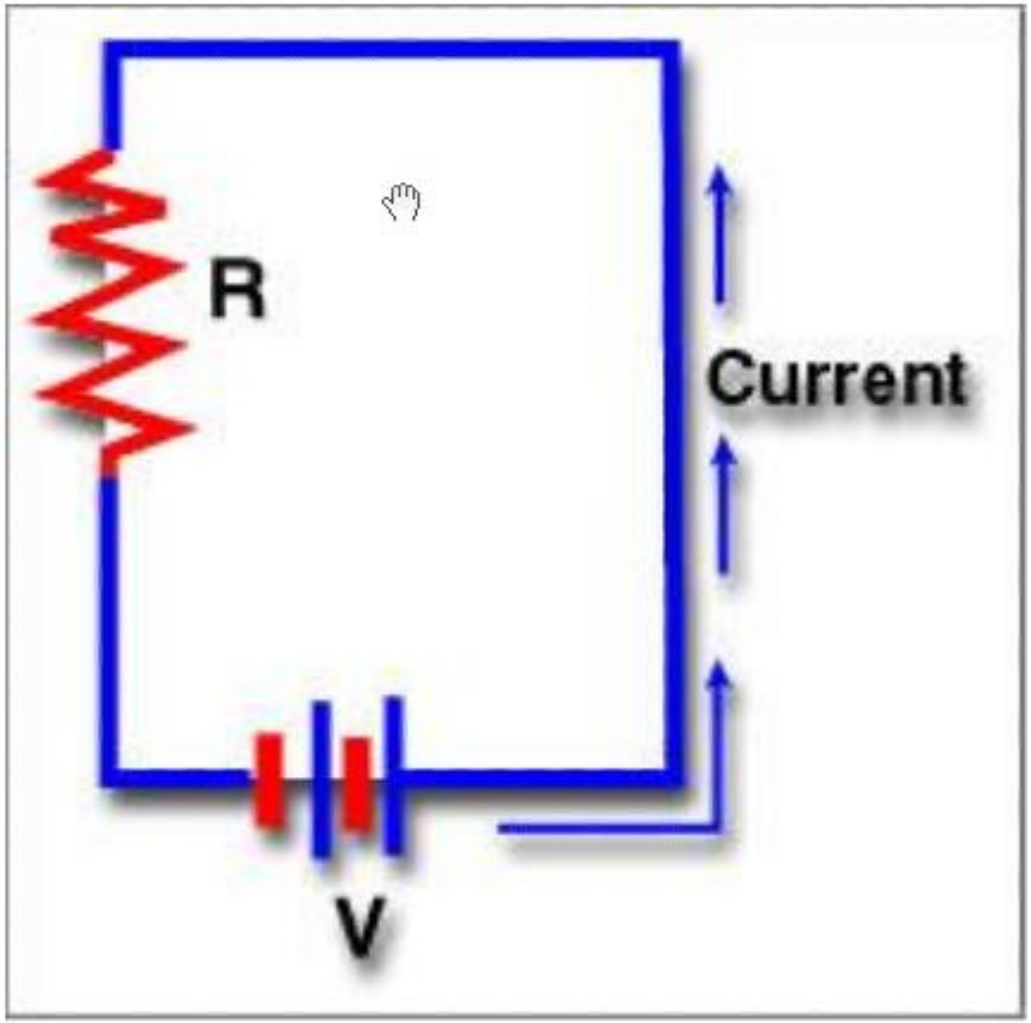
Electron, Conventional
Metric, American
Conventional, Electron

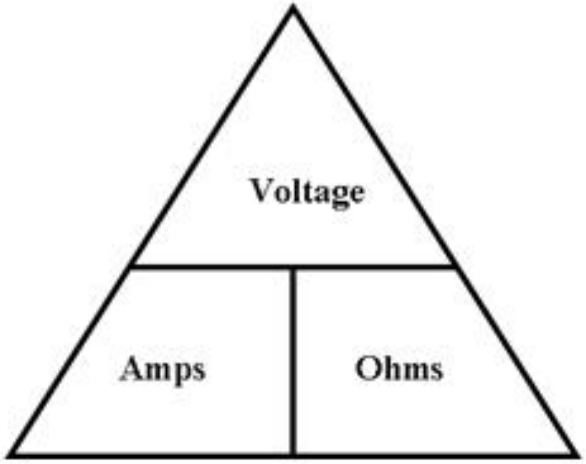
7. _____ (EMF) is the electrical pressure or force that causes electrons to flow.



Voltage
Amperage
Resistance

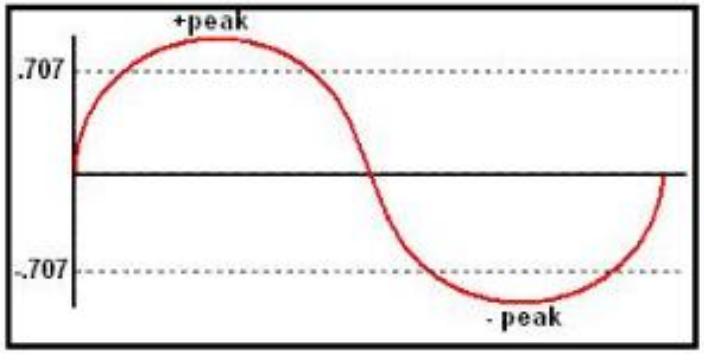
8. _____ to flow is measured in Ohms and abbreviated with the Greek letter omega. Ω

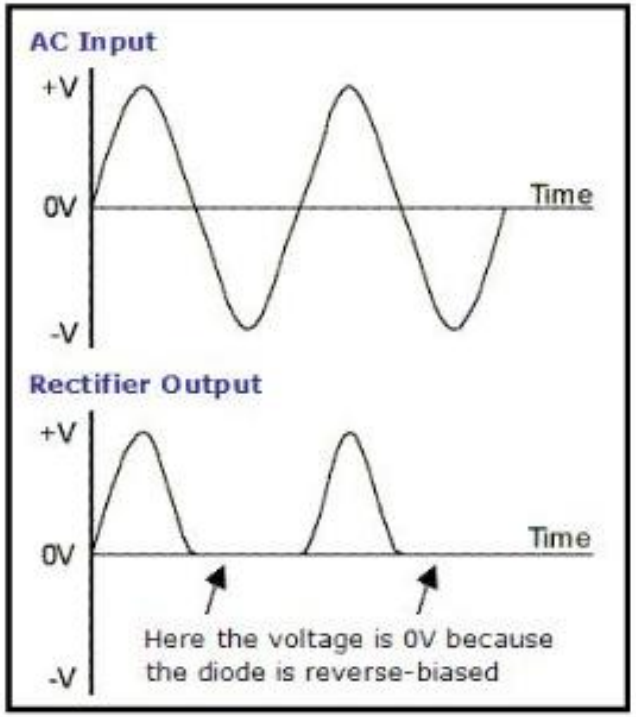


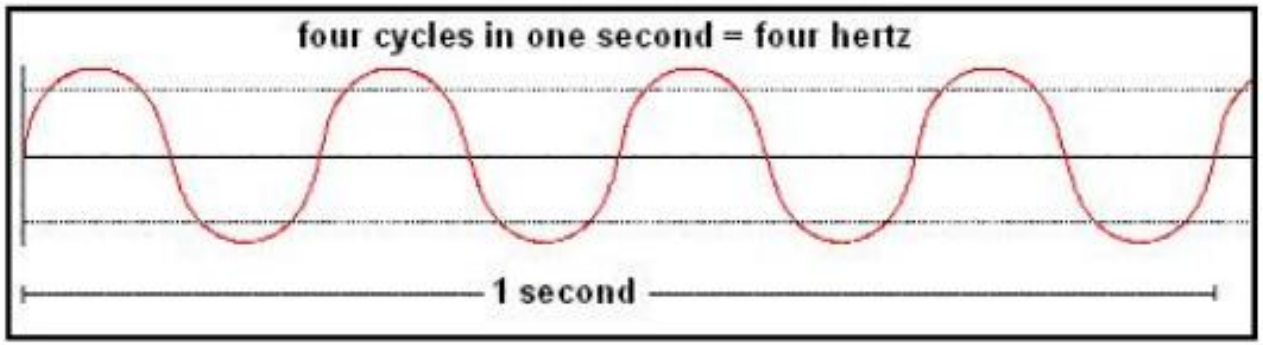


Voltage
Amperage
Resistance

9. When graphed on a lab scope, DC voltage produces a _____ line and AC produces a _____ wave.

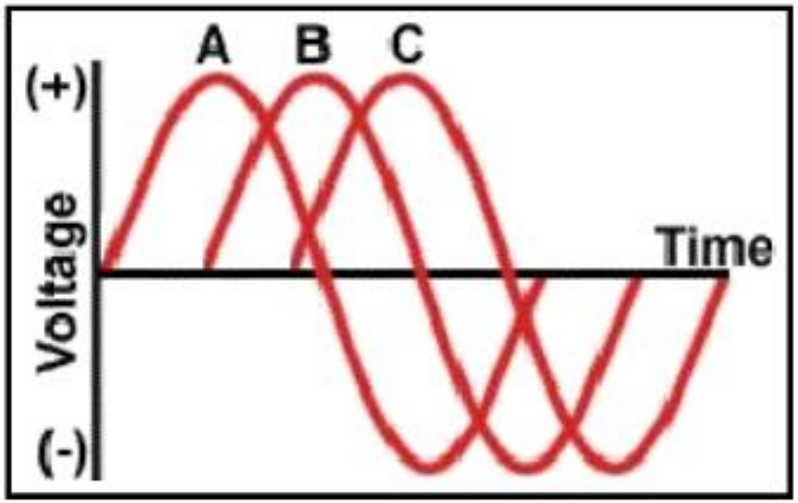


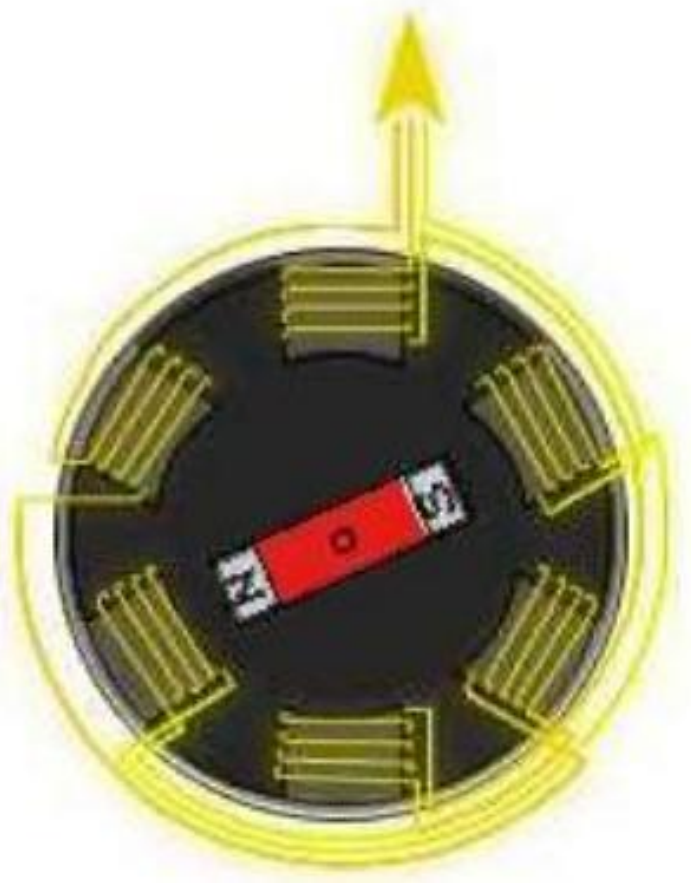




Flat, Sine
Flat, Tangent
Sine, Flat

10. *If a circuit has 2 or more voltage pulses, but each has its own sine wave that begins and ends its cycle at a different time, the waves are "_____ _____ _____"*

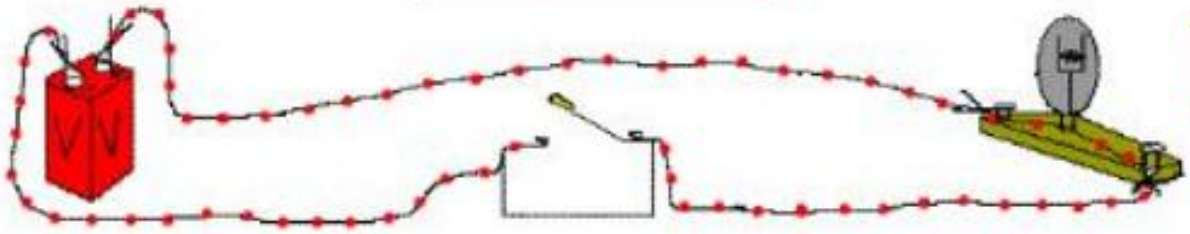




Out of Touch
Out of Phase
Out of Line

11. A complete circuit is said to be closed and has _____.
An open circuit is incomplete.

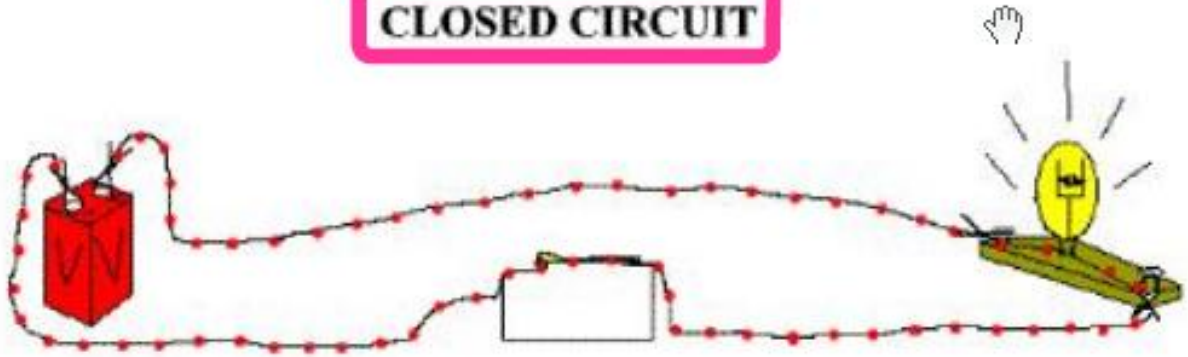
OPEN CIRCUIT



No Continuity

Continuity
Ambiguity
Immunity

CLOSED CIRCUIT



Continuity

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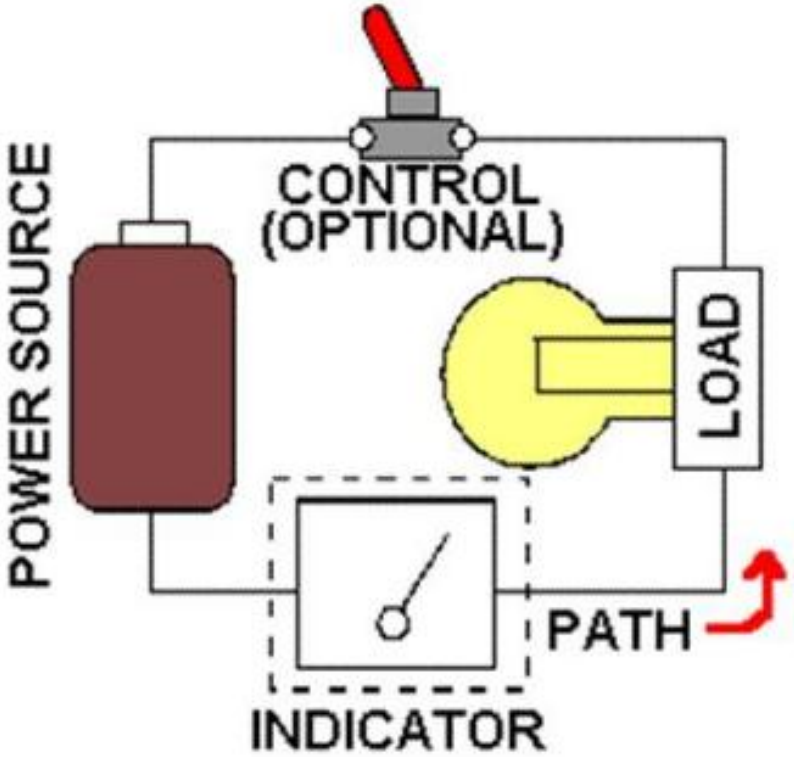
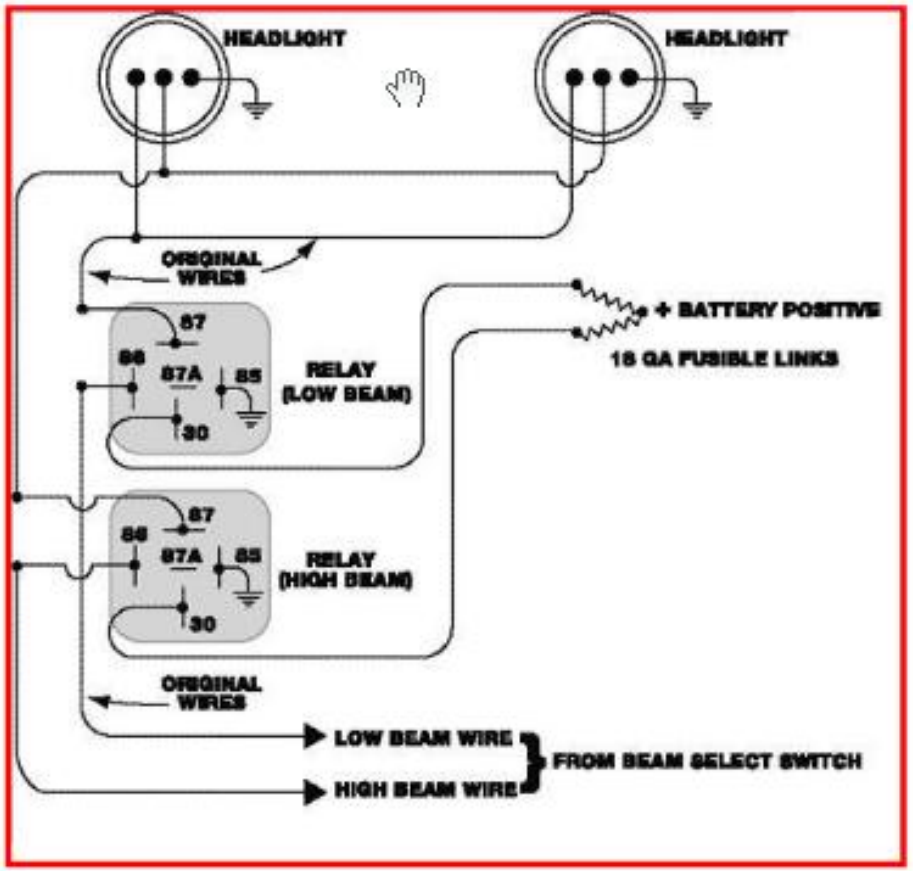
12. Circuit components that use power are said to put a _____ on the circuit or consume electricity.



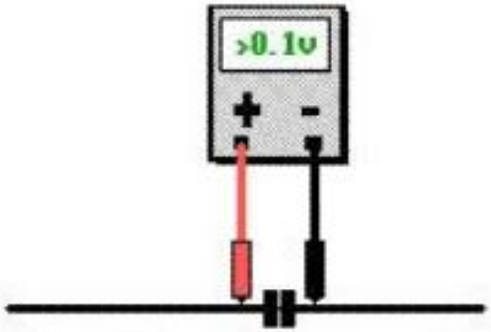
The "load" or "consumer" name the circuit.



Toad
Load
Road

13. Measuring _____ _____ tells how much energy is being consumed or used by the load.

VOLTAGE DROP



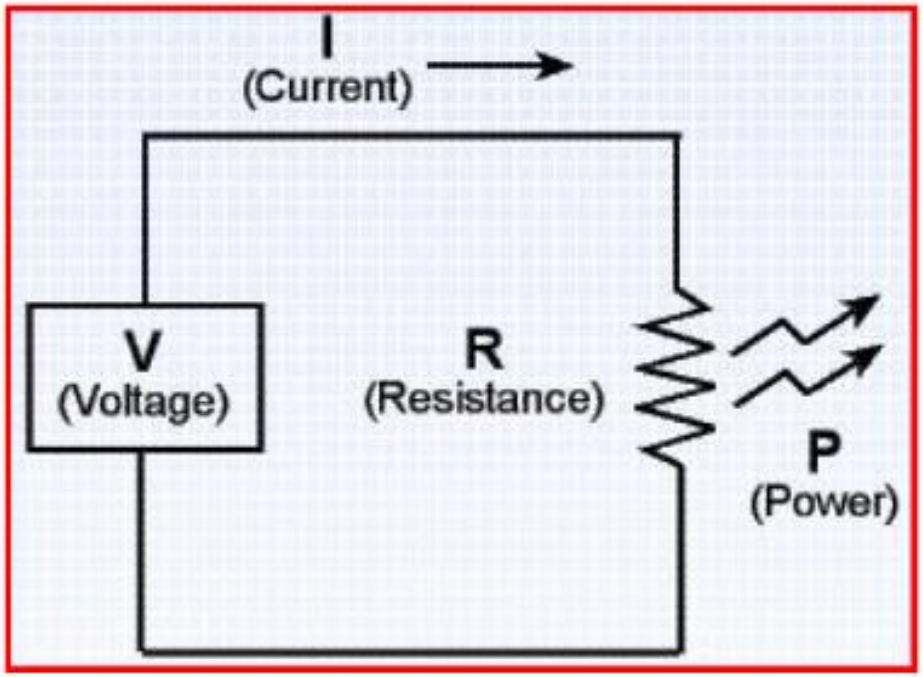
Check for voltage drop across the connector
A good reading is less than 0.1 volt

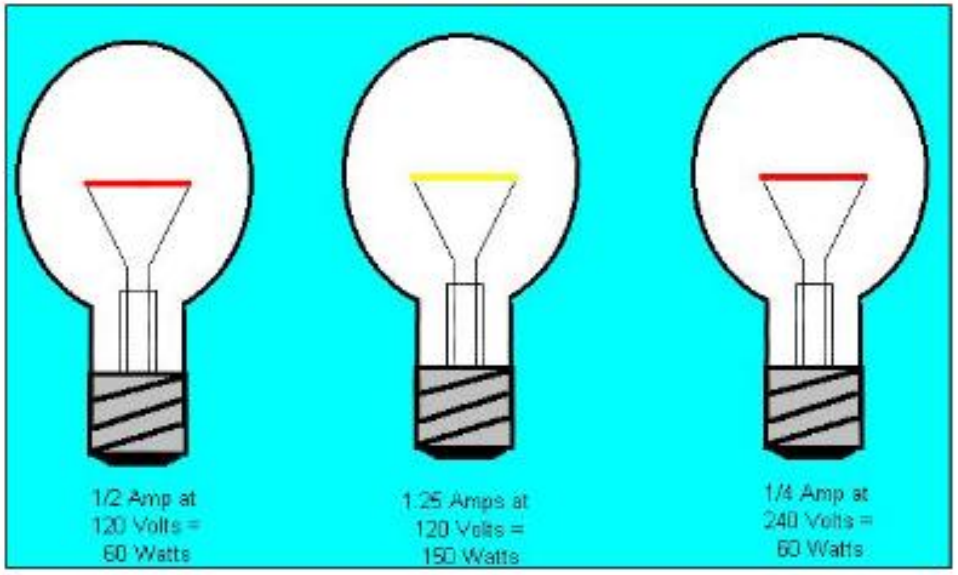
Voltage Drop
Voltage Flow
Voltage Level

ATASA 5th Basics of Electrical Systems

14. Electrical power usage is expressed in _____.
P = I x E or W = A x V

Voltage
Amperage
Wattage





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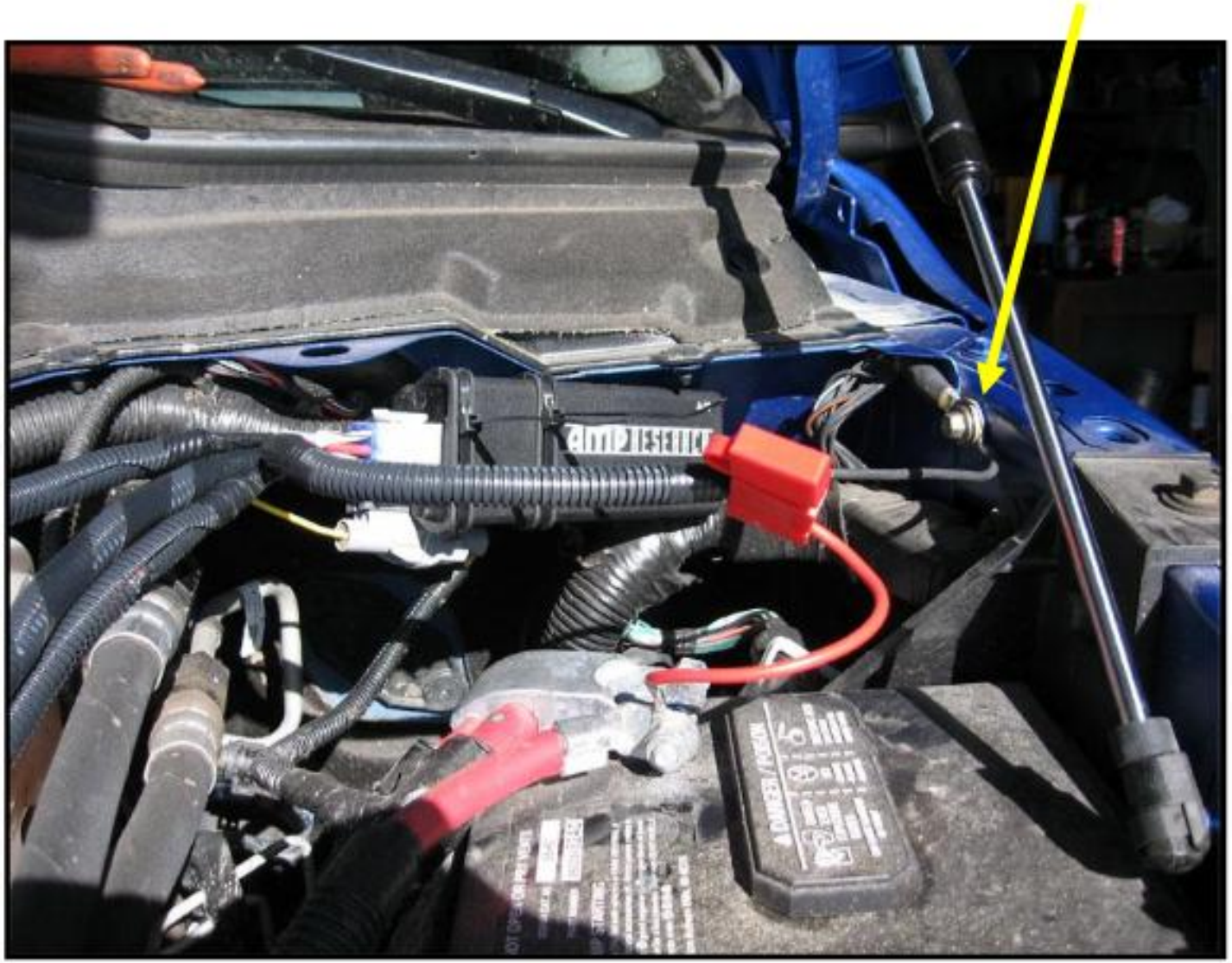
15. The vehicle chassis forms the _____ path for circuits through body, frame & engine block.

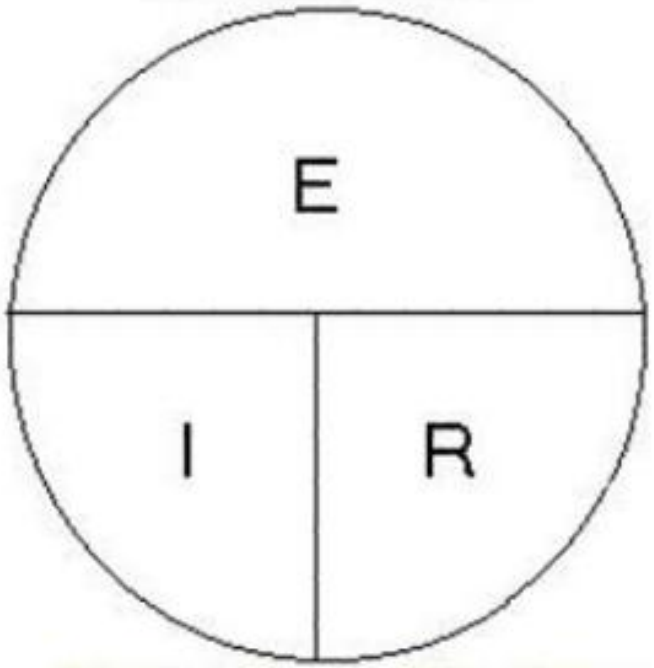


Supply
Ground
Necessary

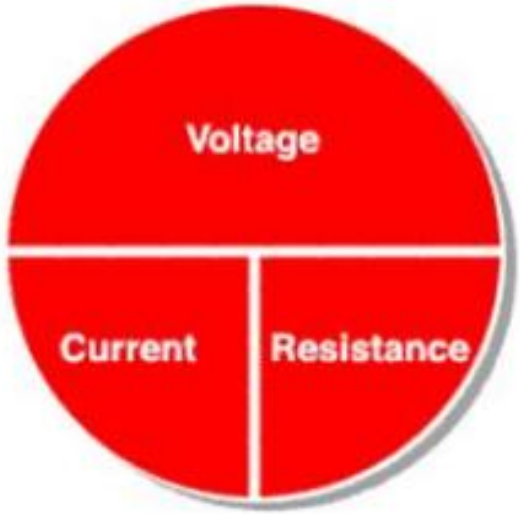
16. _____ _____ is the mathematical relationship between volts, ohms, & amps in every circuit.

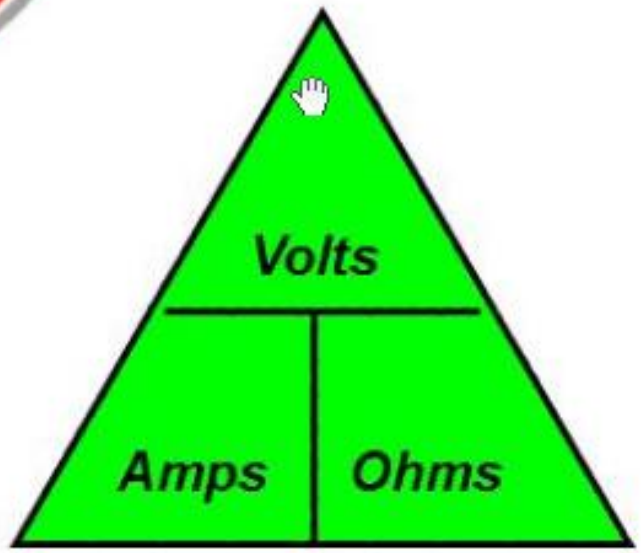
"It takes 1 volt of electrical pressure to push 1 ampere of current through 1 ohm of resistance."

Watt's Law
Ohm's Law
Pascal's Law

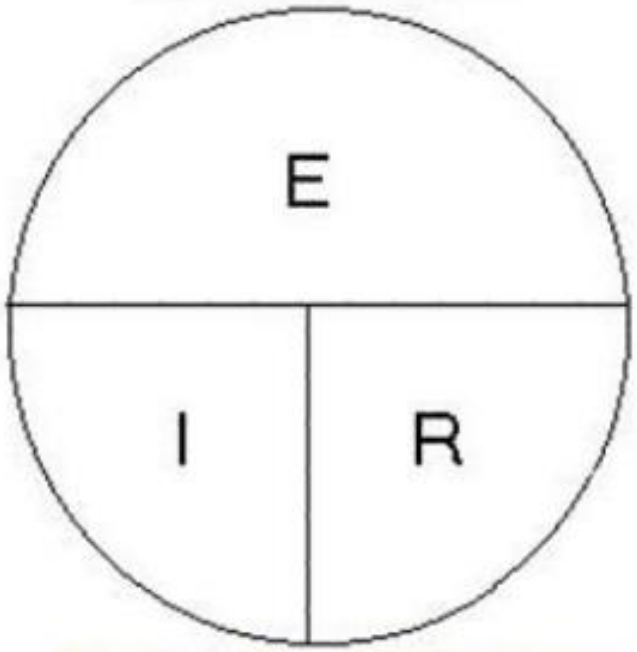


Ohm's Law E=I/R where
E=volts, I=amps and R=ohms

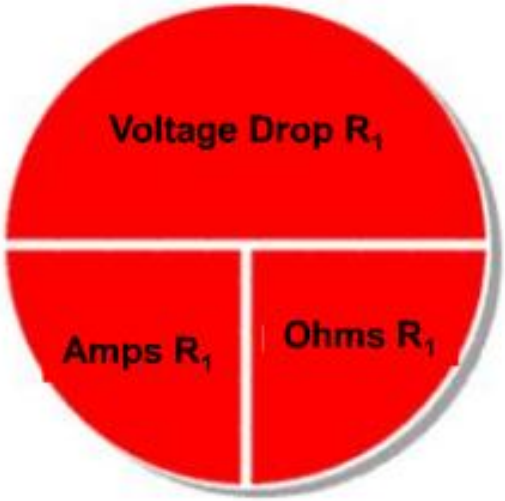


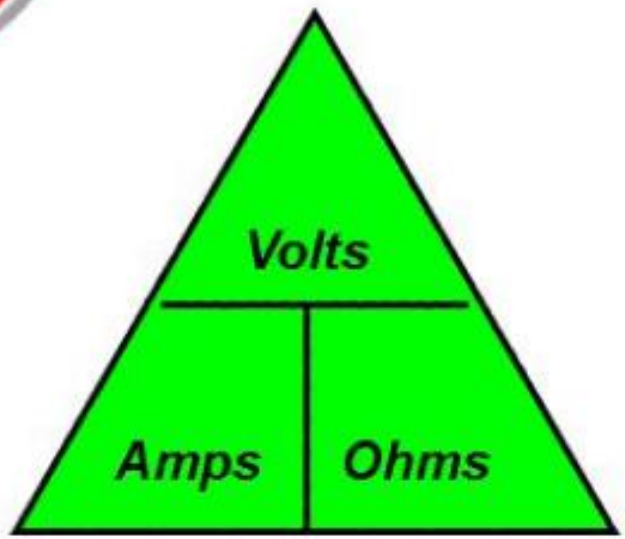


17. Voltage drop can be calculated using Ohm's law. True or False

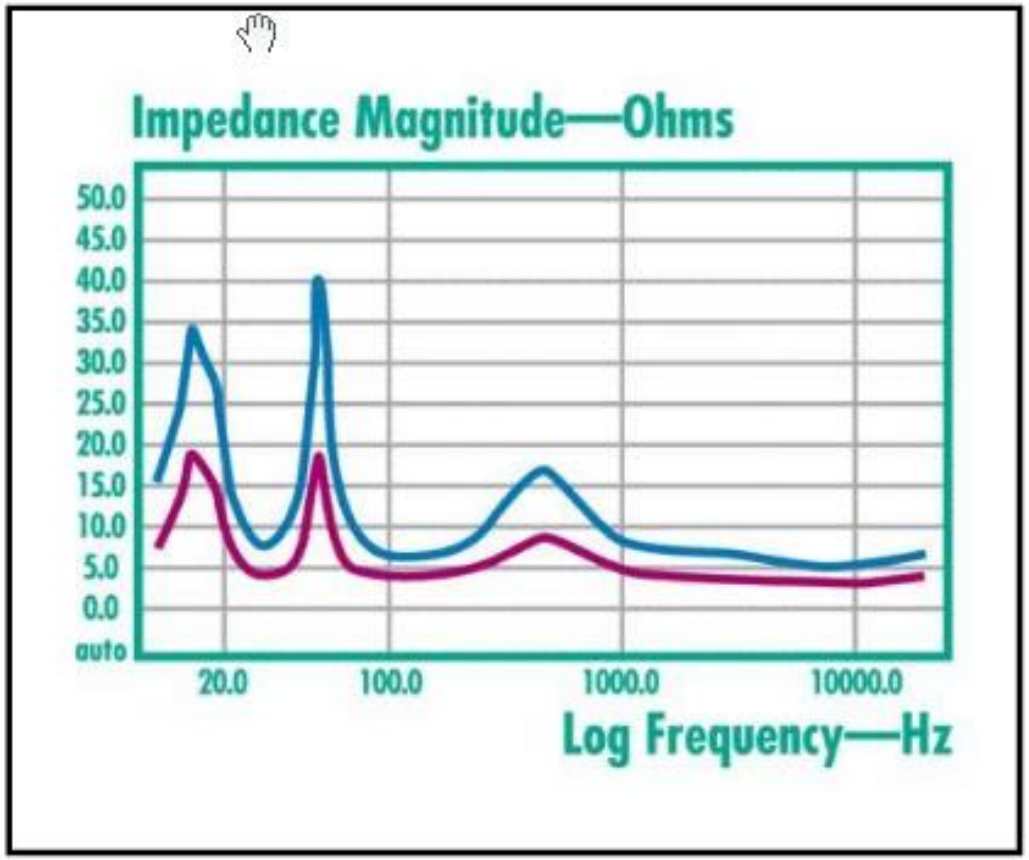


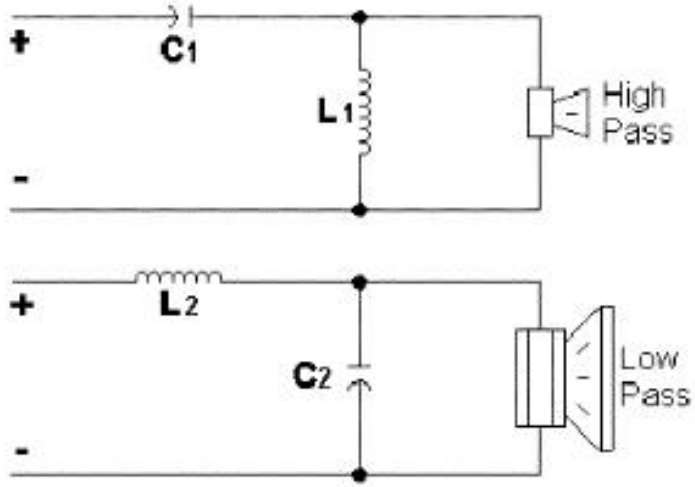
Ohm's Law E=I/R where
E=volts, I=amps and R=ohms





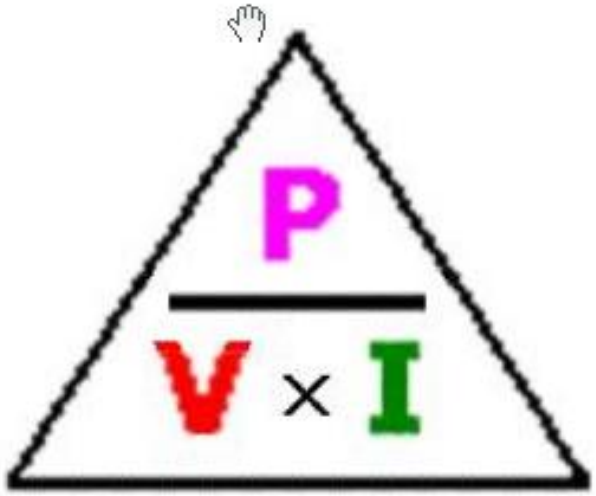
18. In AC circuits, the actual resistance of a load is called its _____.





Impedance
Amperage
Resistance

19. _____ law is the name given to the formula that calculates electrical power used by a load.



Watt's Law
Ohm's Law
Pascal's Law

http://www.sengpielaudio.com/calculator-ohm.htm

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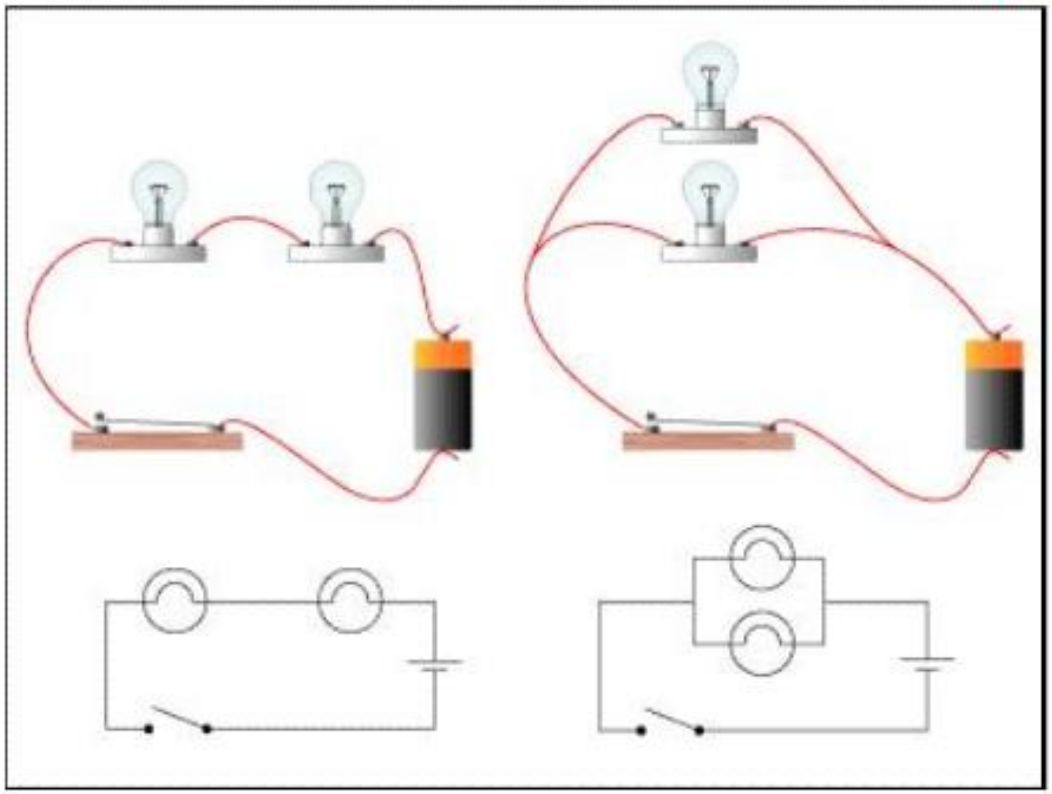
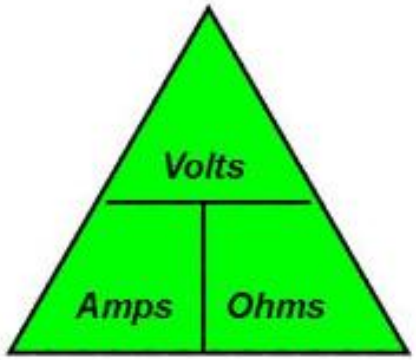
20. Circuits must have consumers or _____, power _____, and _____ providing paths along with controllers & protection devices properly located to perform desired operations.

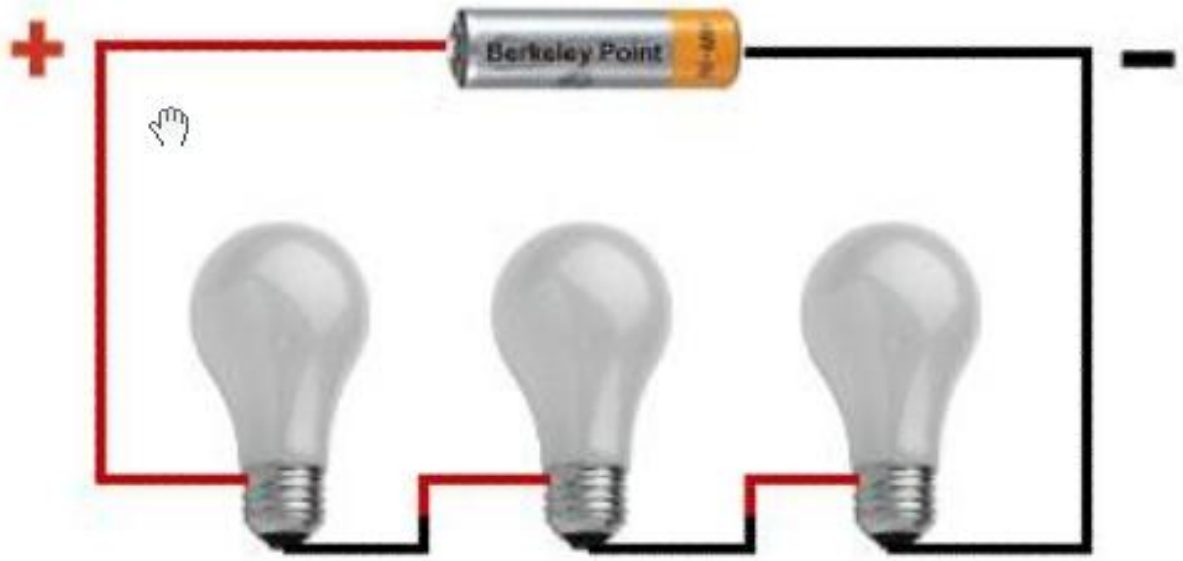
Consumer has the Resistance
Source has the Voltage
Conductive Path carries the Amperage



Loads, Sources, Conductors
Pascals, Ohms, Volts
Wires, Fuses, Batteries



21. In a _____ circuit, the voltage _____ at each load, the _____ is the same throughout the circuit, and the total resistance is the sum of all the individual resistances.

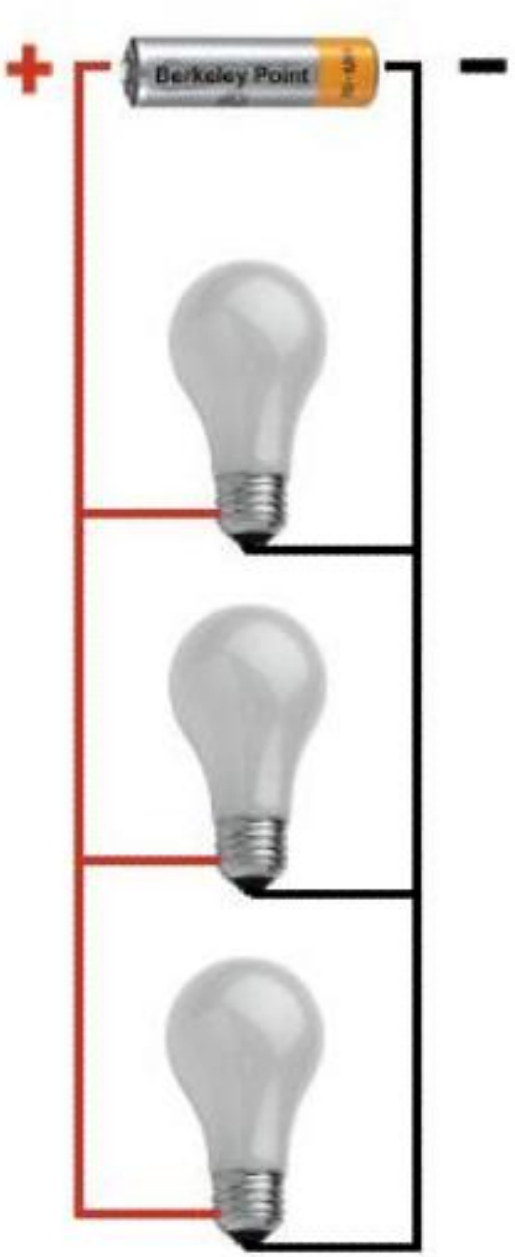


Series, Drops, Current
Series, Increases, Resistance
Series, Drops, Resistance

Note: The sum of the individual voltage drops must equal the source voltage.

22. In a _____ circuit, the voltage applied to each leg is the same, current through each leg will be different if the resistances values are different, the sum of current from each leg

Series
Parallel
Series-Parallel



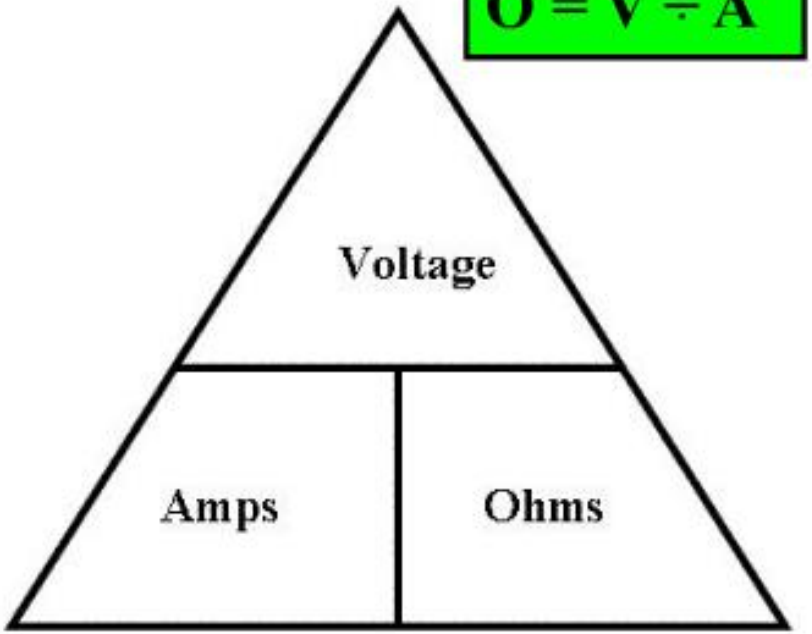
23. In a series-parallel circuit, the total _____ is equal to the voltage divided by the total Ω.

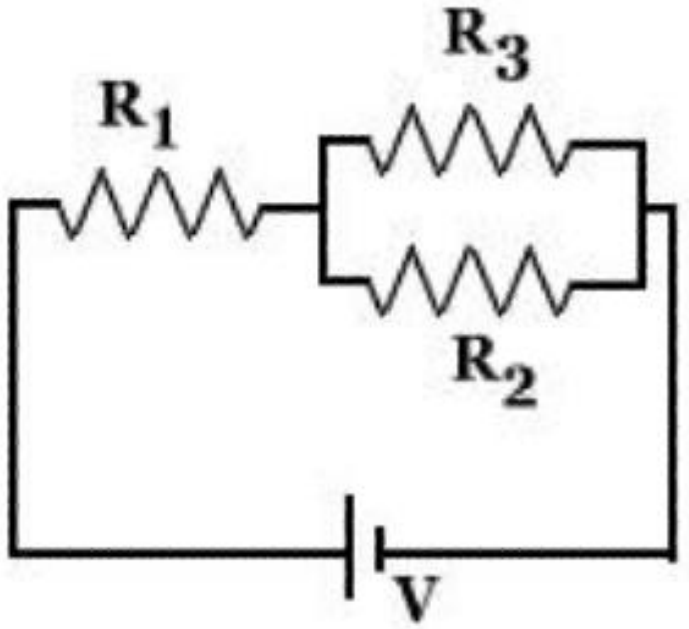
Voltage
Amperage
Ohms

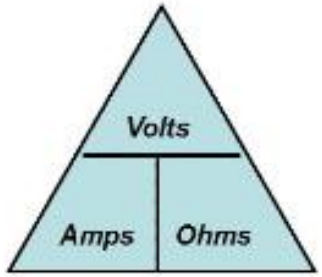
$V = A \times O$

$A = V \div O$

$O = V \div A$

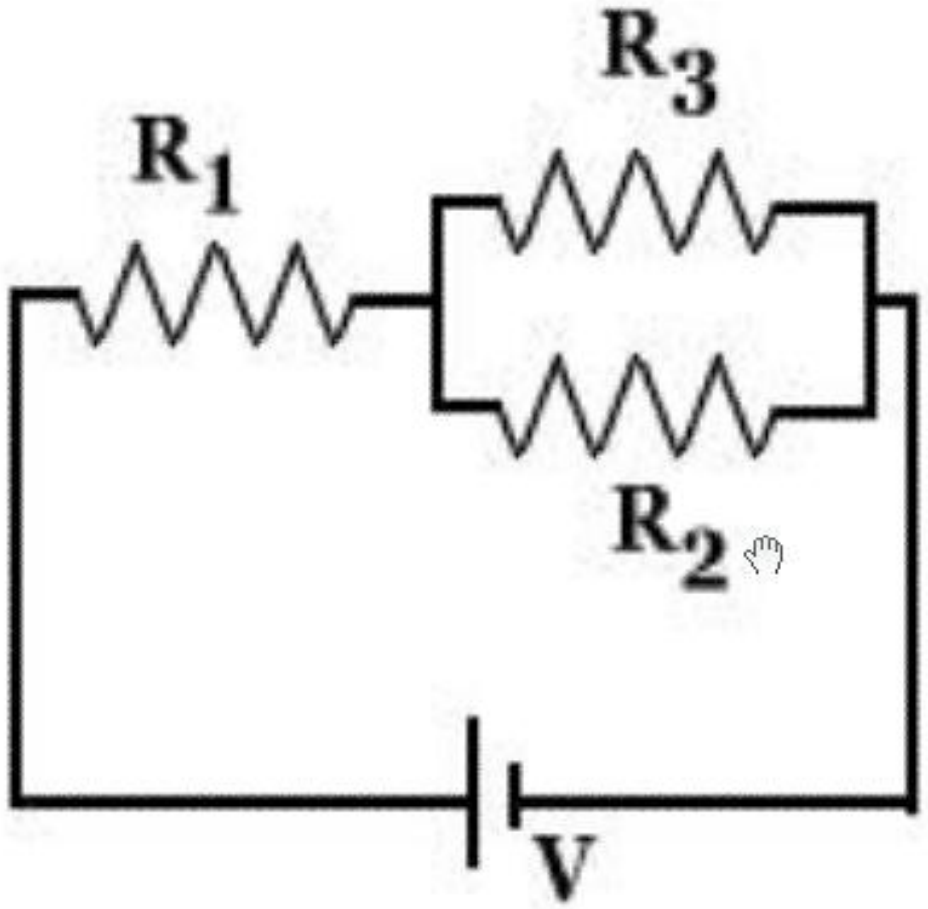






24. When using Ohm's law to calculate series-parallel values, determine all the values for the _____ circuit(s) first. Then treat it as a series circuit for the rest of the math operations.

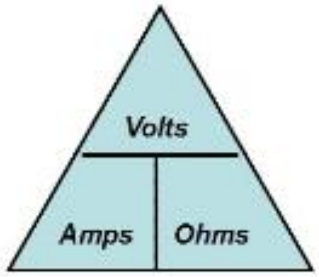
Series
Parallel
Series-Parallel



$V = A \times O$

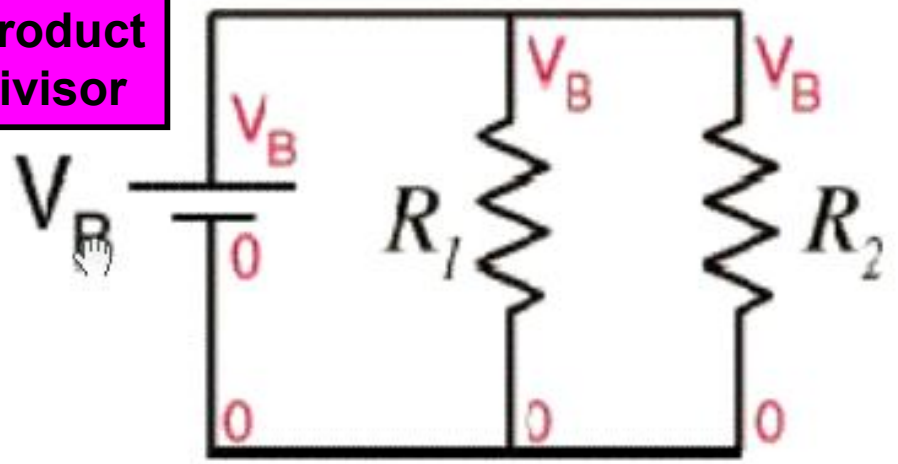
$A = V \div O$

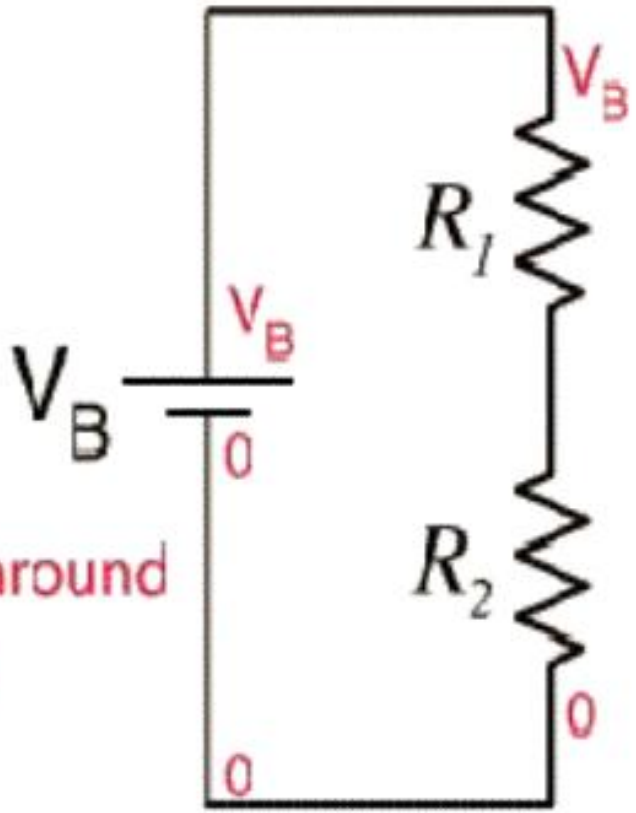
$O = V \div A$



25. Kirchhoff's voltage law states that the _____ of the voltage drops in a circuit equals the source.

Sum
Product
Divisor

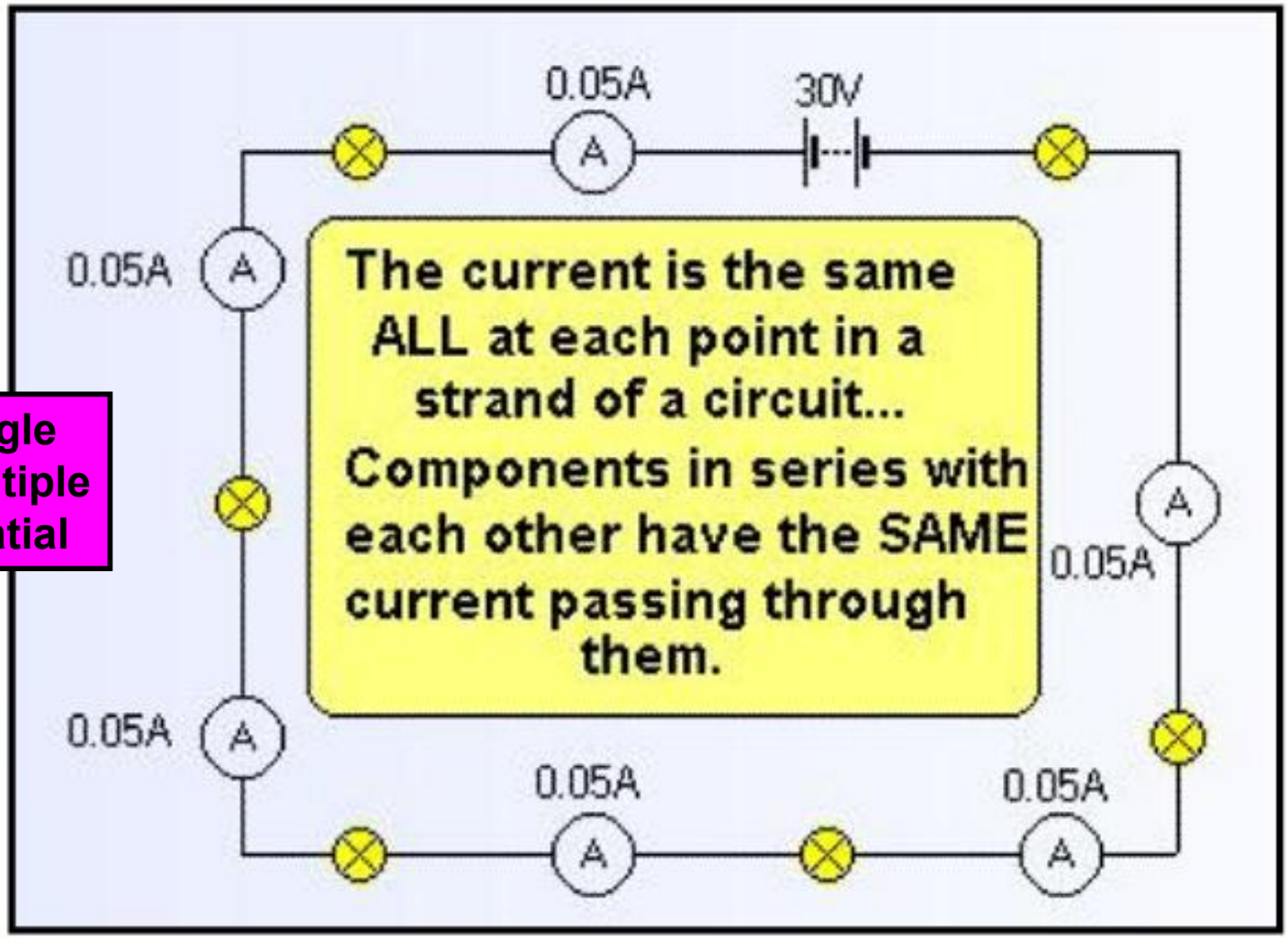




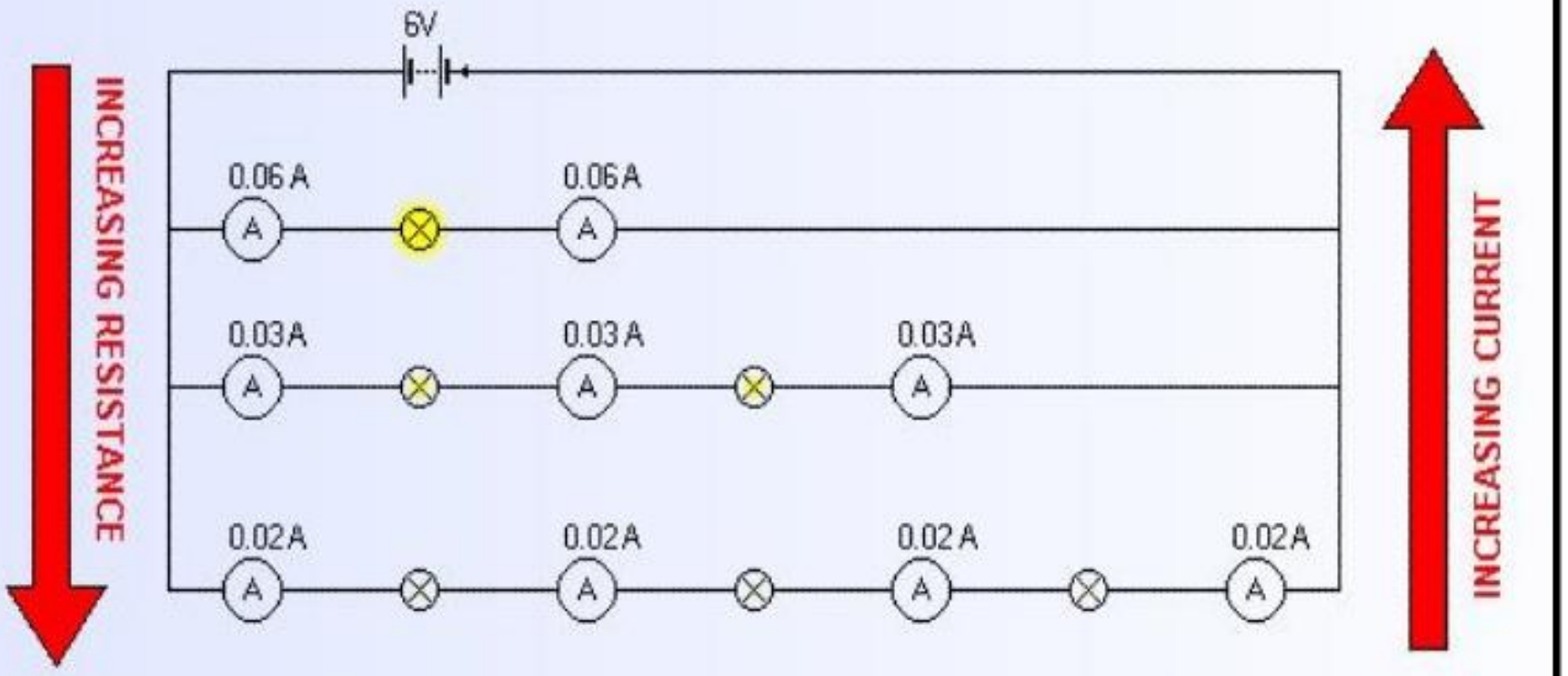
Voltage Law: The net voltage drop around any closed loop path must be zero.

For any path you follow around the circuit, the sum of the voltages rises (like batteries) must equal the sum of the voltage drops. Voltage represents energy per unit charge, and conservation of energy demands that energy is neither created nor destroyed.

26. Kirchhoff's amperage law states that at any _____ point in a circuit, the current arriving to that point is equal to the current leaving. *The sum of the branch amps flows equals total amps.*

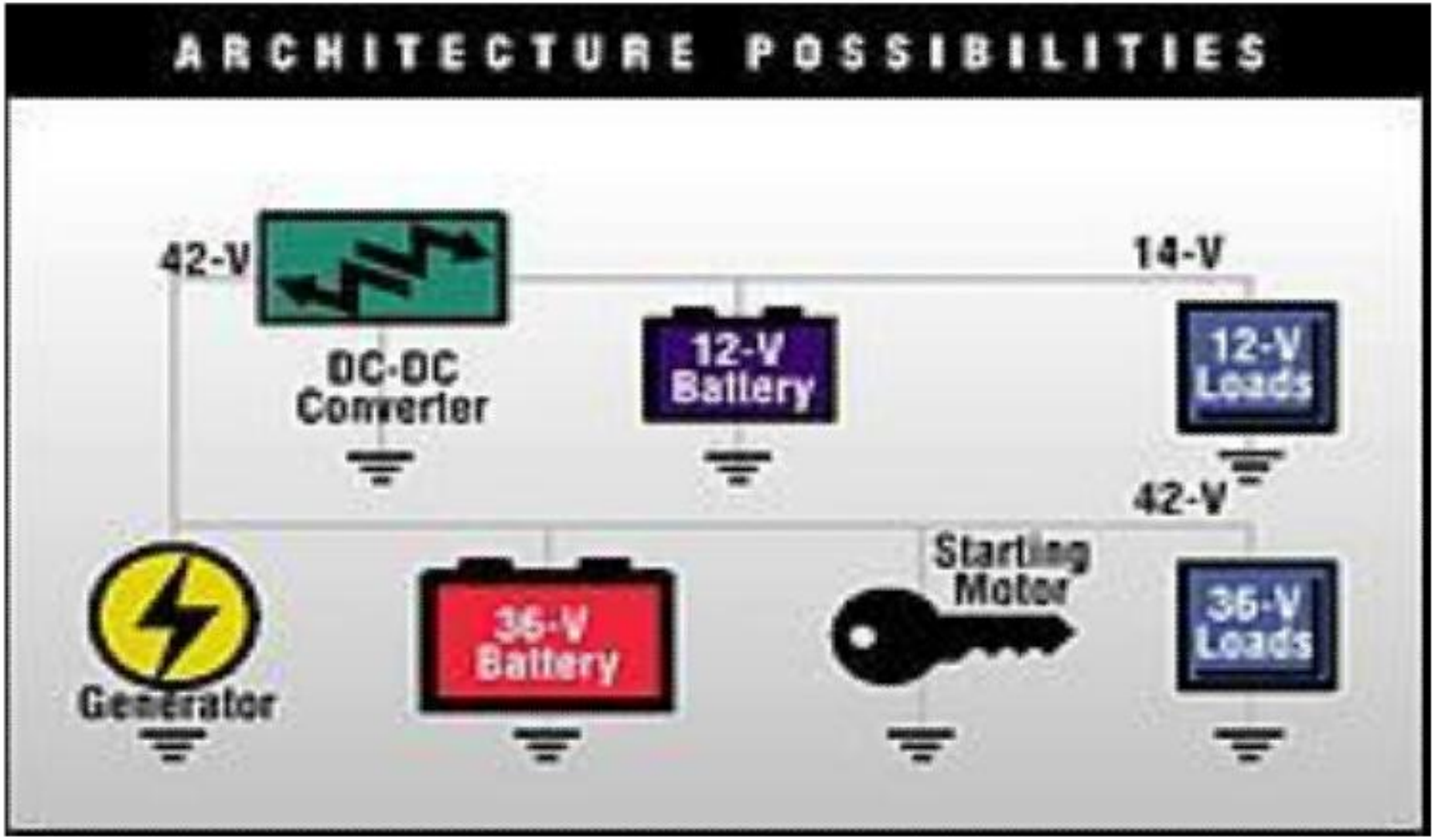


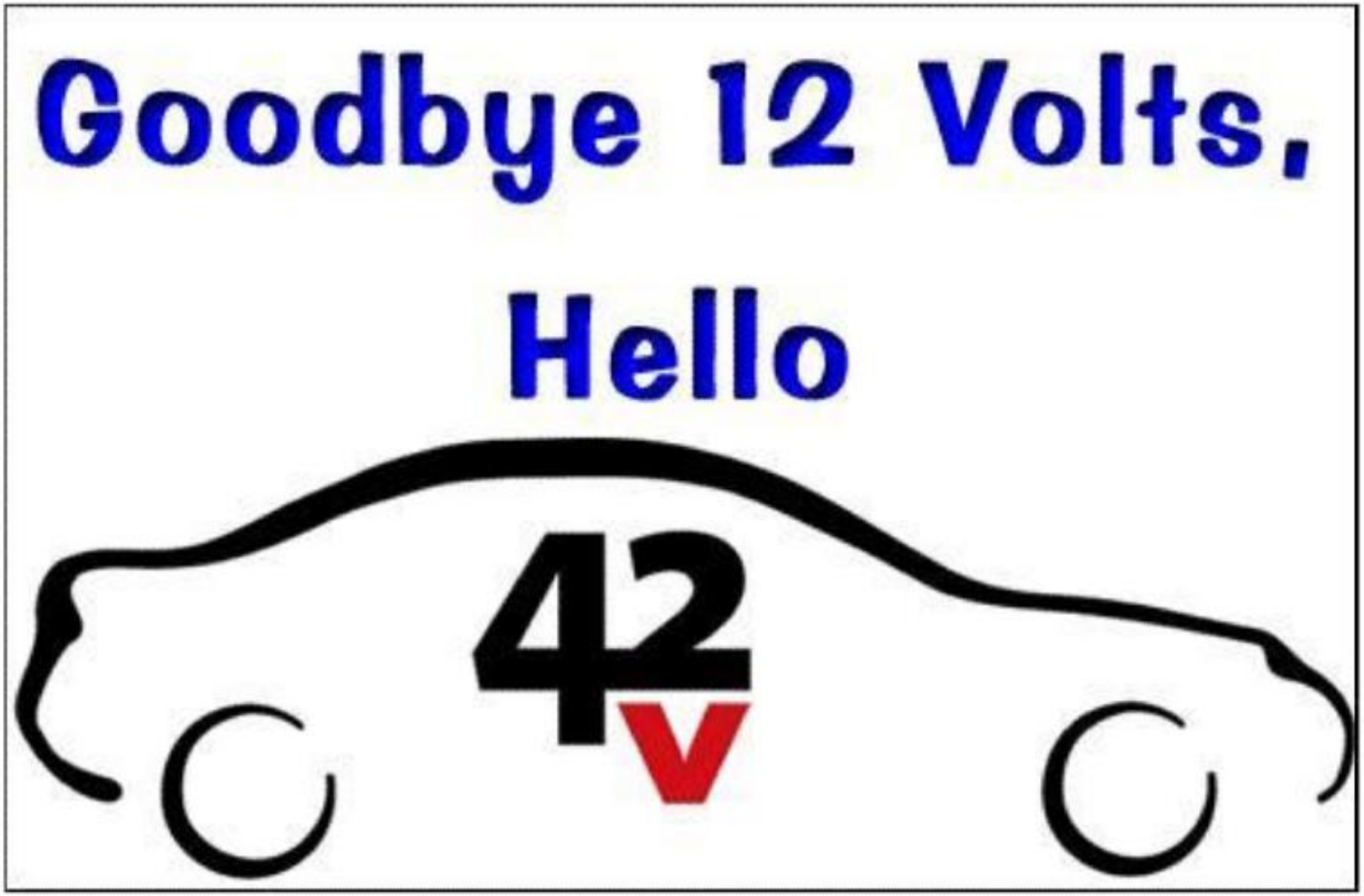
Single
Multiple
Spatial



- Note that the current in EACH STRAND of the circuit is the same along its whole length..... but if a strand has more bulbs (and therefore more resistance to the current) in it, the current within the strand is less.
- If the number of bulbs doubles the current halves.. if it triples the current drops to a third....

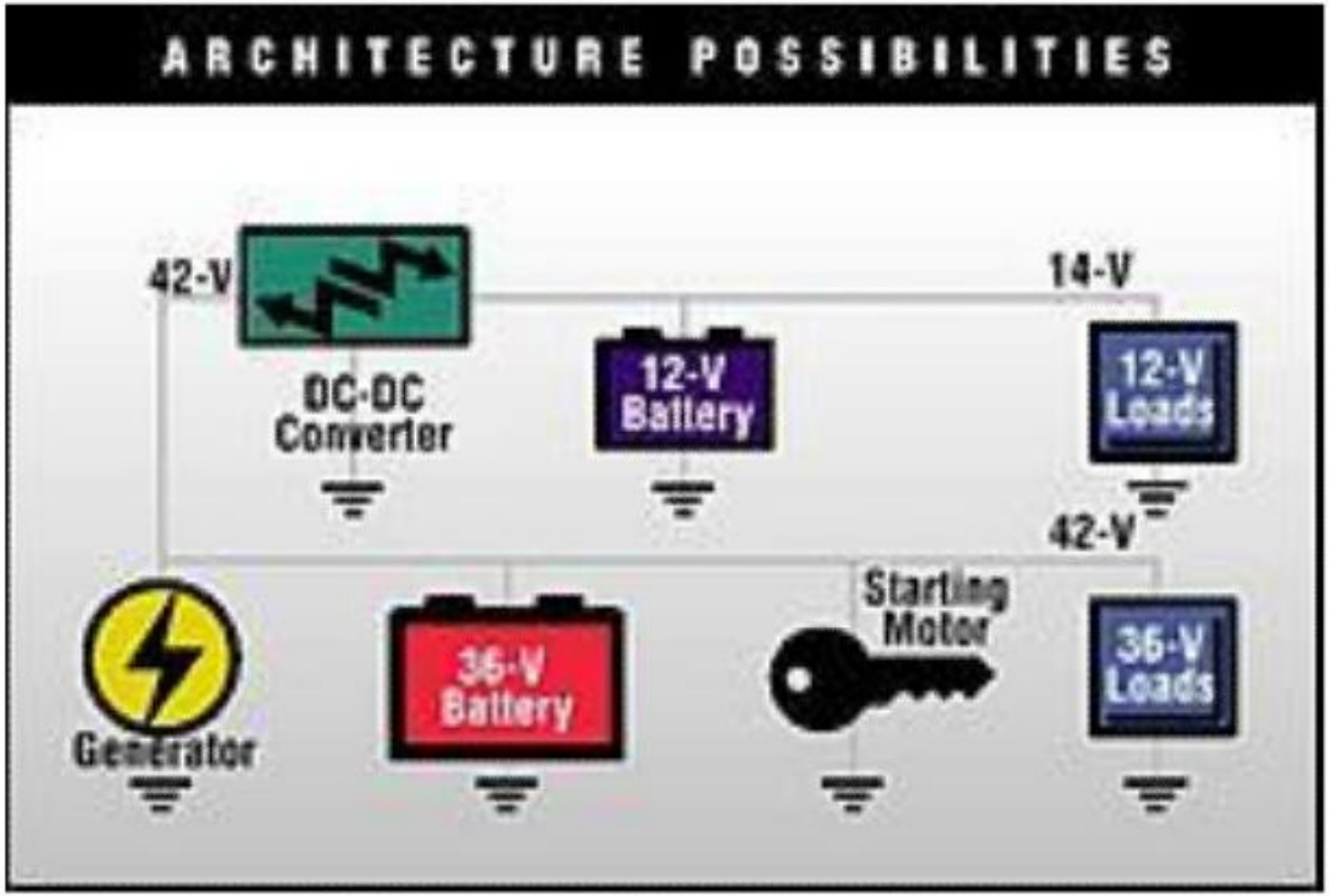
27. There are plans for ____ volt systems with a single 36 volt battery and dual voltage outputs.



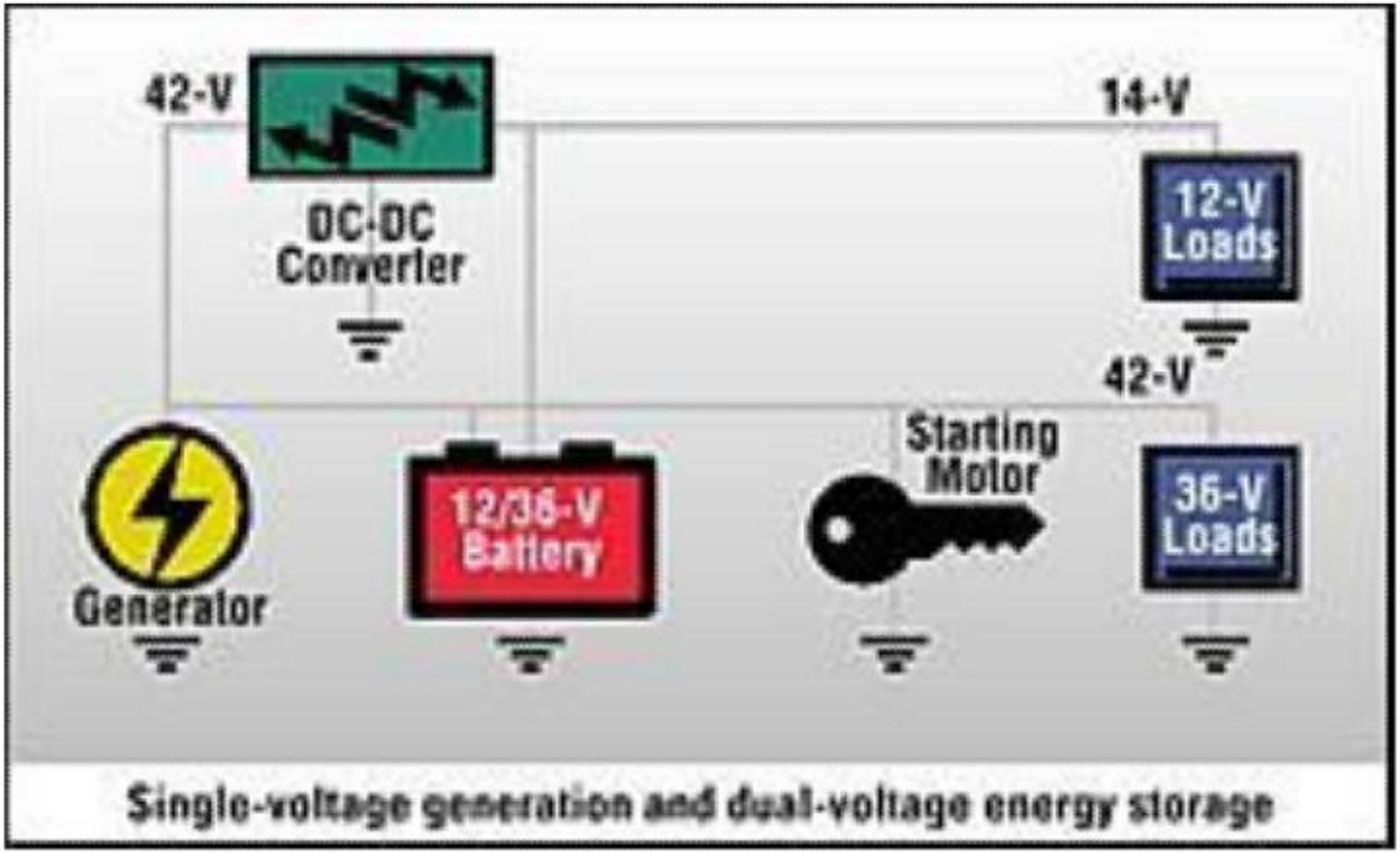

Goodbye 12 Volts,
Hello
42
V

ATASA 5th Basics of Electrical Systems

Single voltage generation and single voltage energy storage - a 42 volt alternator charges a 36 volt battery which services 36 volt loads, with a DC/DC converter used to charge a 12 volt battery that services 12 volt loads.

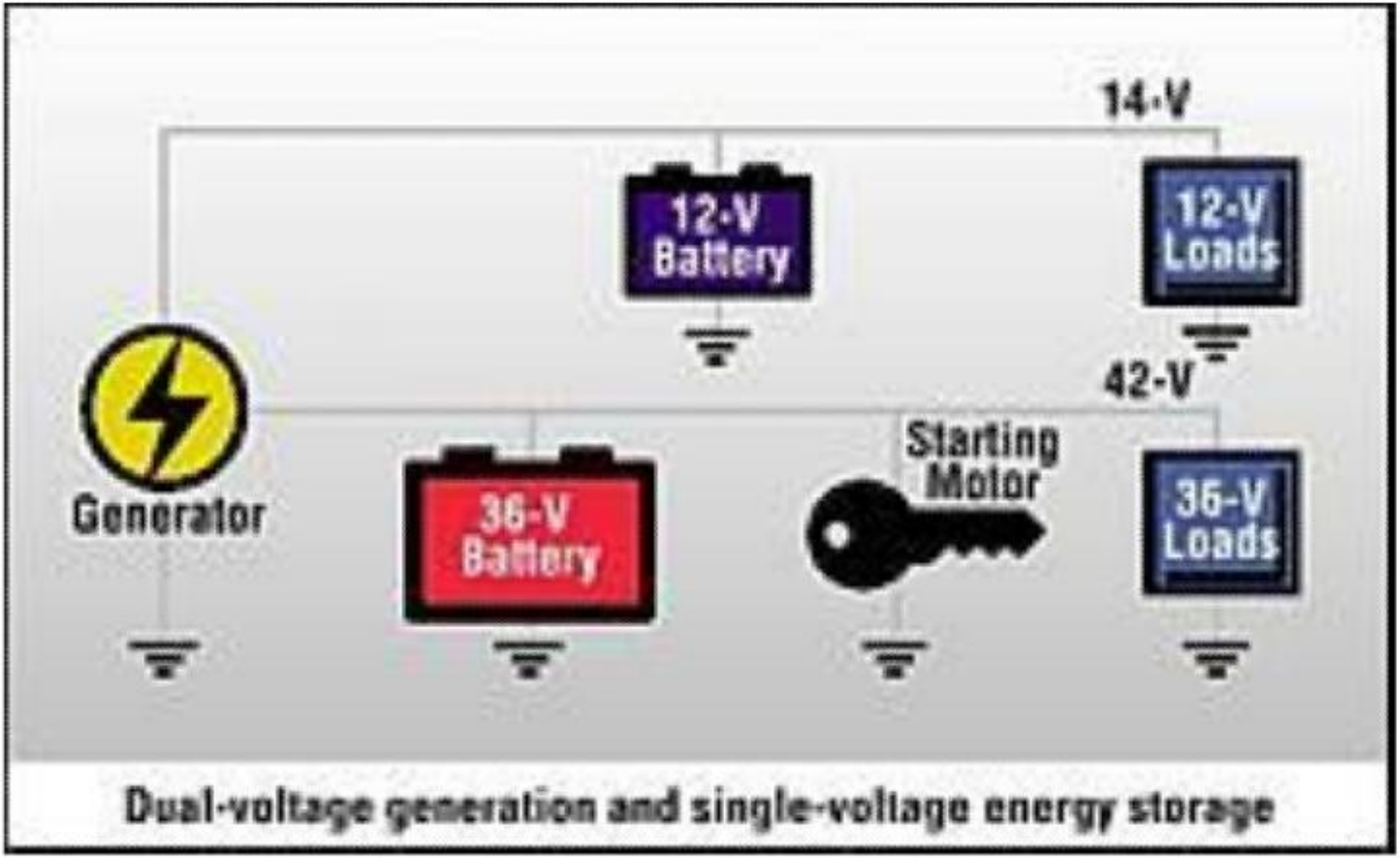


Single voltage generation and dual voltage energy storage - a 42 volt alternator charges the 36 volt side of a dual 12/36 volt battery, with a DC/DC converter used to charge the 12 volt portion of the battery.



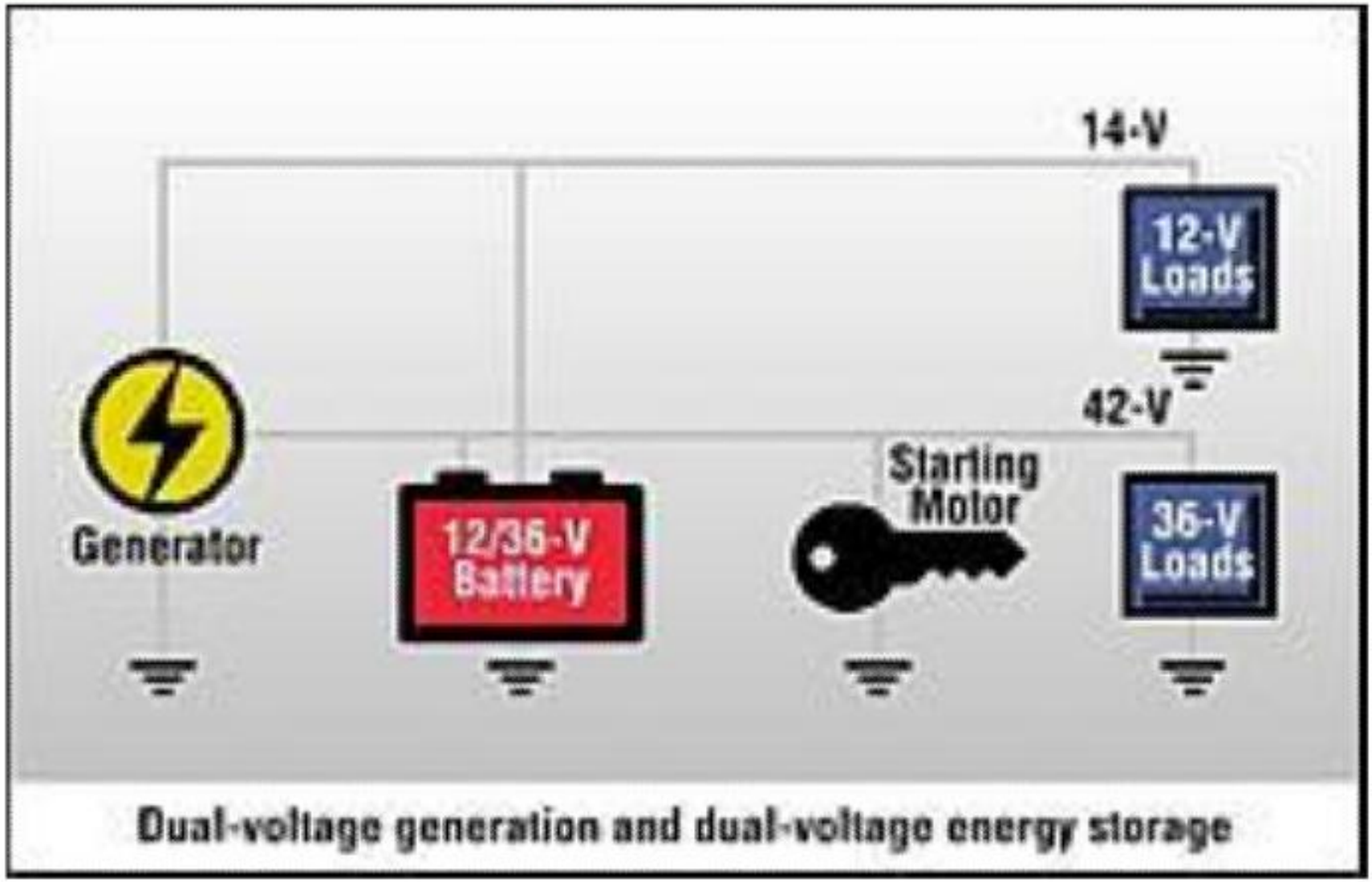
ATASA 5th Basics of Electrical Systems

Dual voltage generation and single voltage energy storage - where a dual 14/42 volt alternator charges two separate systems, one 12 volts and the other 36 volts.



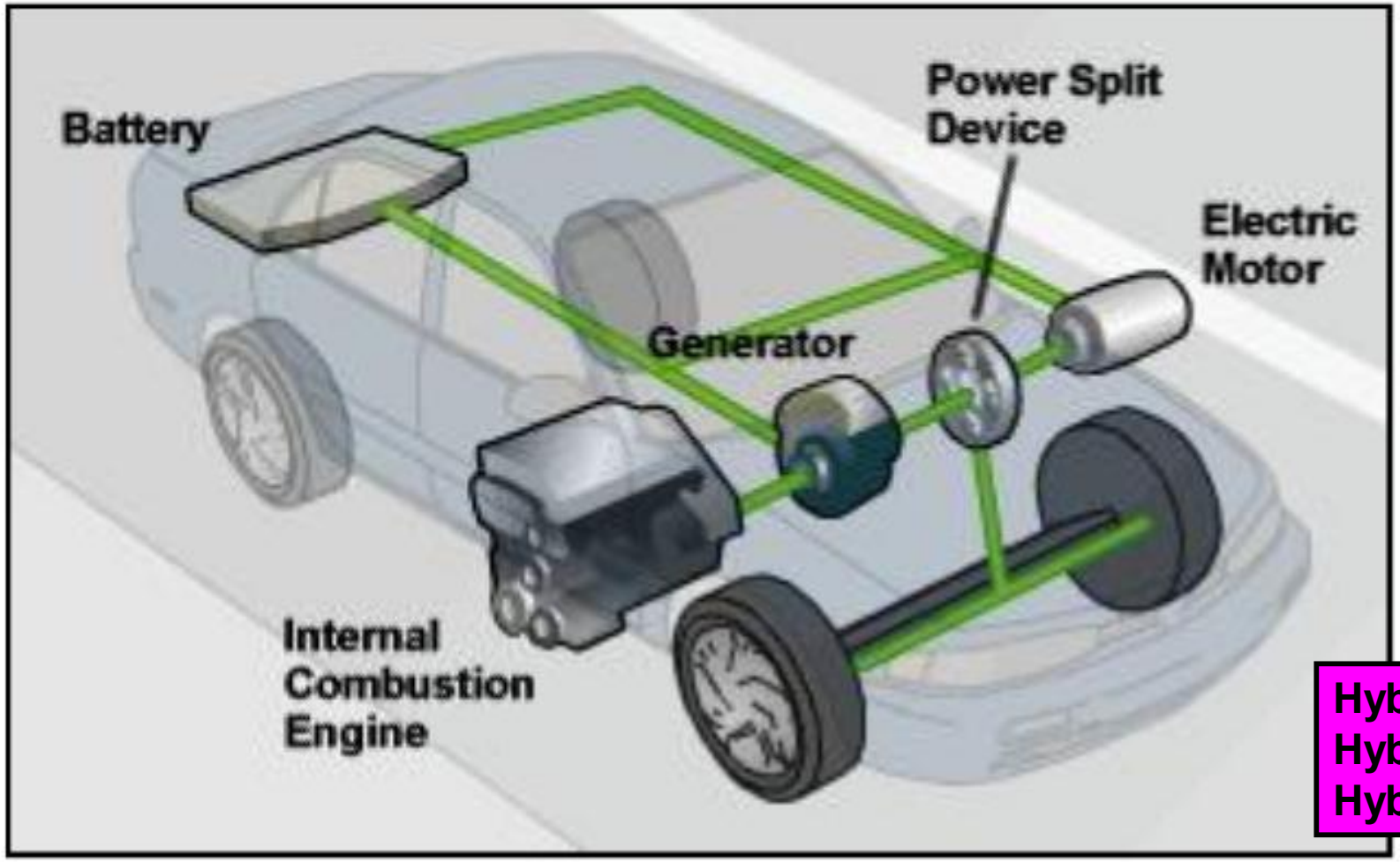
Dual-voltage generation and single-voltage energy storage

Dual voltage generation and dual voltage energy storage - where a dual 14/42 volt alternator charges a dual 12/36 volt battery.



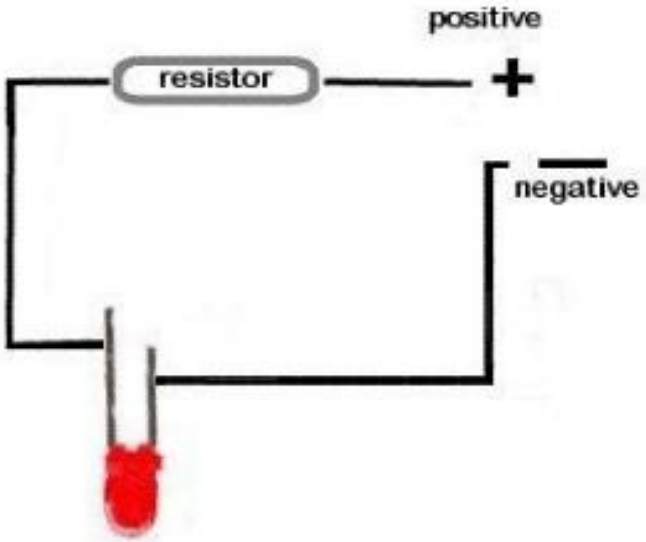
Current Technology	Benefits of 42 volt Architecture
Electric power steering	More power, improved fuel economy
Electric brakes	Redundant power supplies
Power windows, power seats, power hatchback lifts	Reduced size and mass of motors; more efficient operation
Heated catalytic converter	Lower emissions; quicker light-off time
Heating, ventilation, airconditioning blower motors and cooling fans	Greater efficiency; smaller/lighter units; flexible packaging
Mobile multimedia	More power available for video, mobile phones, navigation systems, audio amplifiers, fax machines
Electric water pumps	Improved efficiency; longer service life
Selected engine management system components (eg exhaust gas recirculation valves, ignition systems, control actuators)	Reduced size and mass; increased performance
Fuel pumps	Reduced size and mass
Heated seats	Faster heating, more efficient operation; increased power

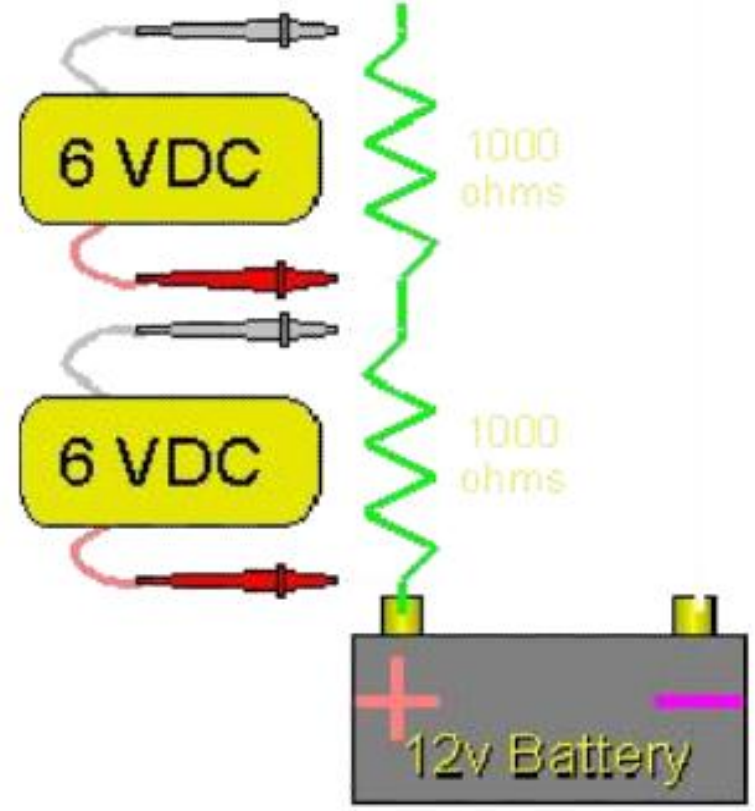
28. _____ vehicles run on 42 to 600 volts.
High voltage is used to move the vehicle, 12 volt systems power the lighting & accessories, and 5 volts is used as reference voltage in EEC systems.



Hybird
Hybrid
Hybred

29. _____ drop voltage and limit current flow and in doing so, produce heat.

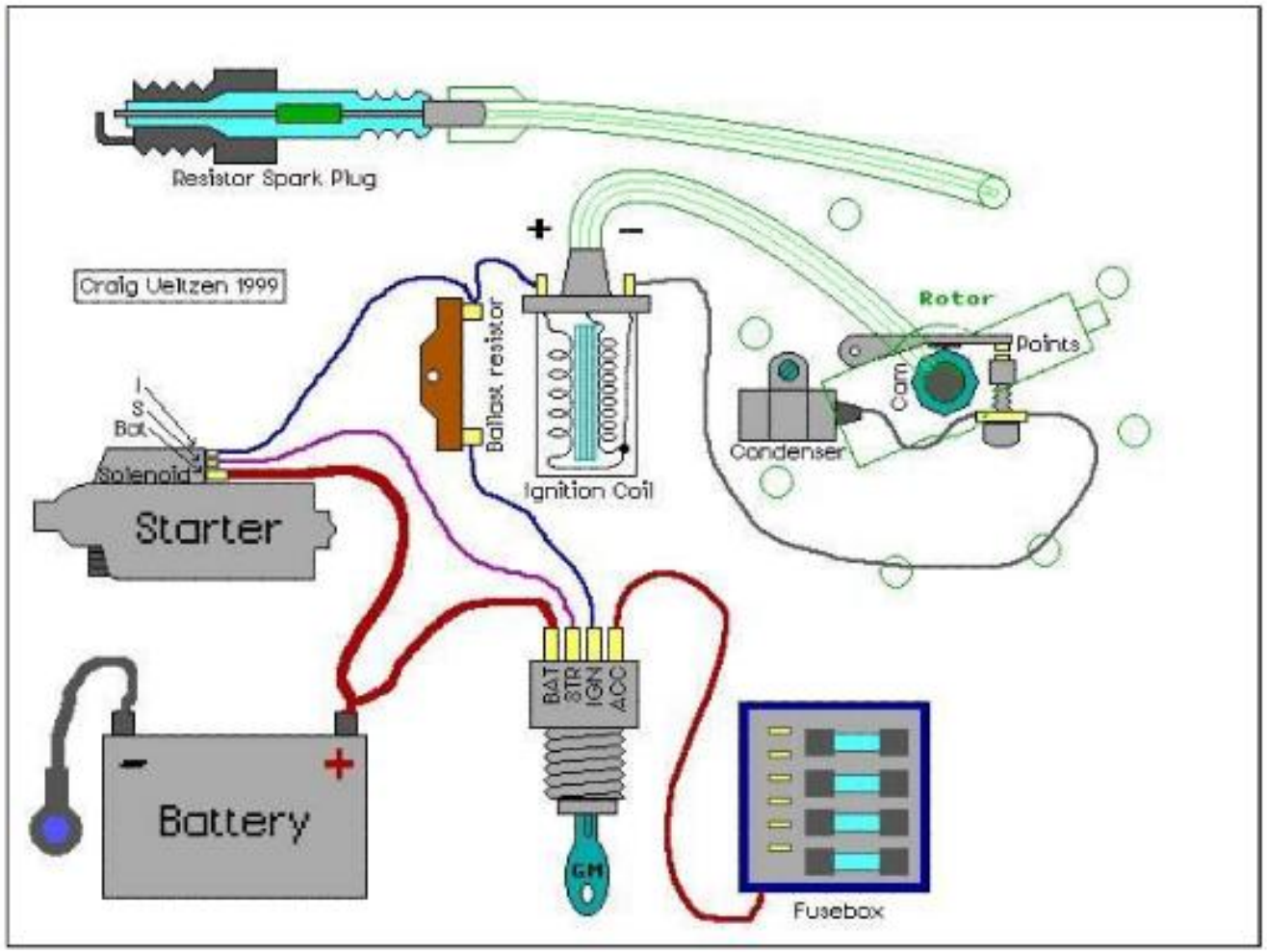




http://www.bcae1.com/resistrs.htm

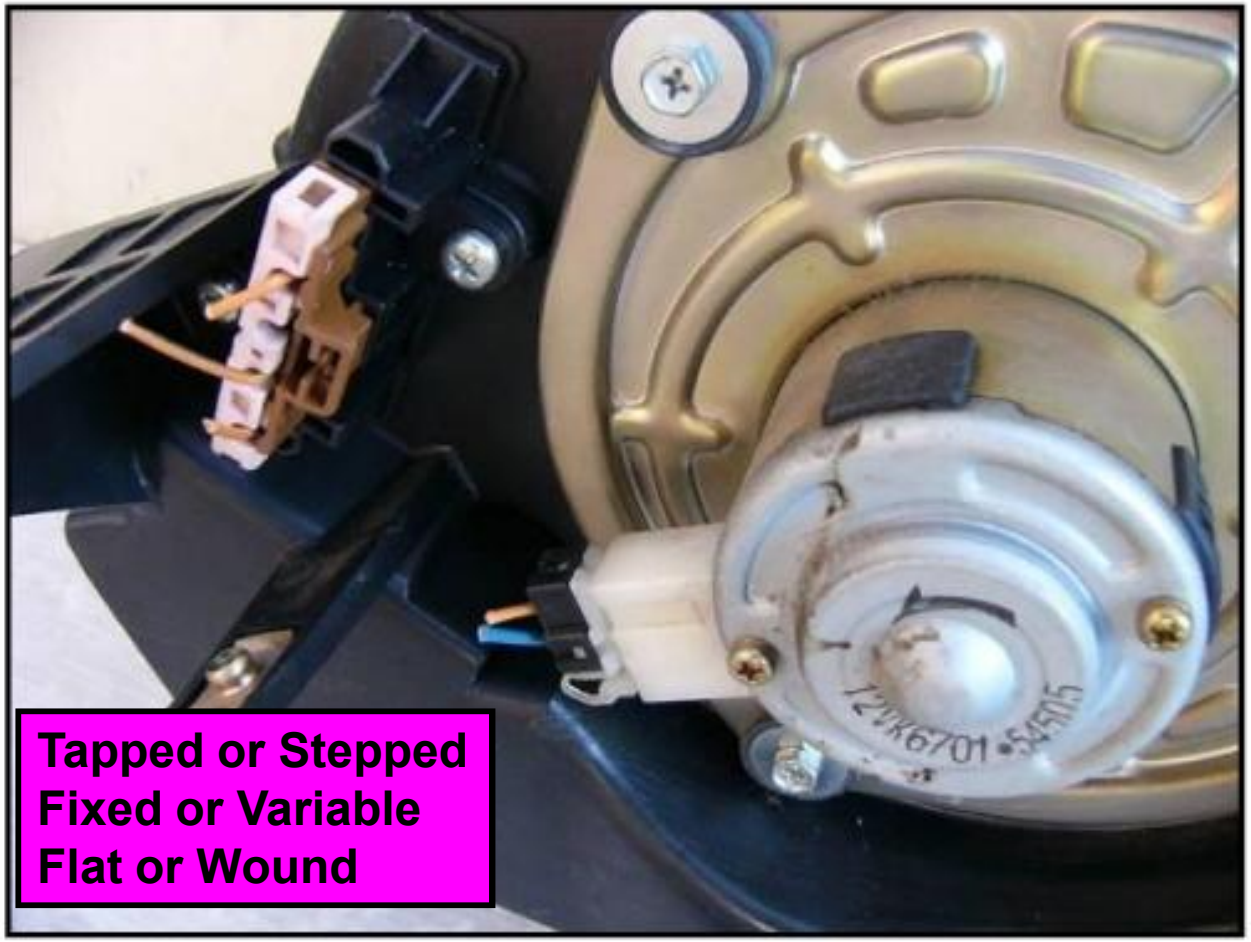
Resistors
Capacitors
Batteries

30. An ignition system ballast resistor or resistance wire is an example of a _____ value resistor.



Variable
Fixed

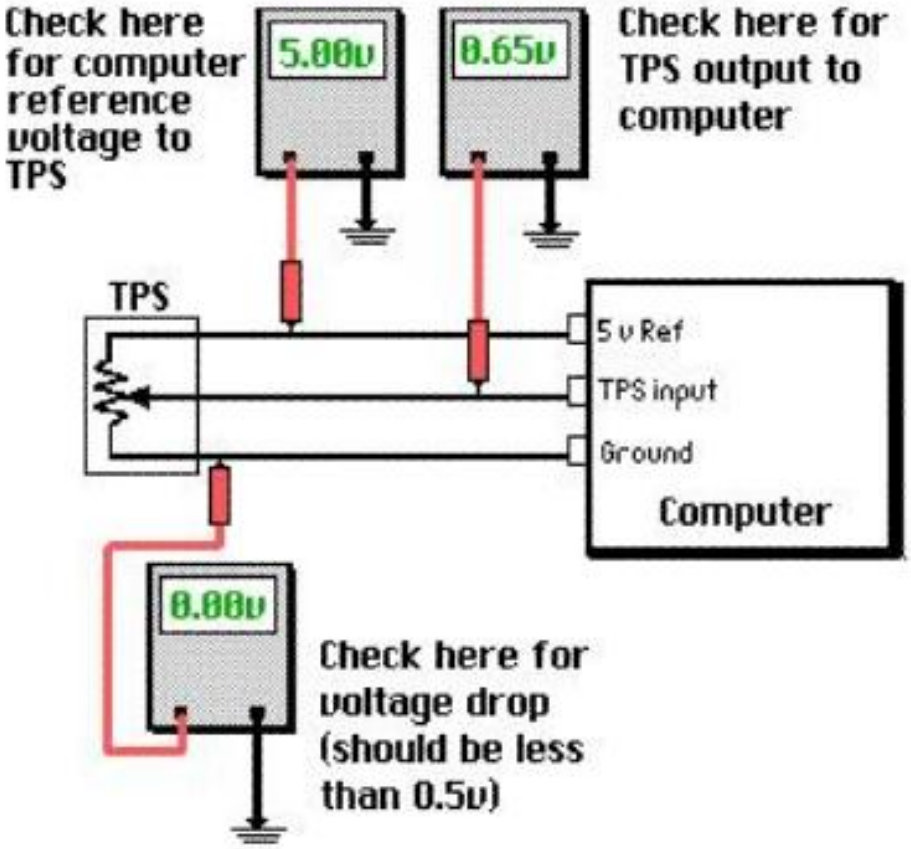
31. A blower motor resistor is a _____ or _____ resistor used to control fan speed.



Tapped or Stepped
Fixed or Variable
Flat or Wound

32. A TPS is an example of a _____.
(5 volt reference, signal return & ground connections)

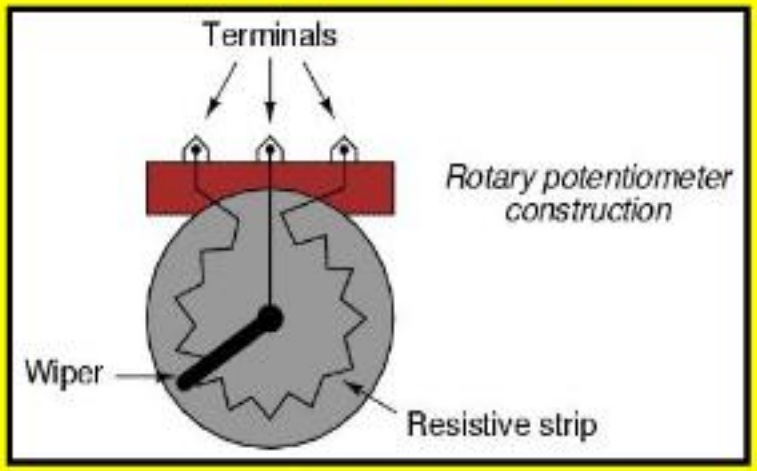
TPS Voltage Checks



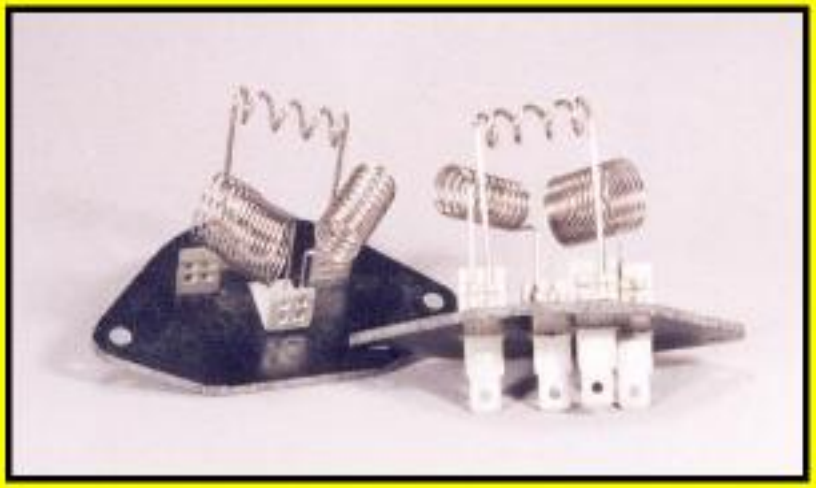
Rheostat
Potentiometer
Thermistor

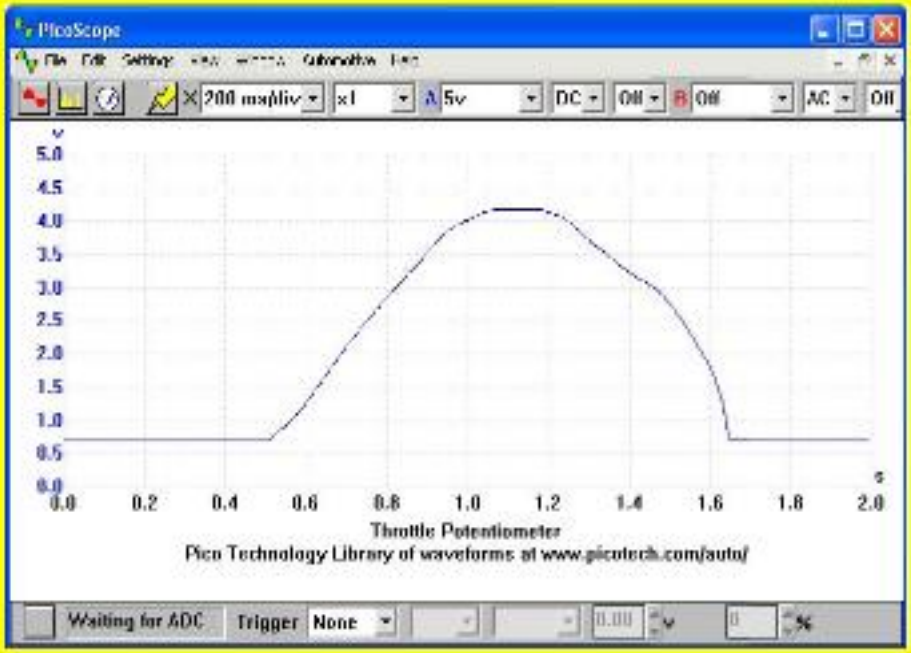
Ballast Resistor

Potentiometer

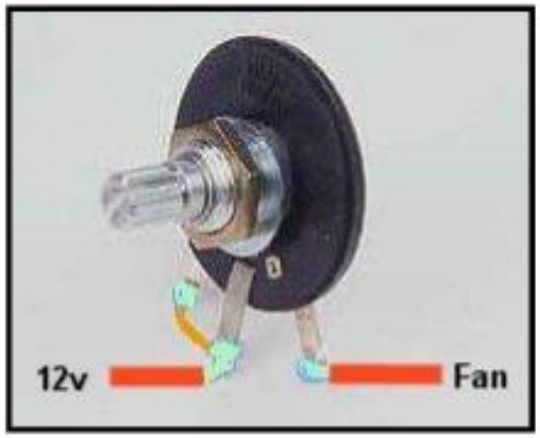


Tapped or Stepped Resistor



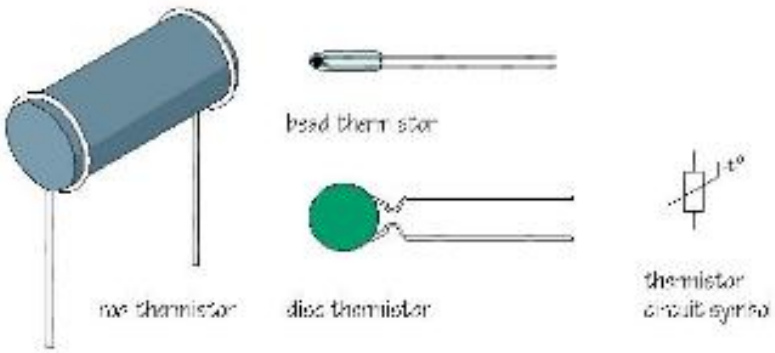


33. The VAT-40 & VAT 45 machines contain a carbon pile _____ with 2 connections.

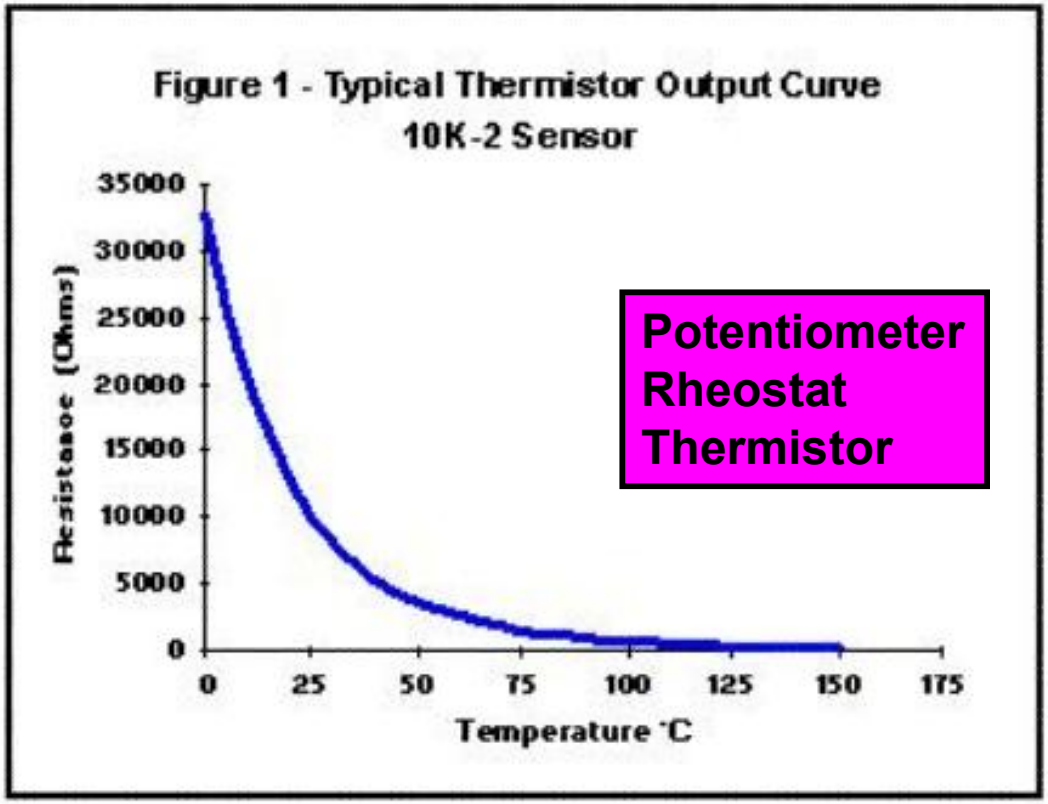


Potentiometer
Rheostat
Frequency

34. A _____ is used to provide compensating voltage in components or act as a temperature sensor as in an IAT or an ECT.
They may be NTC or PTC in design.



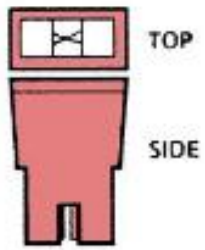
Thermistors are thermally sensitive resistors known for exhibiting a large change in resistance with only a small change in temperature.
It is important to note that a thermistor's change in resistance is non-linear.
It follows a pre-defined curve which is provided by the thermistor manufacturer.
An example of a thermistor output curve can be seen in Figure 1.
Thermistors are manufactured to follow a specific curve with a high degree of accuracy.



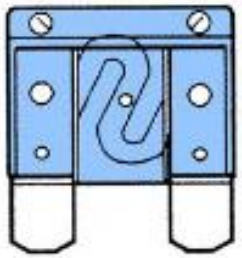
Potentiometer
Rheostat
Thermistor

ATASA 5th Basics of Electrical Systems

35. Circuit protection from amperage overloads or shorts that cause increased current flow is provided by _____, _____ _____, _____ - _____, & _____ _____.

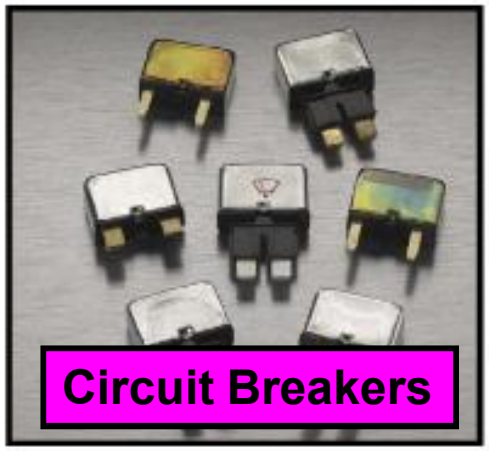


Fuse Element

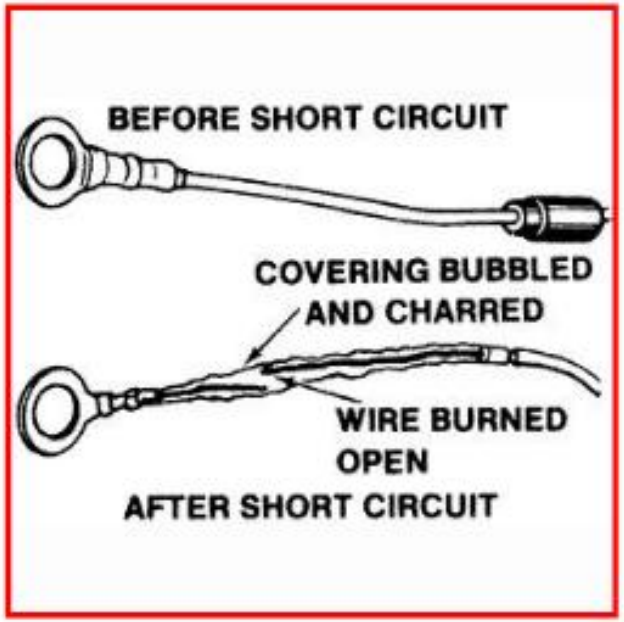

Maxifuse


Autofuse


Minifuse



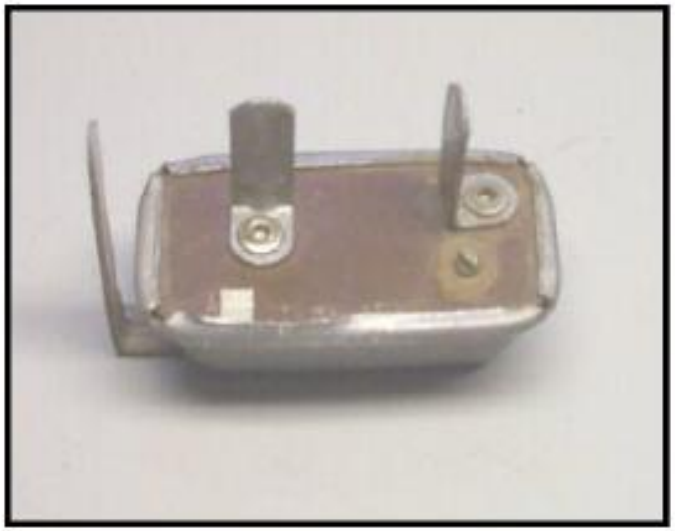
Protection from Resistance Down & Amperage Up



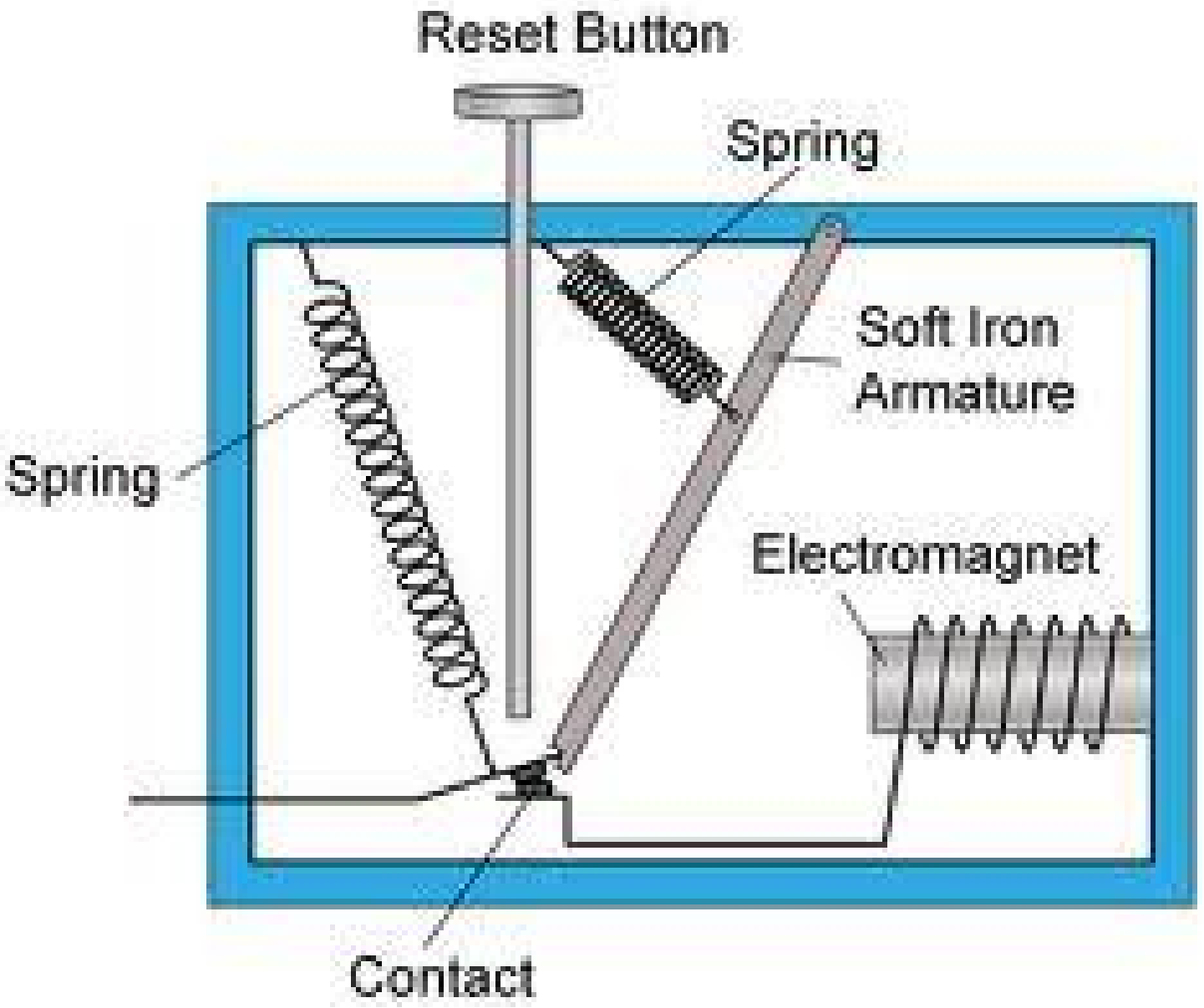
36. Some circuit breakers are _____, while others need to be manually reset.

Auto Reset Circuit Breaker

Single pole thermal type breakers which are used in 6 - 24VDC circuits. Applications include trucks, buses, portable generators, recreational vehicles, trolling motors and *others. Conforms to SAE J553 standard.*

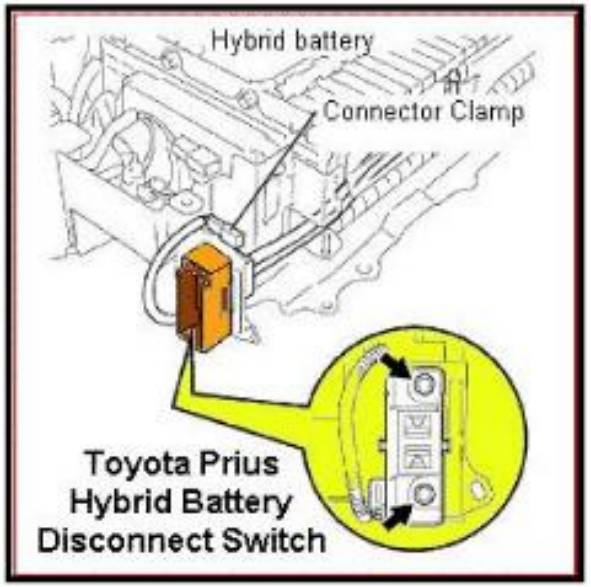


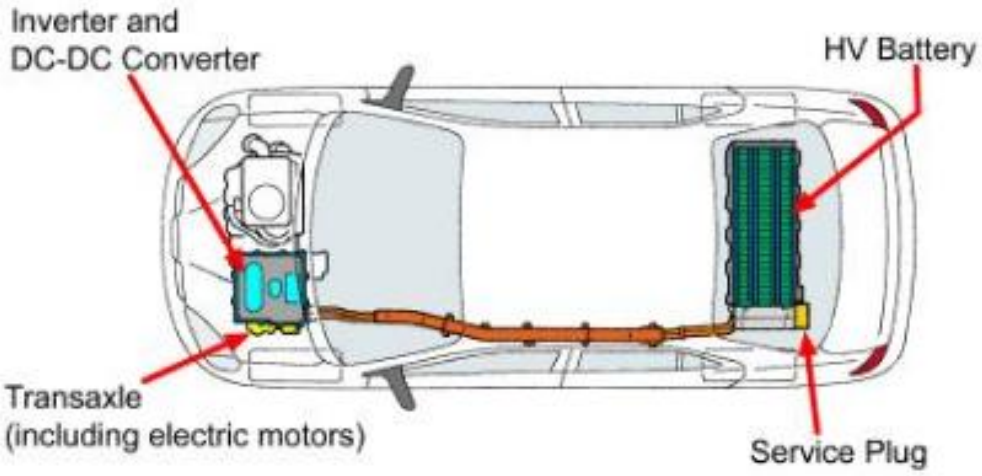
Series
Parallel
Cycling

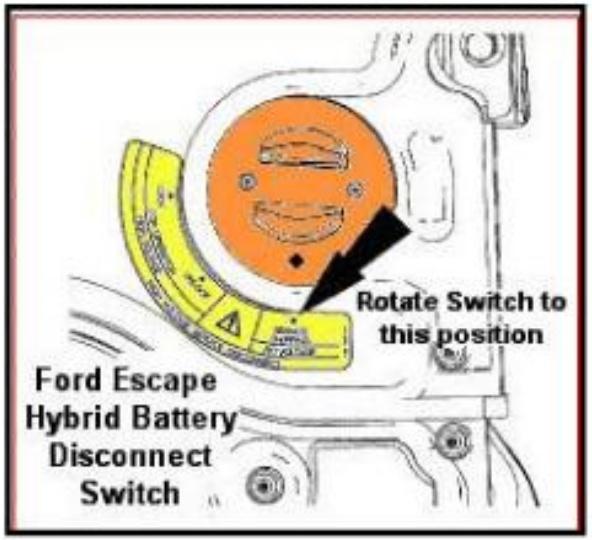

Reset Button
Spring
Soft Iron
Armature
Spring
Electromagnet
Contact

37. _____ _____ (42 volt) protection devices have unique designs to prevent wrong installation.

High Voltage
Low Voltage
Orange & Blue

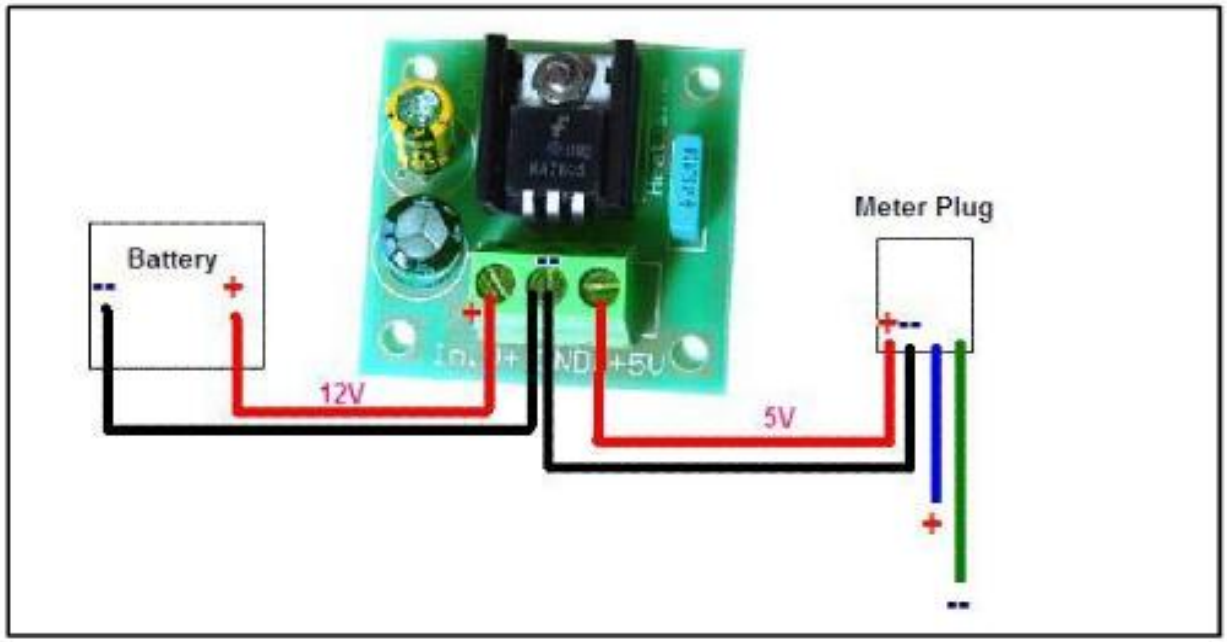




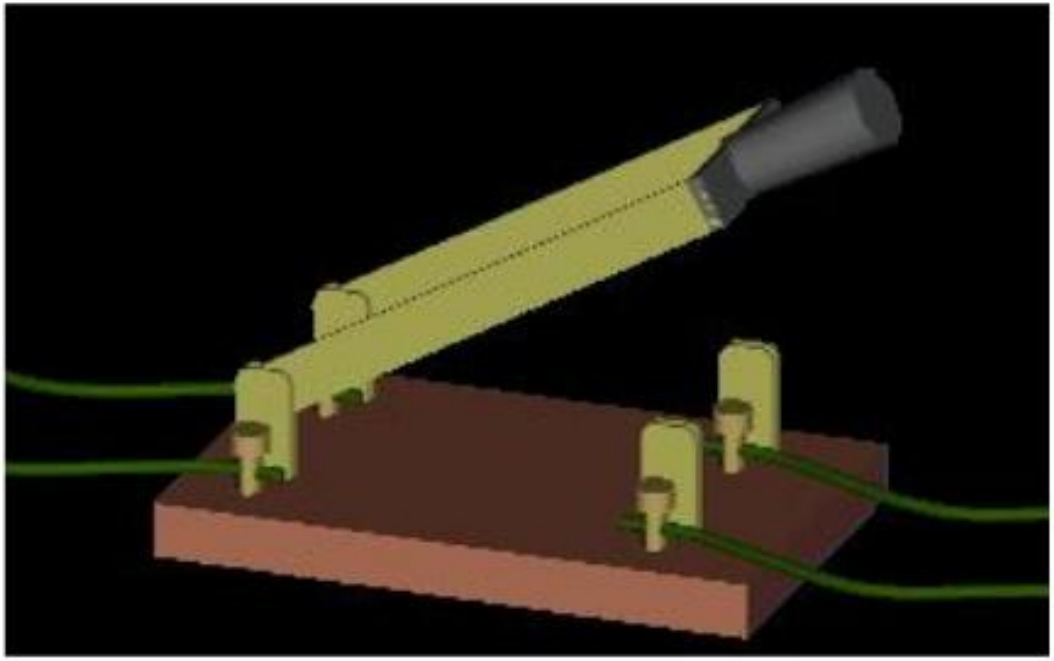


38. Instrument Voltage _____ (IVR) restrict voltage to sensitive instrument cluster gauges.

Simulators
Resistors
Regulators



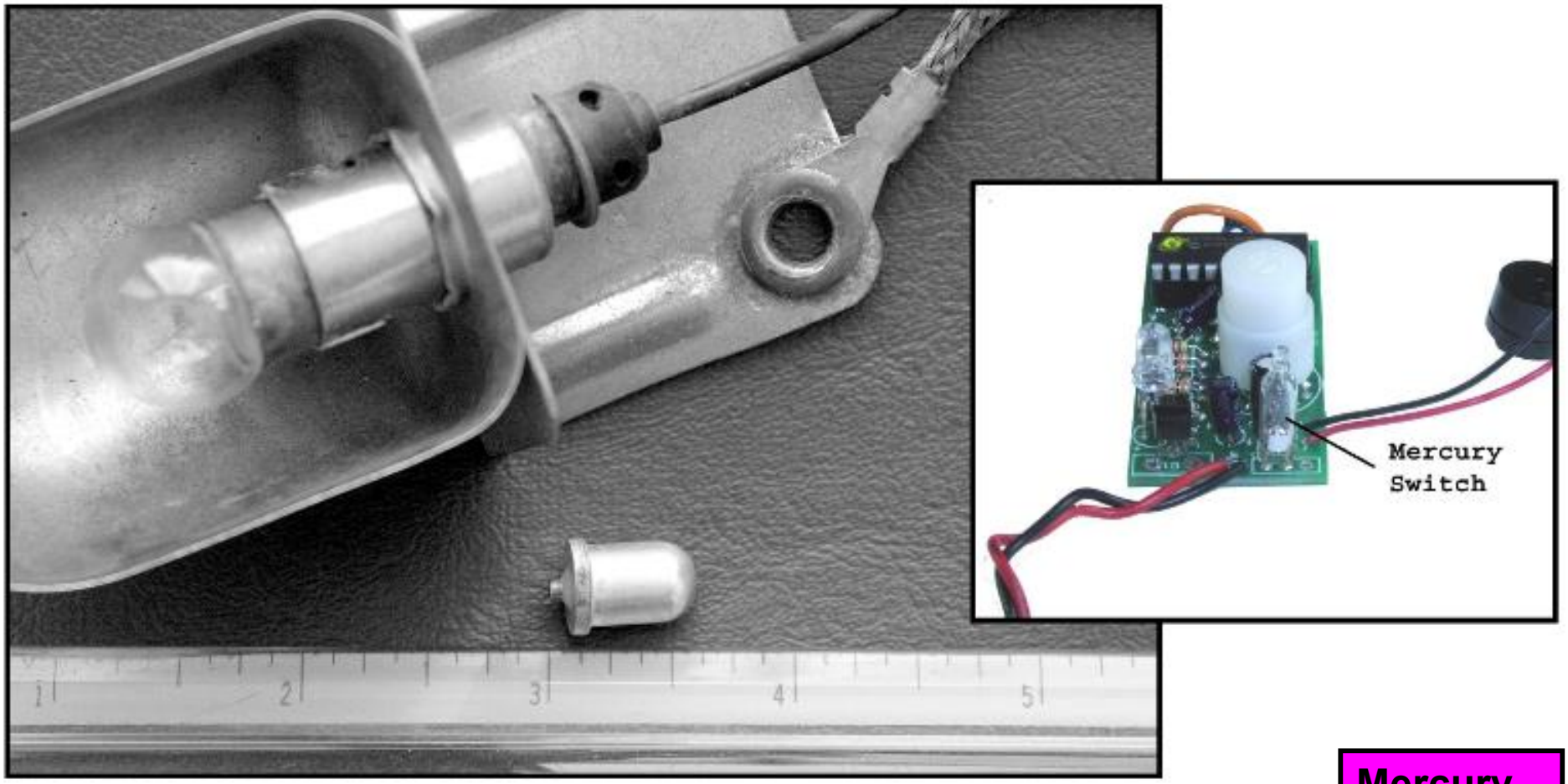
39. A switch is described by it's _____ (# of output circuits) & its _____ (# of input circuits). (SPDT)



It is said that this switch has Double Poles, and a Single Throw. This switch is known as a DPST switch.

Throws & Poles

40. A _____ switch is used to detect motion, as in the opening of the trunk or hood.

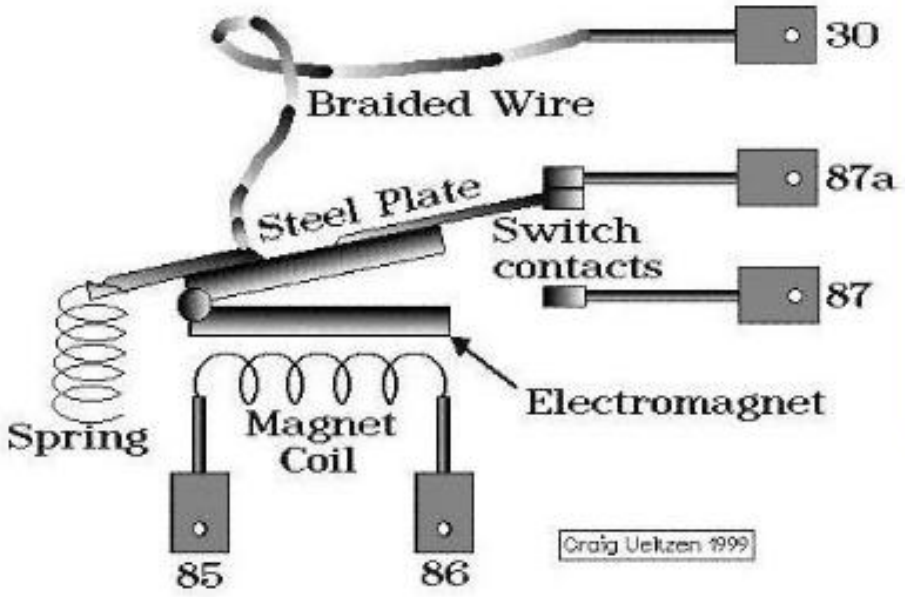


Mercury
Hydrogen
Copper

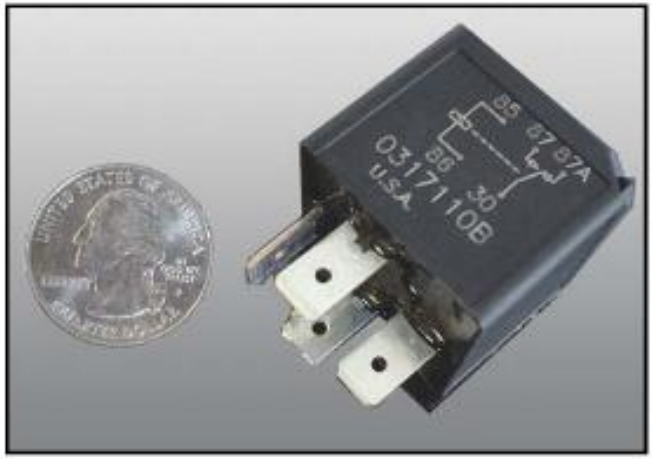
41. A temperature-sensitive switch usually contains a _____ element. It can be NO or NC.

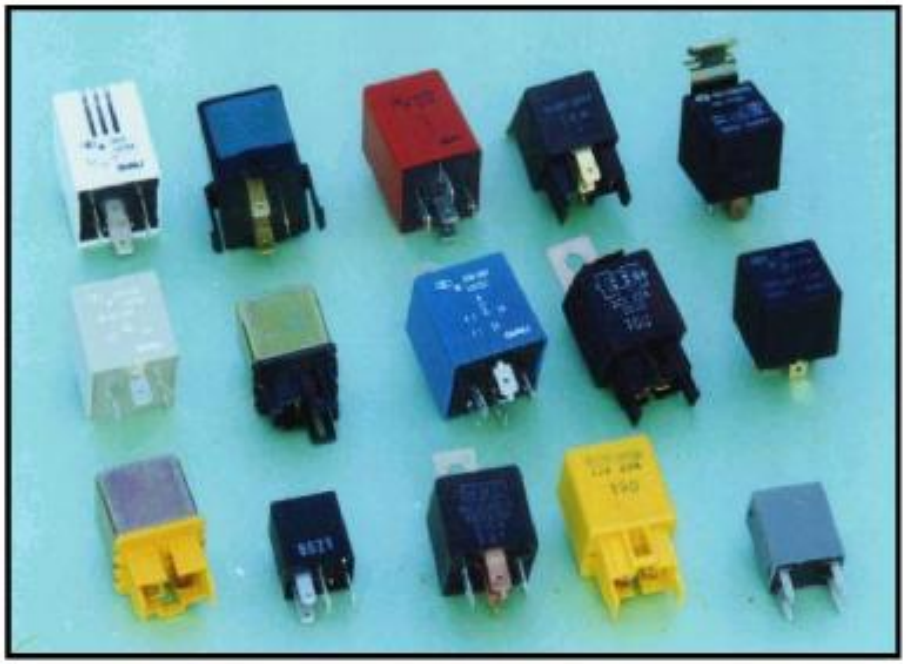
Mechanical
Chemical
Thermal

ATASA 5th Basics of Electrical Systems



42. A relay is an electromagnetic switch that allows a small amount of current to control a higher current circuit.
    #85 to #86 = coil
    #30 = source
    #87 = switched current
    #87a = sensing or NC

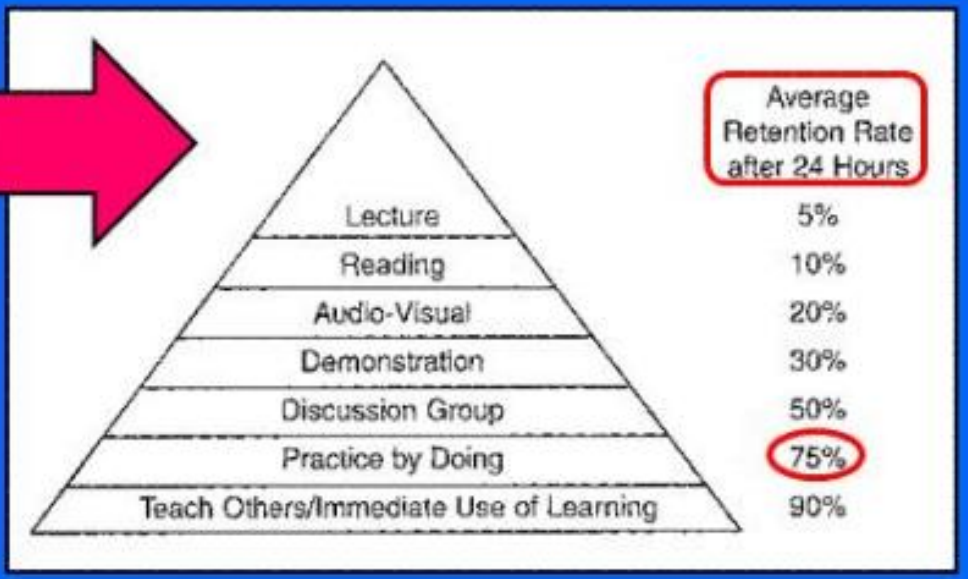




ATASA 5th Basics of Electrical Systems

43. Explain Relay Operation in your own words:

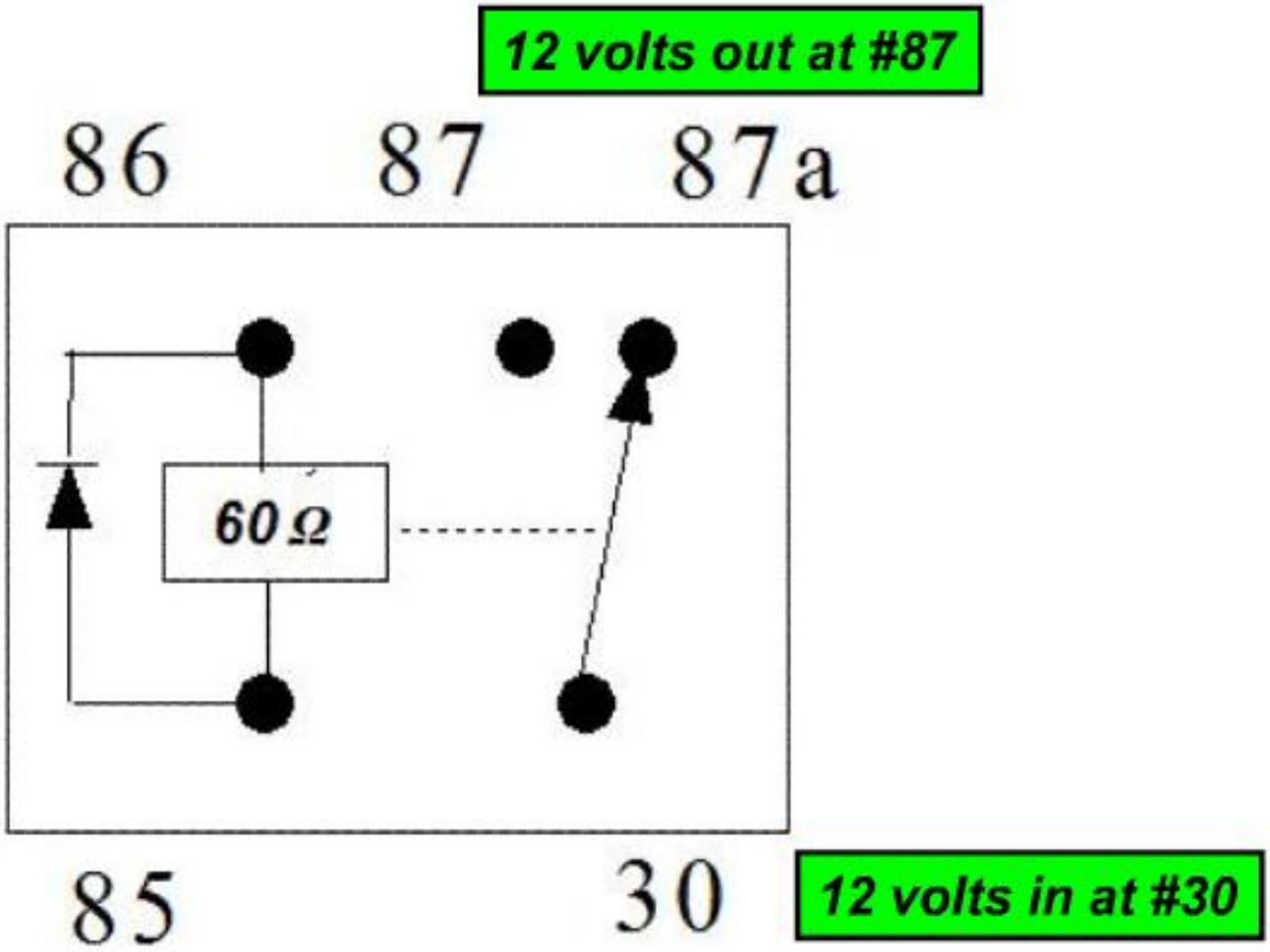
This is why our classes work for you!

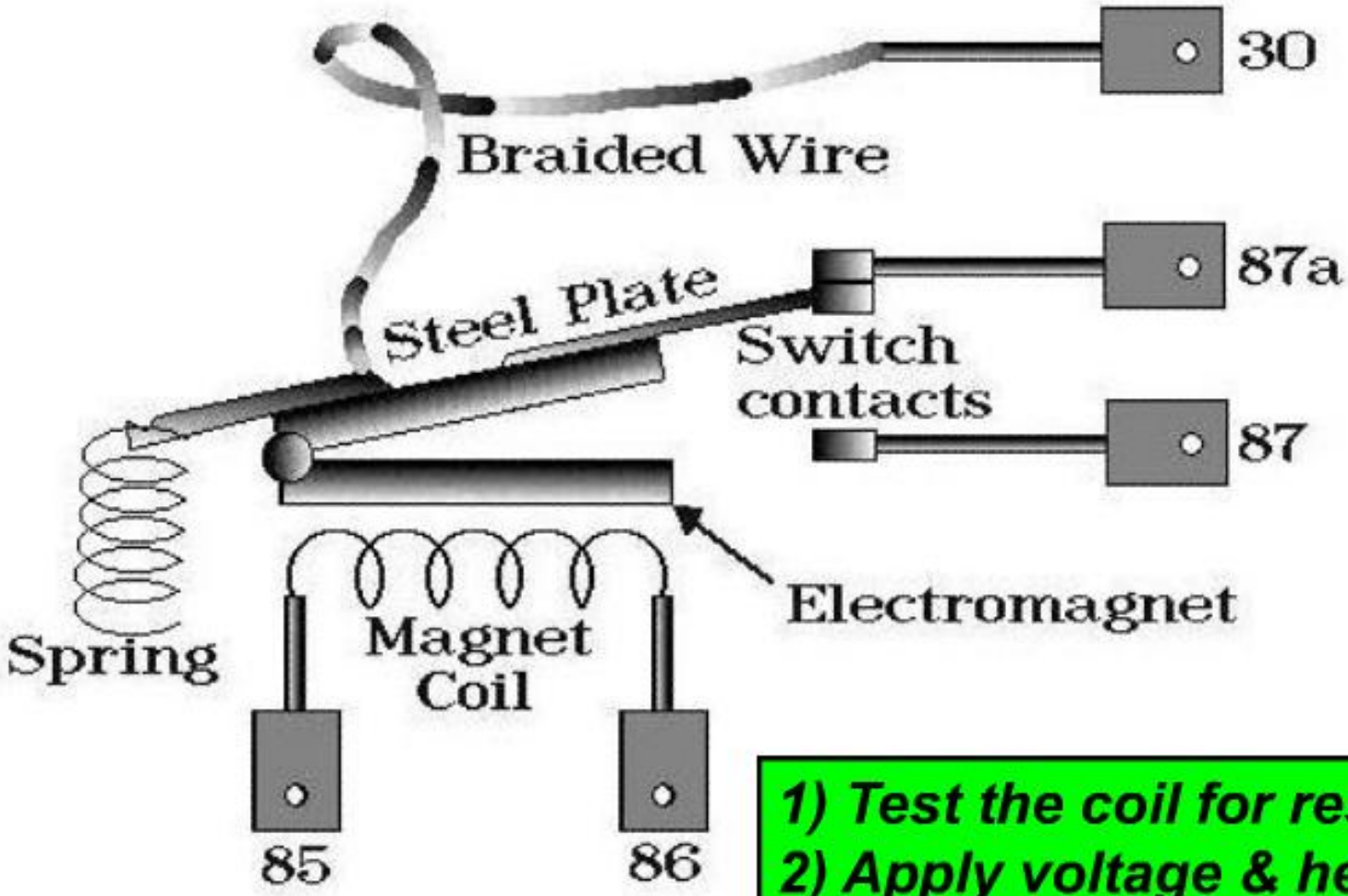


YOUR KEY TO THE FUTURE
ASE
NATEF
NATIONAL AUTOMOTIVE TECHNICIANS EDUCATION FOUNDATION, INC.

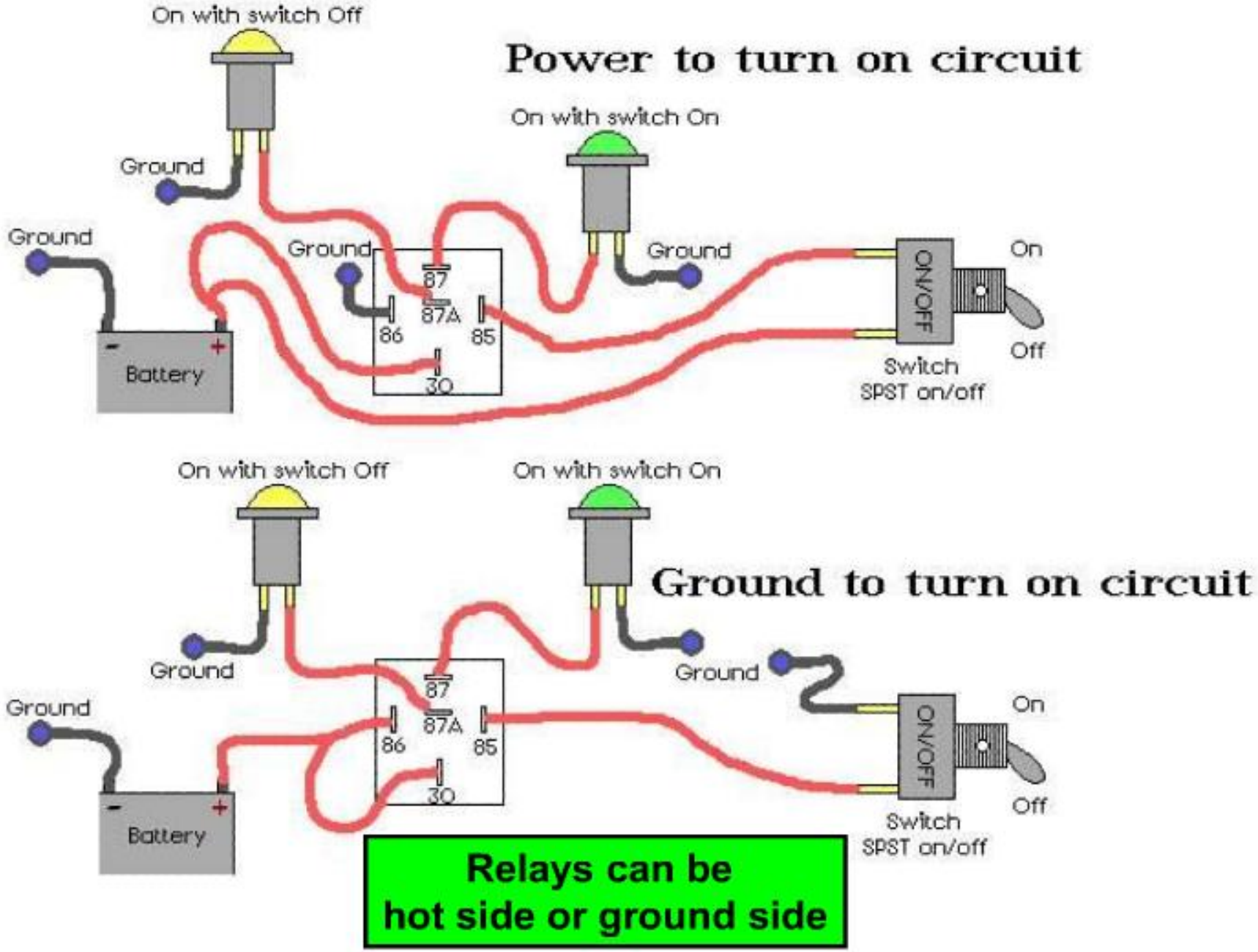
If the coil between 85 & 86 is energized with a small current, then the contacts between 30 & 87 pull shut & conduct a higher current.

44. The voltage into a relay (12) is the same as the voltage going out.
True or False

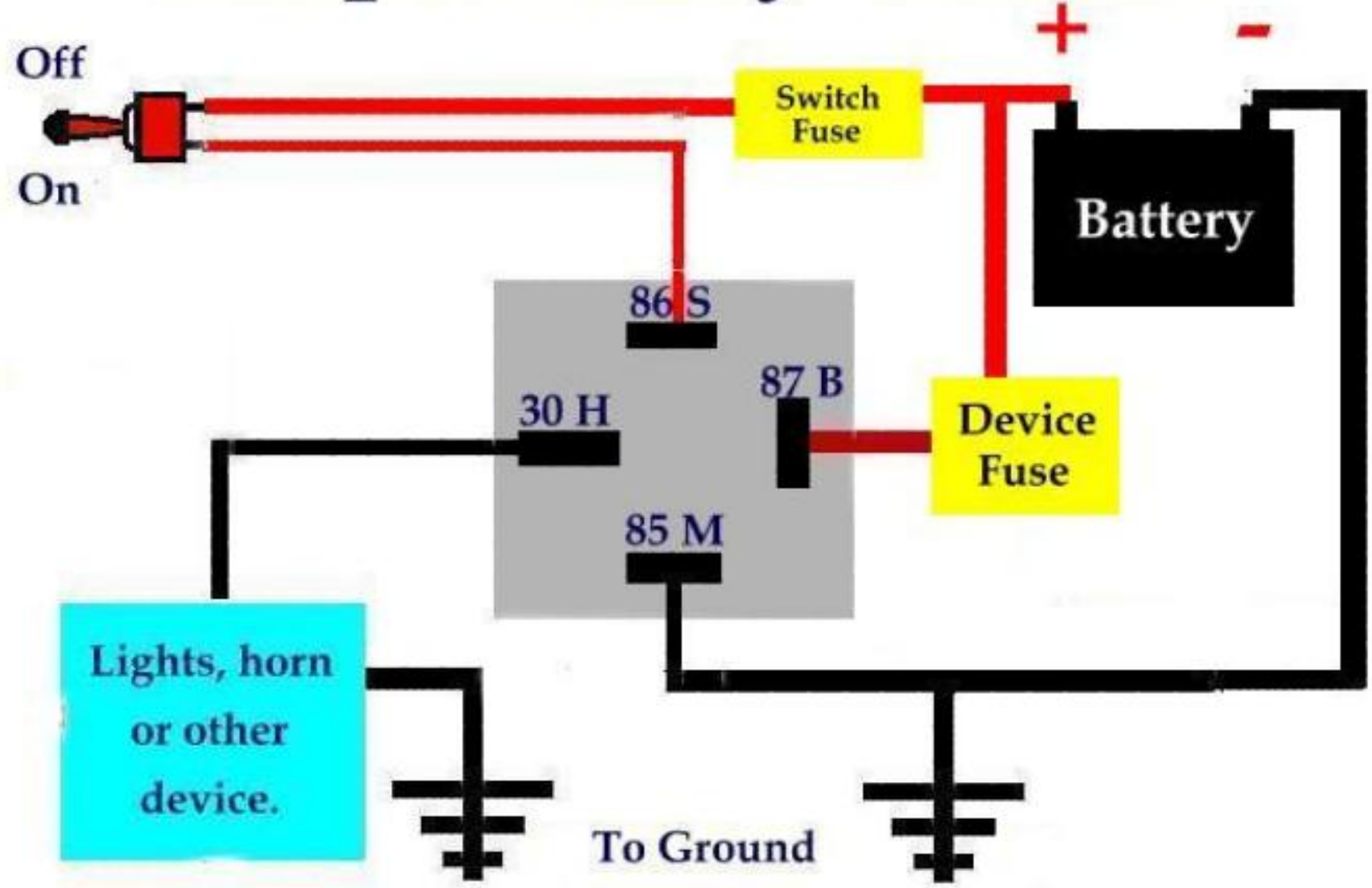




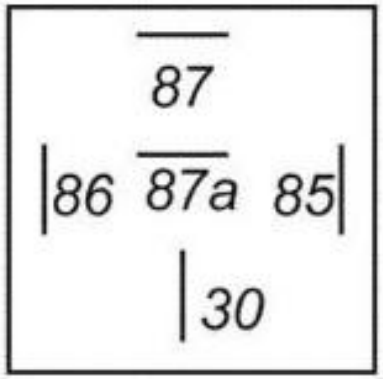
1) Test the coil for resistance
2) Apply voltage & hear the click
3) VERIFY 30 to 87 continuity

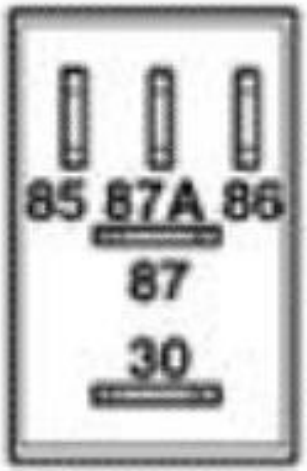

On with switch Off
Power to turn on circuit
On with switch On
Ground
Ground
Ground
Ground
87
87A
86
85
30
Battery
ON/OFF
On
Off
Switch
SPST on/off
On with switch Off
On with switch On
Ground to turn on circuit
Ground
Ground
Ground
87
87A
86
85
30
Battery
ON/OFF
On
Off
Switch
SPST on/off
Relays can be
hot side or ground side

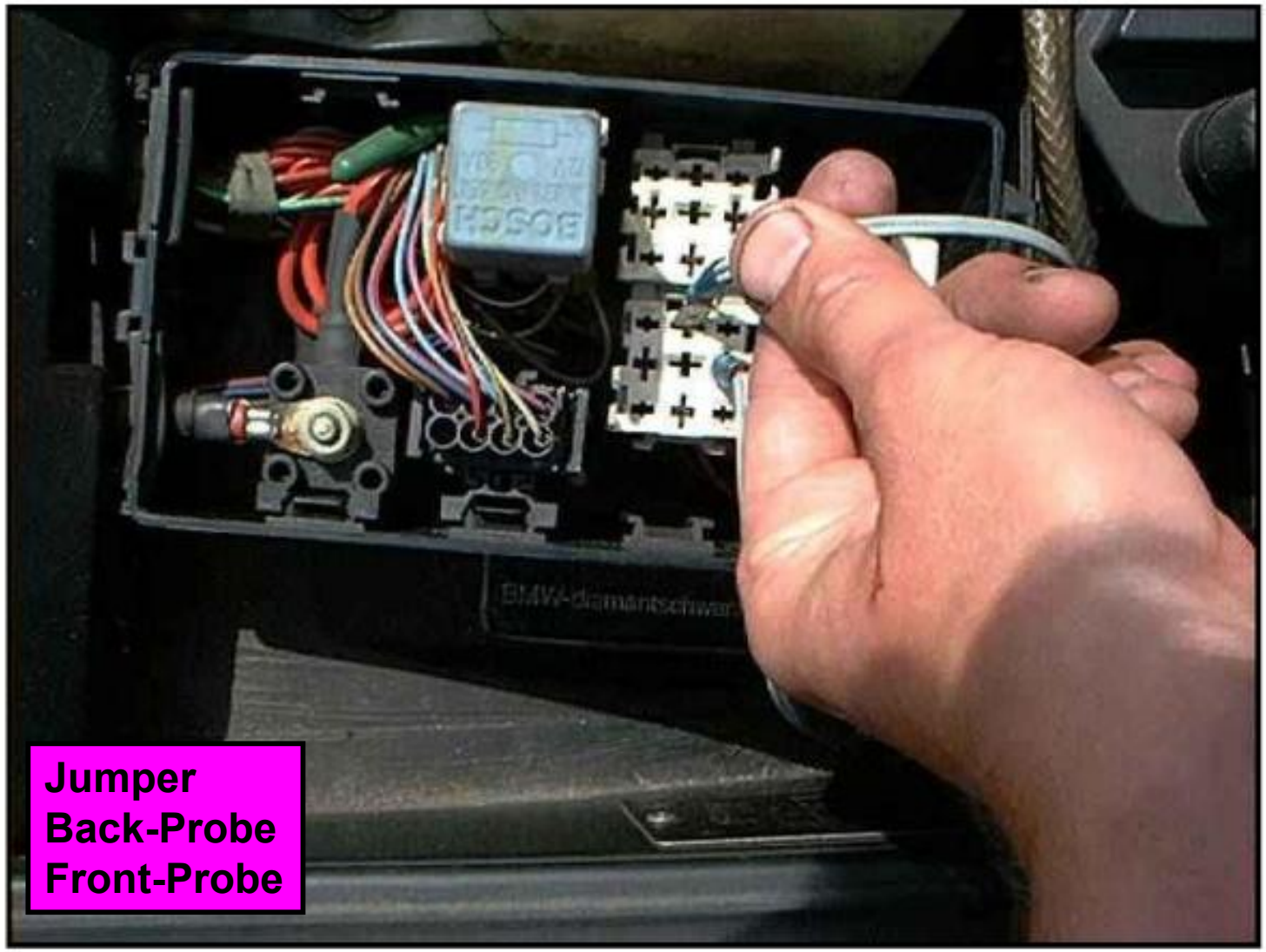
Simple Relay Circuit.



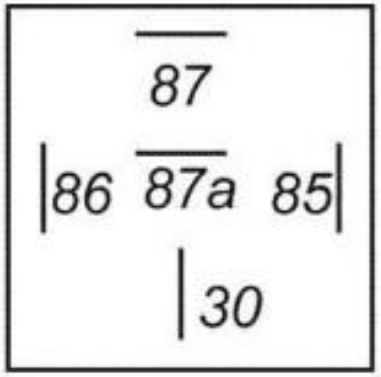
45. Suspect relays can be checked with _____ wires or by substitution with a known good unit.

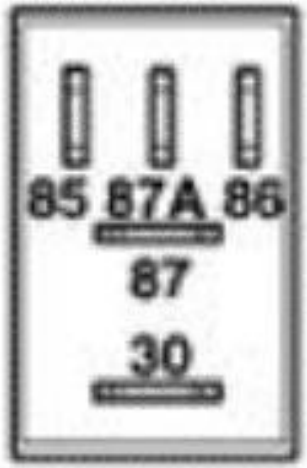




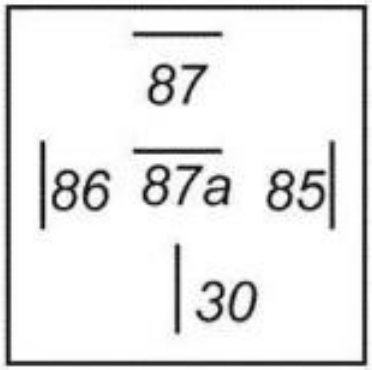


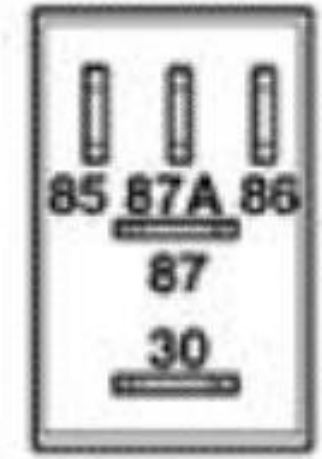
46. Explain trouble shooting by "substitution with a known good unit".

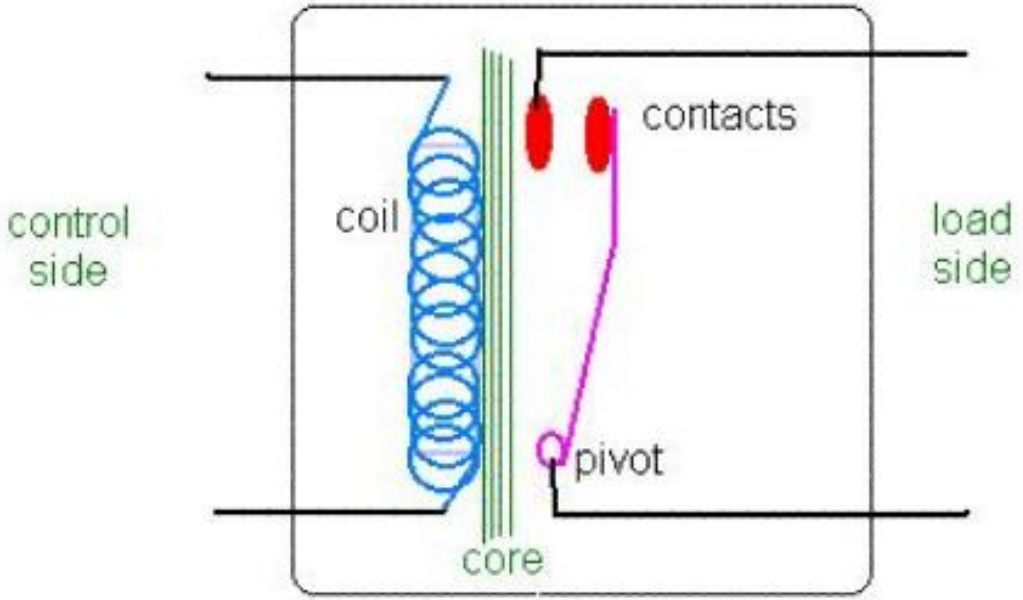


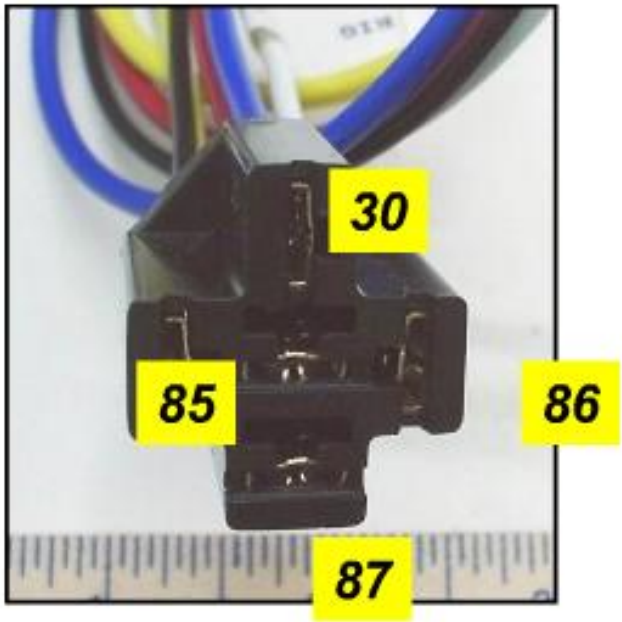


47. What are some drawbacks of this technique?









Relay "Foot Print"

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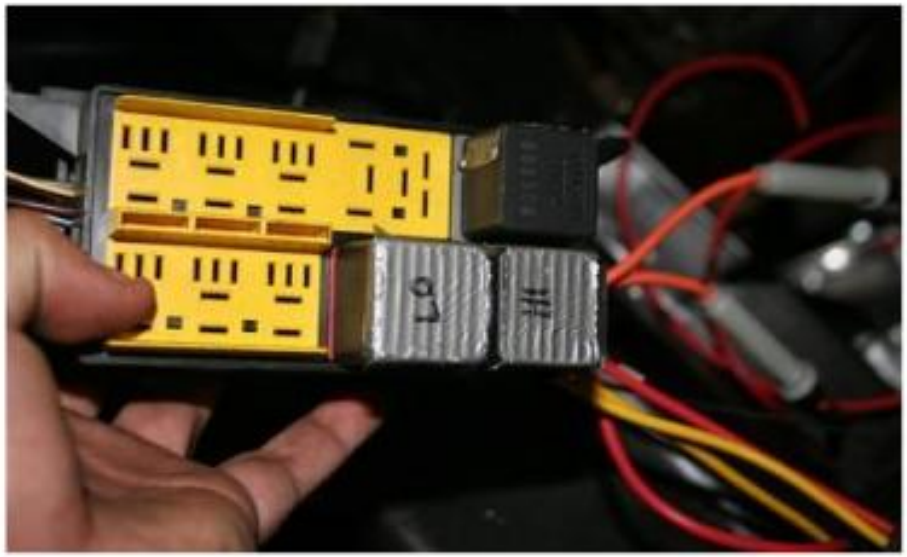
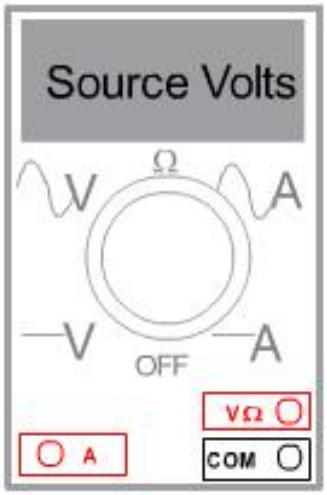
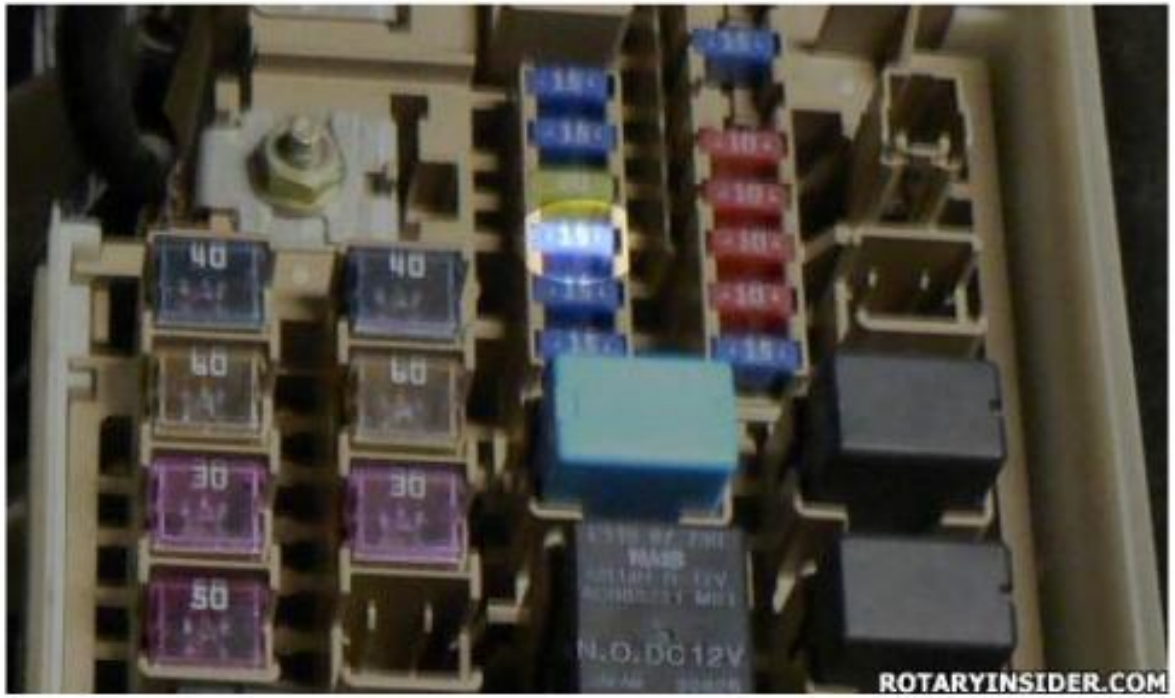
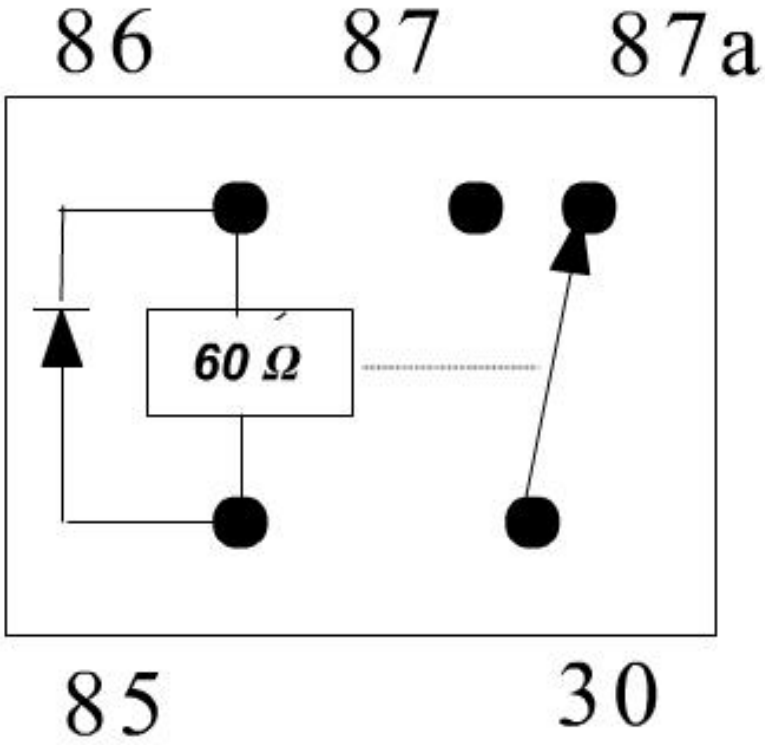


Please Check for Source Voltage!

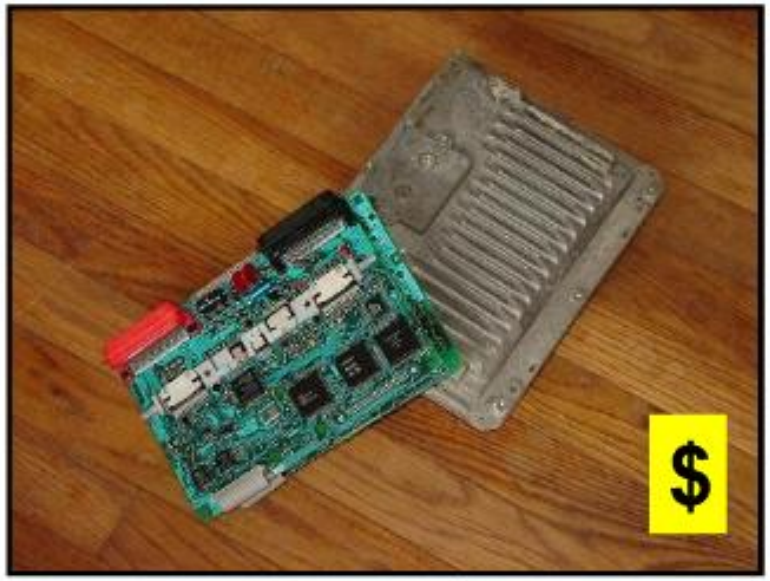




What if the substitute relay coil was shorted to 6 Ω and the circuit was designed for a 60-80 Ω load?



Modules operate in the "control side" of relays



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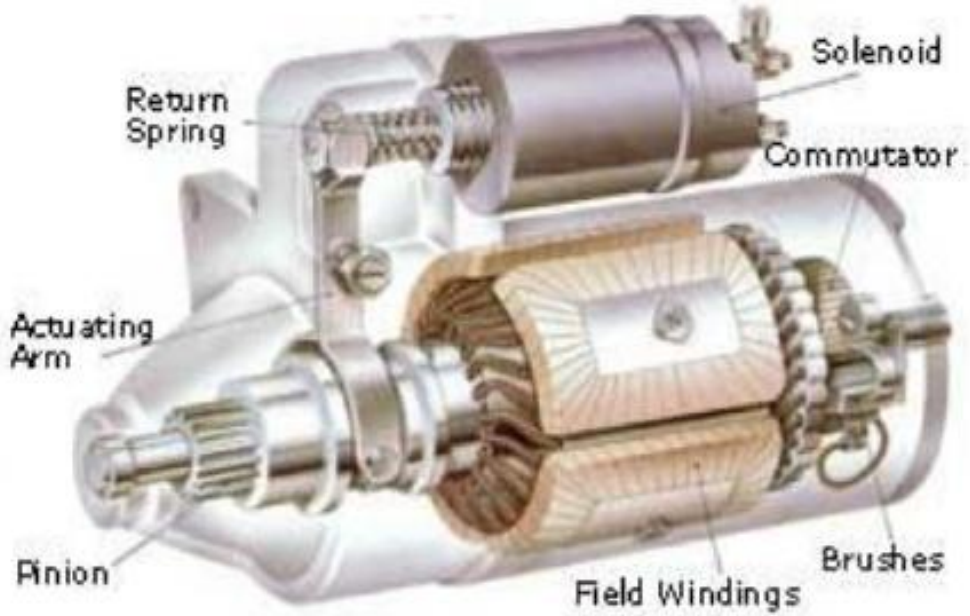
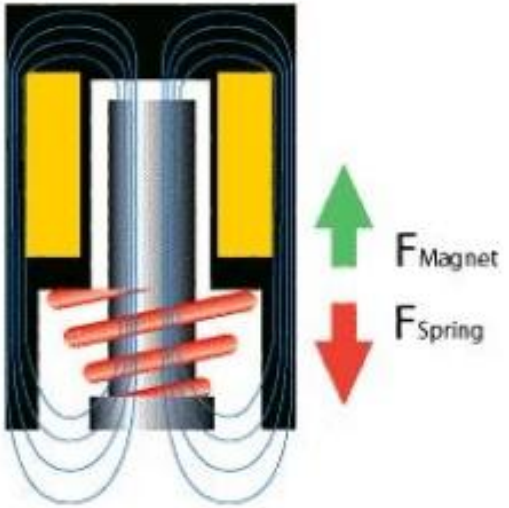




Relay Operation: Relays are electro-mechanical, "if : then" switches.
If the coil between 85 to 86 is energized (fed & grounded) :
Then the contacts between 30 & 87 close to conduct. (continuity)

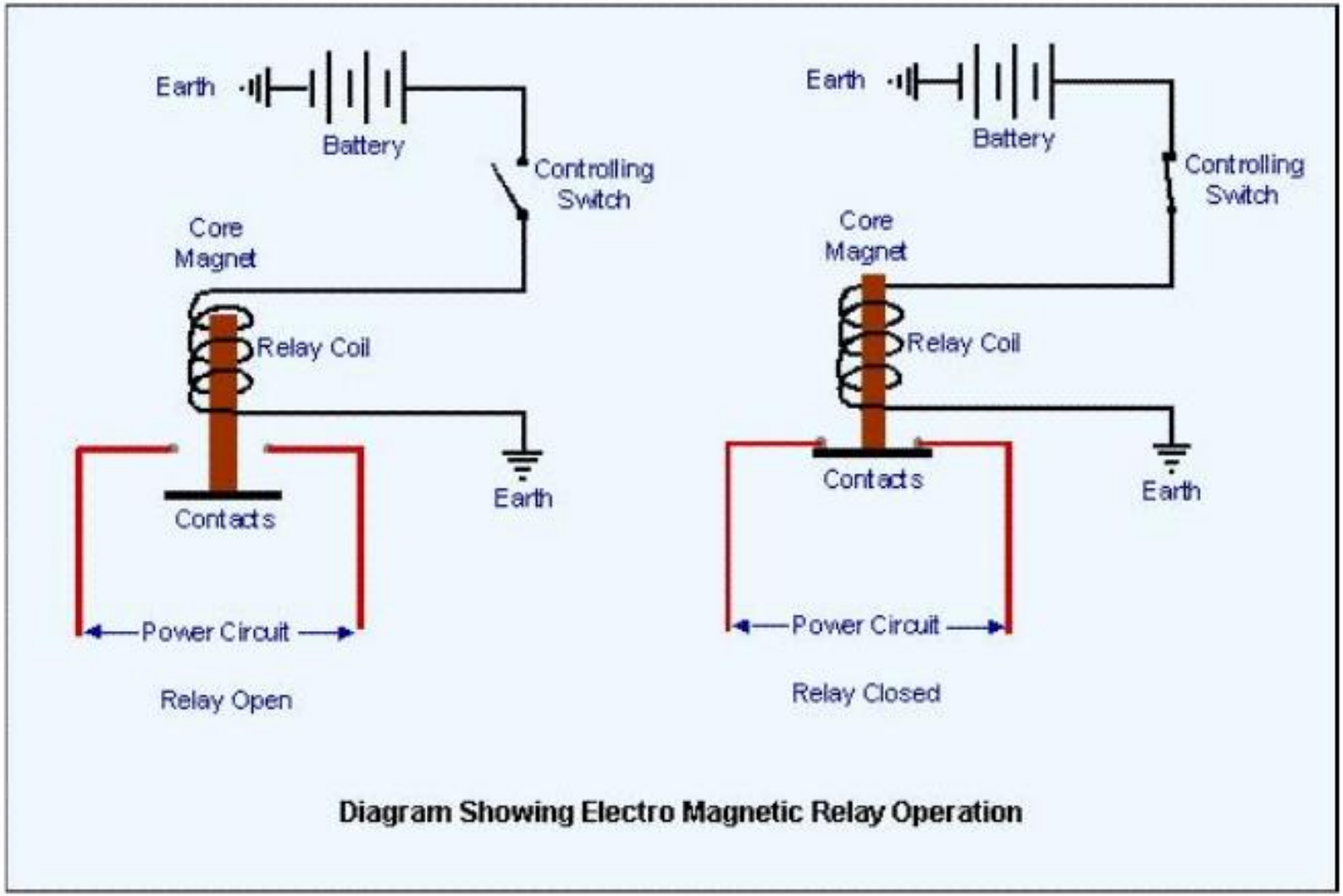
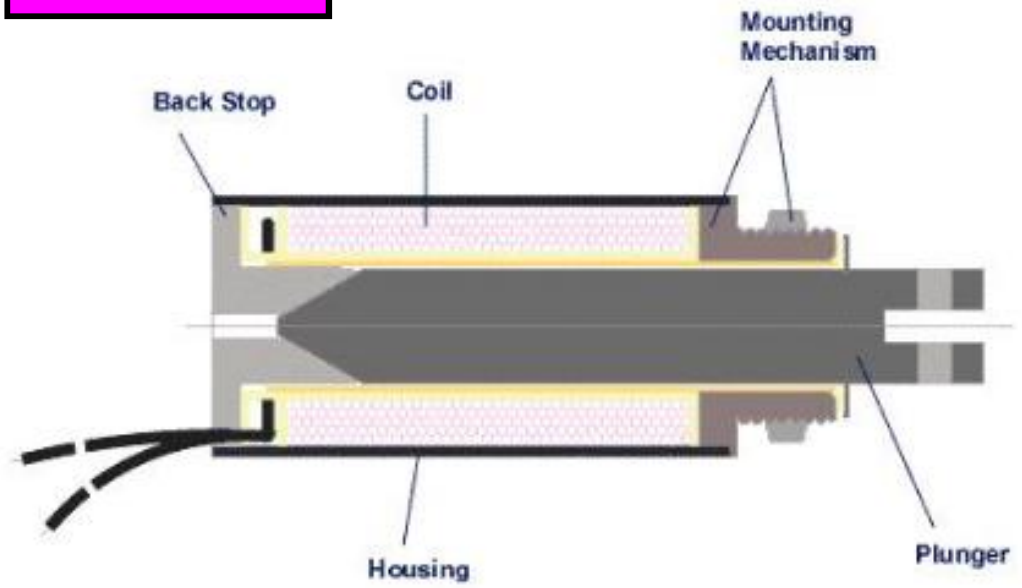


Diagram Showing Electro Magnetic Relay Operation

48. A _____ is an electromagnetic switch with a hollow coil of wire and a movable soft iron core or plunger that uses a small amount of current to control a larger current. (starter)

Relay
Solenoid
Transformer



Pull Type Solenoid

49. Conductors are materials that have *less than 4 electrons in their outer orbit.* (loosely held)

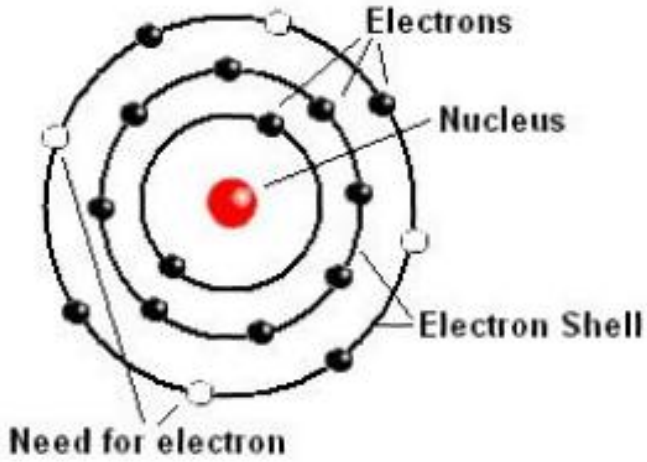
Steel, Copper, Gold, Aluminum

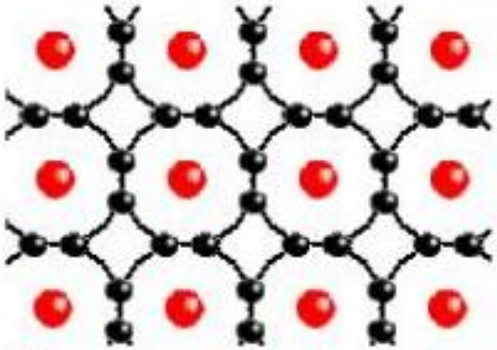
50. Insulators are materials that have *more than 4 electrons in their outer orbit.* (tightly held)

Mica, Rubber, Some Plastics

Semi conductors have exactly 4 electrons in their valence ring

Silicon & Germanium





Silicon Atoms sharing electrons to make each other happy.

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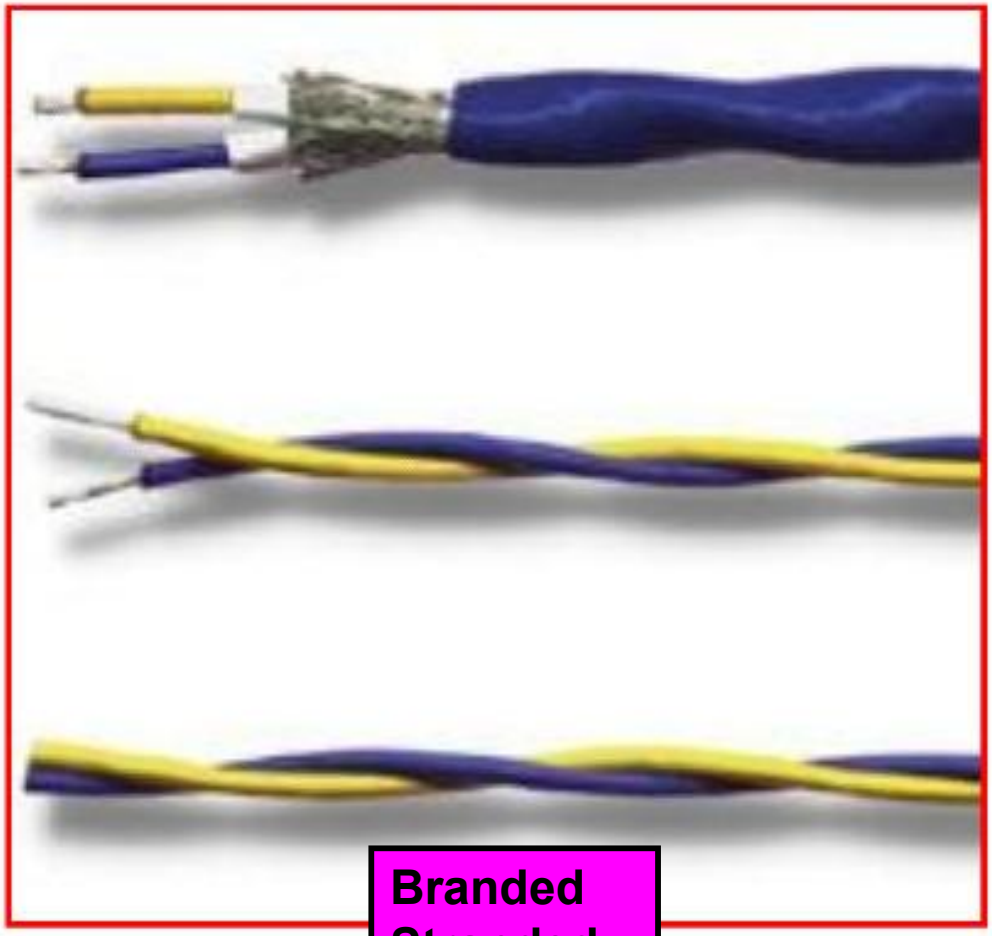
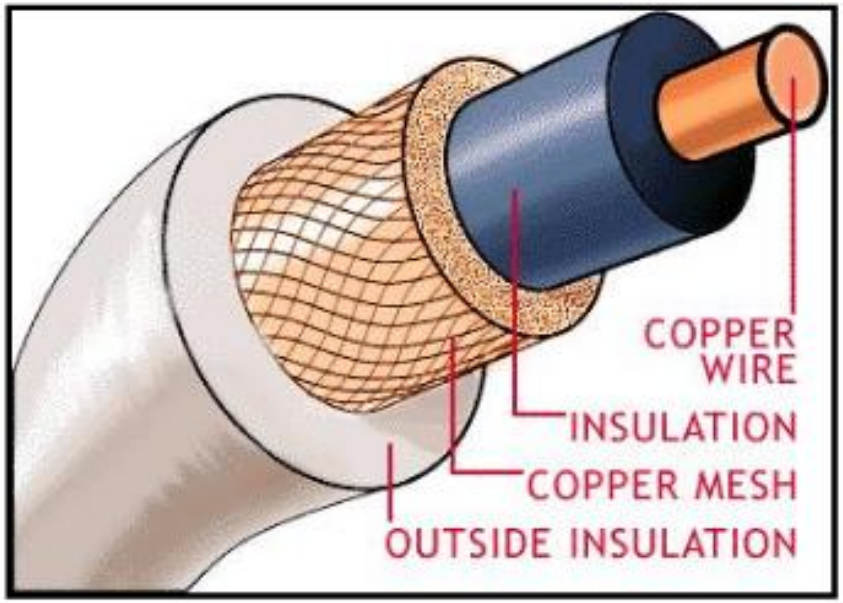
51. Most automotive wiring is multi-_____ for flexibility. A shielded cable, like coaxial, or twisted pairs are often used to prevent unwanted induced voltage interference in CAN circuits.



Branded
Stranded
Demanded



A bundle of unshielded twisted pair (UTP)

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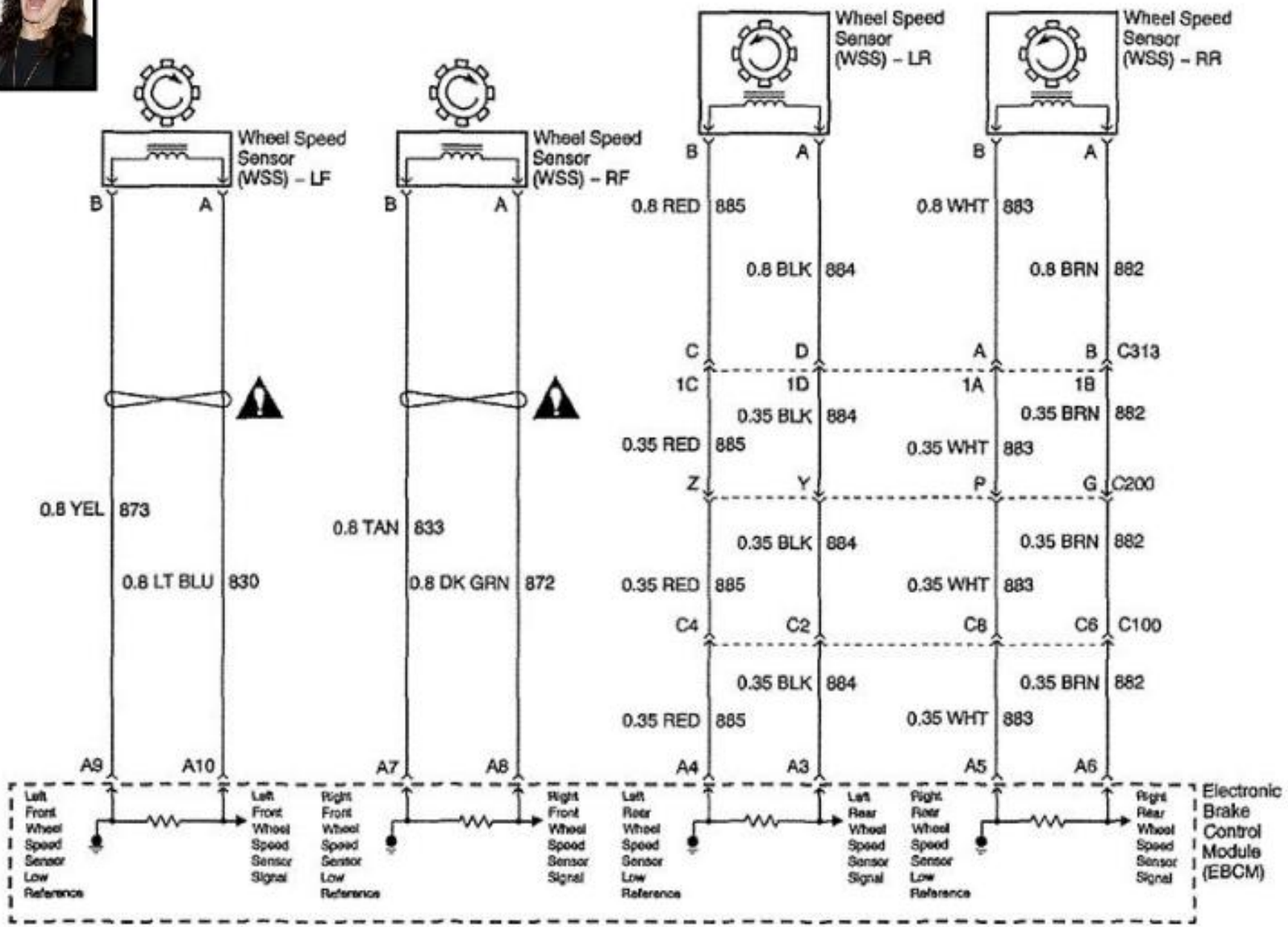


52. The larger the AWG number, the _____ in diameter a wire is. (metric is opposite!!)

Smaller
Larger

Conversion table - American Wire Gauge - mm. - mm^2

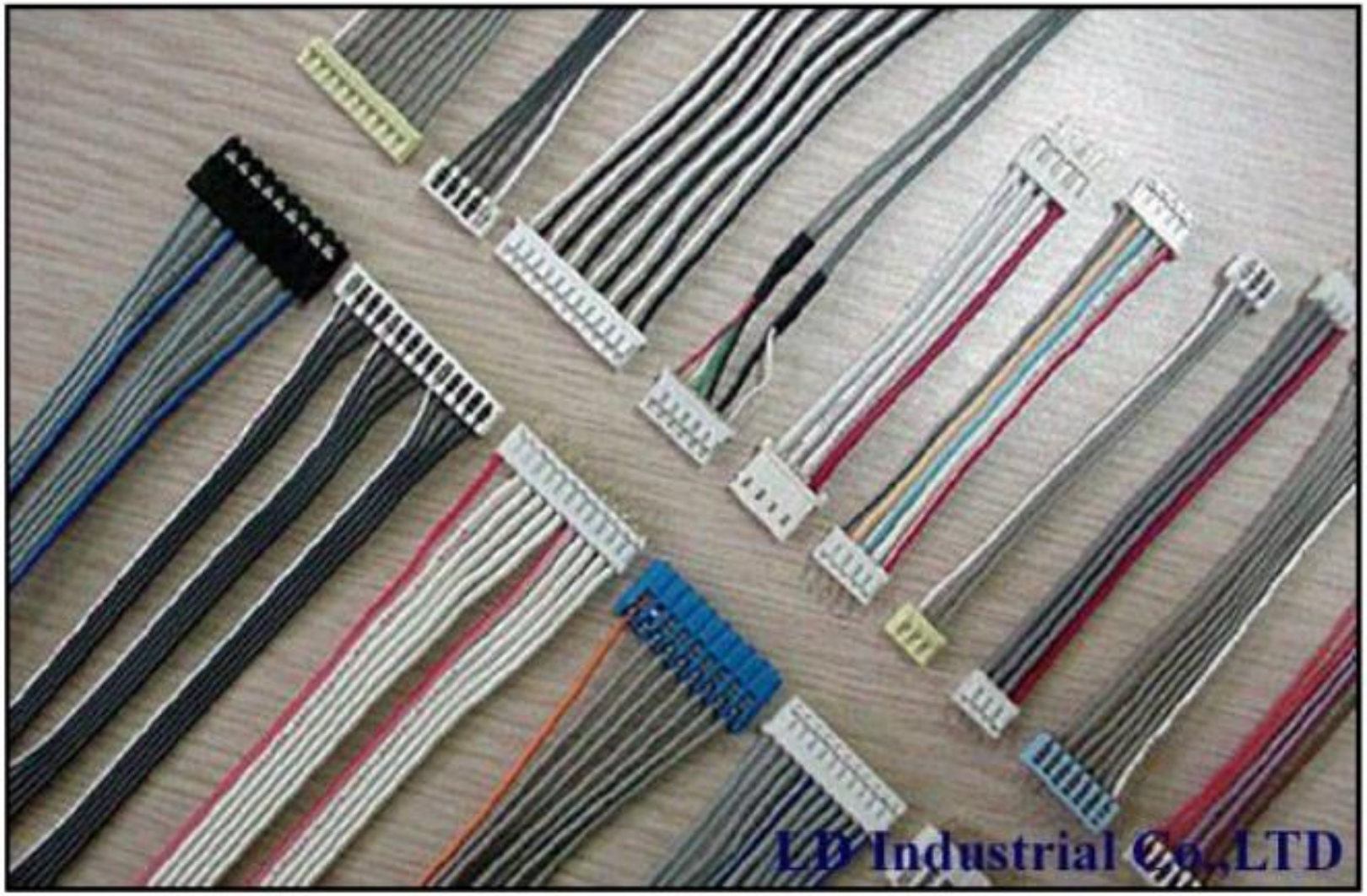
AWG N°	Diam. mm.	Area mm^2	AWG N°	Diam. mm.	Area mm^2
1	7,350	42,400	16	1,290	1,3100
2	6,540	33,600	17	1,150	1,0400
3	5,190	21,200	18	1,024	0,8230
4	5,190	21,200	19	0,912	0,6530
5	4,620	16,800	20	0,812	0,5190
6	4,110	13,300	21	0,723	0,4120
7	3,670	10,600	22	0,644	0,3250
8	3,260	8,350	23	0,573	0,2590
9	2,910	6,620	24	0,511	0,2050
10	2,590	5,270	25	0,455	0,1630
11	2,300	4,150	26	0,405	0,1280
12	2,050	3,310	27	0,361	0,1020
13	1,830	2,630	28	0,321	0,0804
14	1,630	2,080	29	0,286	0,0646
15	1,450	1,650	30	0,255	0,0503

Tnt-Audio Internet HiFi Review http://www.tnt-audio.com

Benchmark: 1mm = .040”

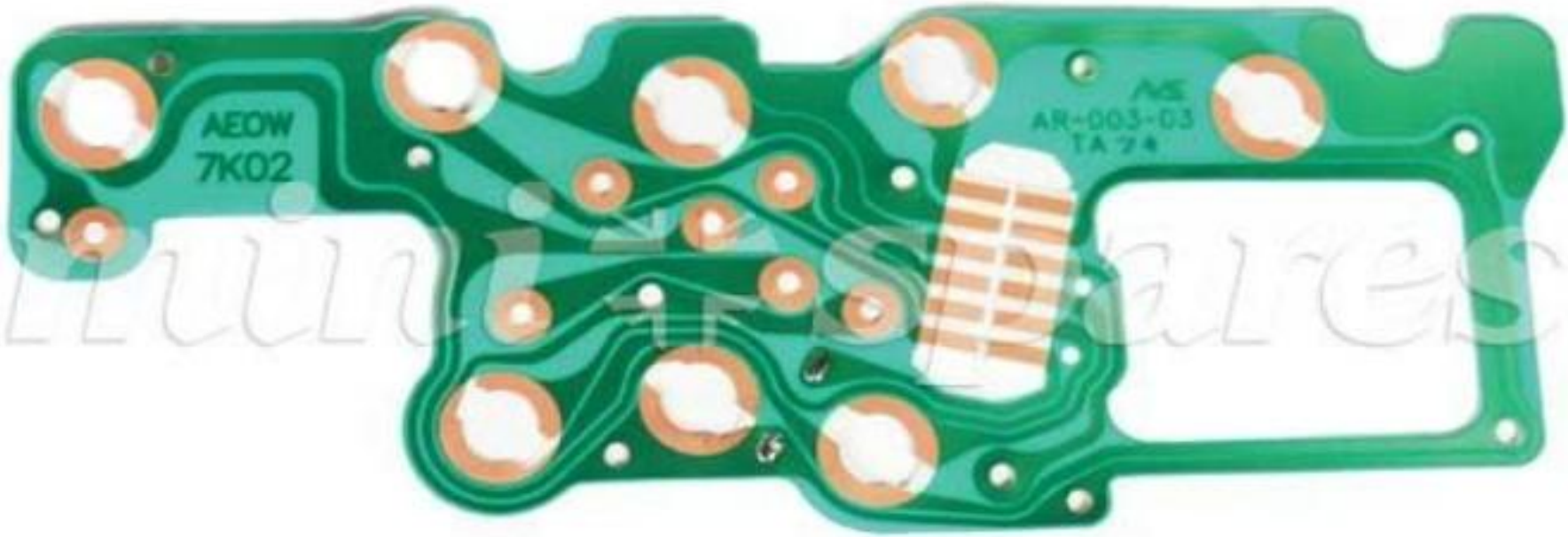
12 gage ≈ 2 mm in diameter or .080” in diameter

53. _____ wiring reduces the bulge or thickness of a wiring harness. This type of wiring is used inside of computer modules and in the steering column where space is limited.



Oval
Flat
Round

54. _____ circuit boards are used inside of computer modules and in the instrument cluster.


AEOW
7K02
AR-003-03
TA 7 4

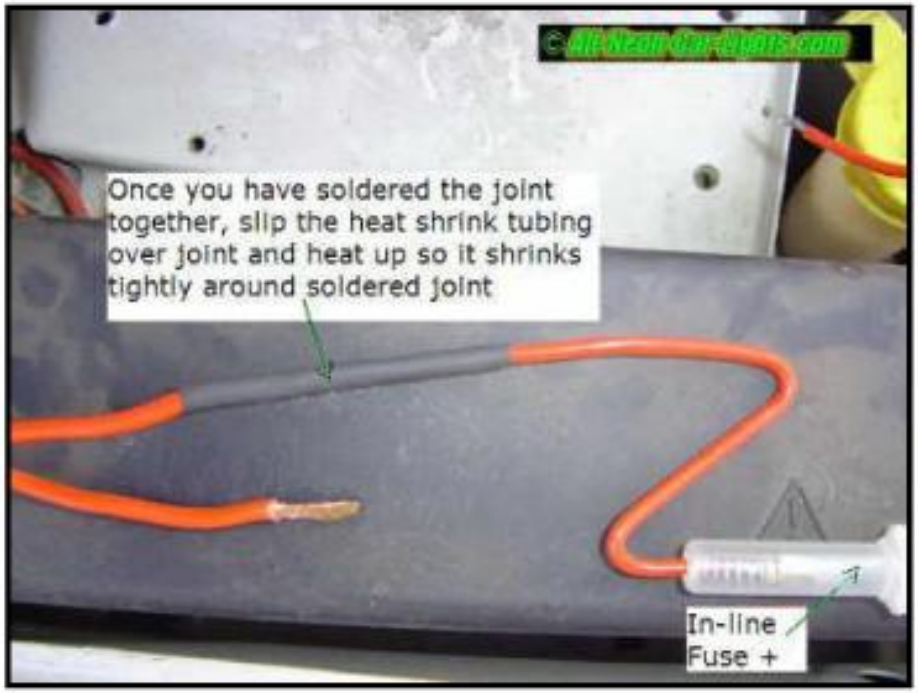

ESOTERIC
PCB,DAC CAL ES
E953206-00A
MADE IN JAPAN

Proper wire repair means crimping, soldering and placing heat shrink tubing over the splice.

Acid Core Solder Or Flux Corrodes Wiring & Causes Voltage Drops!

Use Only Rosin Core Solder


Use heat gun to shrink
the heat shrink tubing


Once you have soldered the joint together, slip the heat shrink tubing over joint and heat up so it shrinks tightly around soldered joint
In-line Fuse +

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If you were taking notes, they should look like this

A) **Electron Flow - Repulsion of electrons = electricity**

a. **protons** - positive charge, located in the nucleus

b. **neutrons** - neutral charge, located in the nucleus

c. **electrons** - negative charge, located in the outer orbits

1. **conductors** - less than 4 electrons in the outer valance orbits
2. **semi-conductors** - exactly 4 electrons in the outer valance orbits
3. **insulators** - more than 4 electrons in the outer valance orbits

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If you were taking notes, they should look like this

B) Circuit - path for electron flow, a closed circuit is on, an open circuit is off

a. **consumer** - names the circuit, uses the electricity, has the resistance, gets hot

b. **source** - has the voltage or "the push" to cause flow

1. chemical = battery made with 2 dissimilar metals in acid
2. mechanical = generator made by cutting magnetic fields with coiled conductors (move either the magnet fields or the coils)
3. static = sweep a dry floor and the sparks fly!
4. piezo = compress a crystal such as quartz & a small voltage is generated
5. thermocouple = heat a junction of dissimilar metals & a small voltage is generated

c. **conductive path** - to and from the source through the user, carries the current

1. contains switches, wiring, protection such as fuses & circuit breakers
2. one-wire system of conductive path makes the return path through either:

a) body
b) framework
c) engine or transmission

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If you were taking notes, they should look like this

C) Circuit Types

a. **series** - consumers arranged like links of a chain - voltage drops at each consumer
amperage is the same throughout, sum of all resistances equals the total resistance

b. **parallel** - consumers arranged like rungs of a ladder - voltage supplied to each consumer is the same
amperage varies at each branch, total resistance is less than the smallest resistive branch
the sum of the current in all the branches equals the total circuit amperage

c. **series-parallel** - combination

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If you were taking notes, they should look like this

D) Units of Electrical Measure

a. **Voltage** - Electromotive Force or push that causes flow (E, EMF, V)
source V = A x O **E = I x R**

b. **Ohms** - Resistance to electron flow (R, O, CEMF)
consumer O = V ÷ A **R = E/I**

c. **Amperage** - Intensity of electron flow, rate of flow , (I, A)
conductive path A = V ÷ O **I = E/R**

d. **Wattage** - Power Consumption (P, W)
W = A x V **P = E x I**

e. **Ohm's Law** is the mathematical relationship between volts, amps, ohms in electrical circuits.

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If you were taking notes, they should look like this

E) Circuit Problems - fall into 3 general categories

a. **opens** - breaks in the circuit consumer or the conductive path
shown as OL or infinite resistance on an ohmmeter

b. **shorts** - to either power or to ground

1. *short to hot* = the consumer is energized at all times

2. *short to ground* = the consumer may be on at all times or may be off at all times

blows fuses or circuit breakers in series circuits if it occurs before consumers

"a fuse never blows without a reason"...too much amperage flow due to too little resistance

c. **high resistance problems** - reduce the intensity or amperage flow to a consumer by adding an undesired voltage drop ***(either on the hot side or the ground side)***

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If you were taking notes, they should look like this

F) **Systems on the Vehicle & on the Engine**

a. **cranking** – spins the engine to initiate the 4 stroke cycle events

b. **charging** – recharges the battery & supplies current for all electrical loads while running

c. **ignition** - sends the kV surge to the plugs with exact timing (distributor, distributorless, coil-on-plug)

d. **accessory & lighting** – operates electronic options and lighting systems

e. **electronic engine controls** – work to attain optimum mileage, performance, and emissions

f. **module communication network** - also known as a "bus" or a Controller Area Network "CAN"

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If you were taking notes, they should look like this

G) Digital Multi-Meter Use DMM or DVOM

a. **ohms tests** - made on components removed from the circuit or without the circuit powered up

1. OL = open = infinite resistance = off = circuit broken
2. less than specified ohms in a coil = melted (shortened)
3. greater resistance than specs = corrosion = voltage drop

b. **volts tests** - connect the meter in parallel to check for source volts

1. + to - is an "available test" for source voltage
2. check for grounds available by probing + and looking for -
3. connect from + to + and operate circuit for "hot or insulated" Voltage Drop
4. connect from - to - and operate circuit for "ground" Voltage Drop

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If you were taking notes, they should look like this

c. **amps tests** - to find current flow in the circuit

1. series connections anywhere in a series circuit or
   series connections in each branch of a parallel circuit

2. inductive connections around any wire you wish to measure flow through

d. **diode testing** - with the "diode test" scale of a DMM

1. ***a good diode reads .4 to .7 voltage drop forward biased***
   red to + and black to - (its conducting but with some VD)

2. ***a good diode reads OL when reverse biased***
   red to - and black to + (its completely blocking flow)

3. **short diodes** conduct easily in both directions
   suspect when battery drains overnight

4. **open diodes** measure OL in both directions
   suspect when no charge is present but coil are good

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If you were taking notes, they should look like this

H) Schematics - symbols used for illustrating circuits, a "must-know" for design and for troubleshooting

a. Be able to sketch common automotive electrical schematic symbols

b. Be able to draw circuits using common automotive electrical schematic symbols

c. Be able to trace power distribution & ground paths in schematic circuit drawings.

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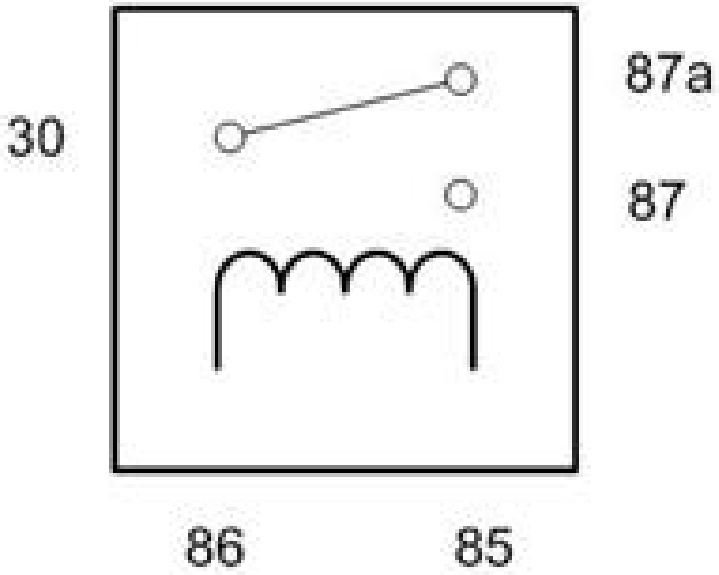
If you were taking notes, they should look like this

Relay Wiring Guide and
Terminal Numbers



30 - High Power Feed (Must be Fused!)
85 - Relay Coil Ground
86 - Relay Coil Feed (Trigger Wire)
87 - High Power Output - Normally Open Contact
87a - High Power Output - Normally Closed Contact

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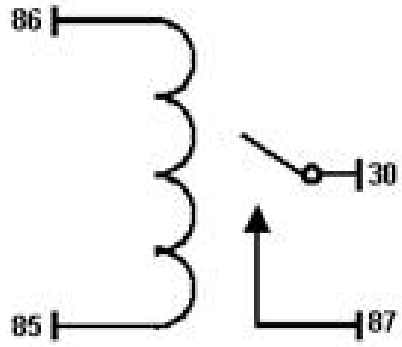
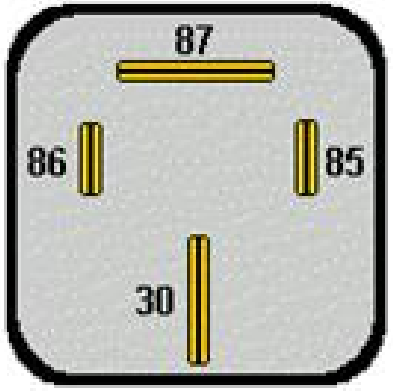
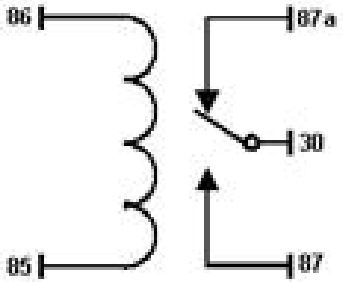
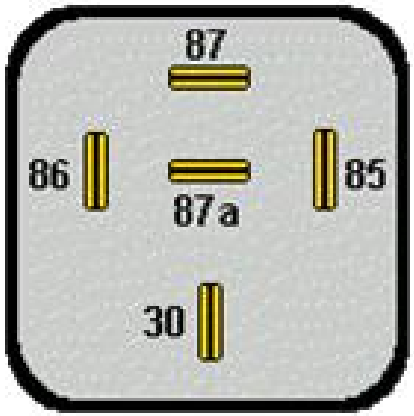
If you were taking notes, they should look like this



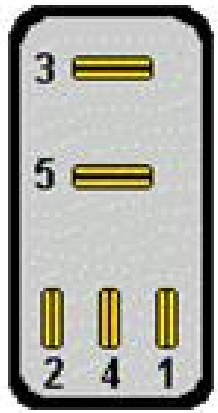


Super ISO

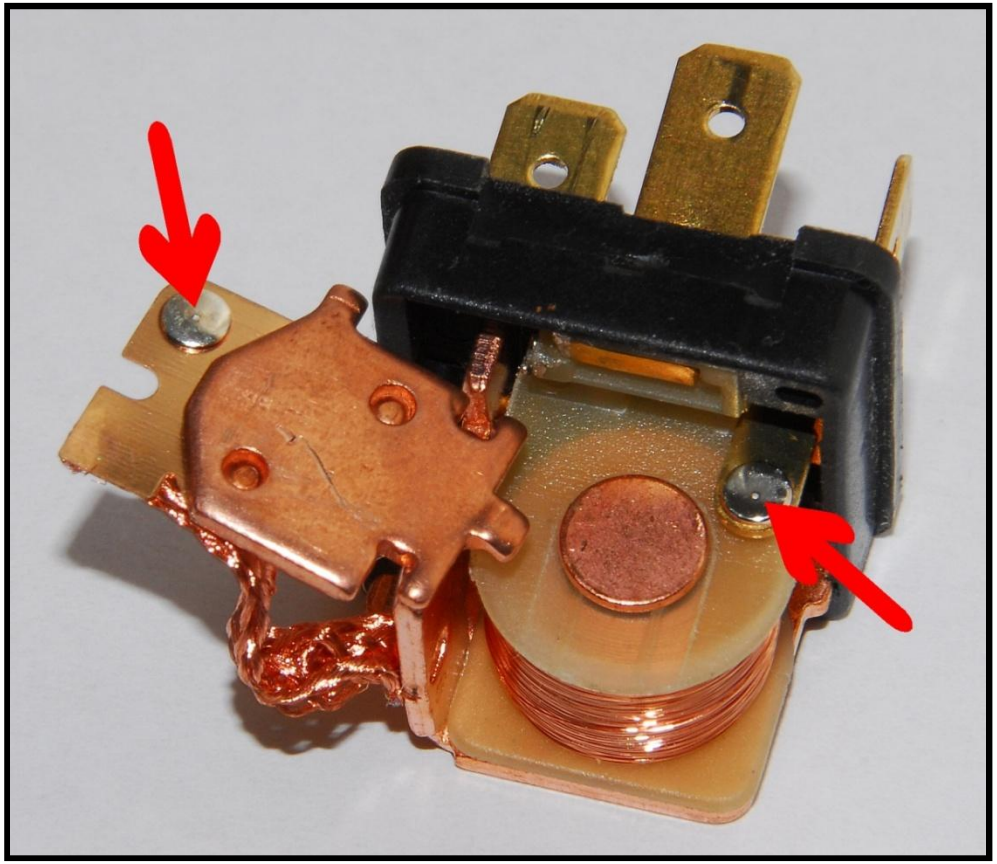




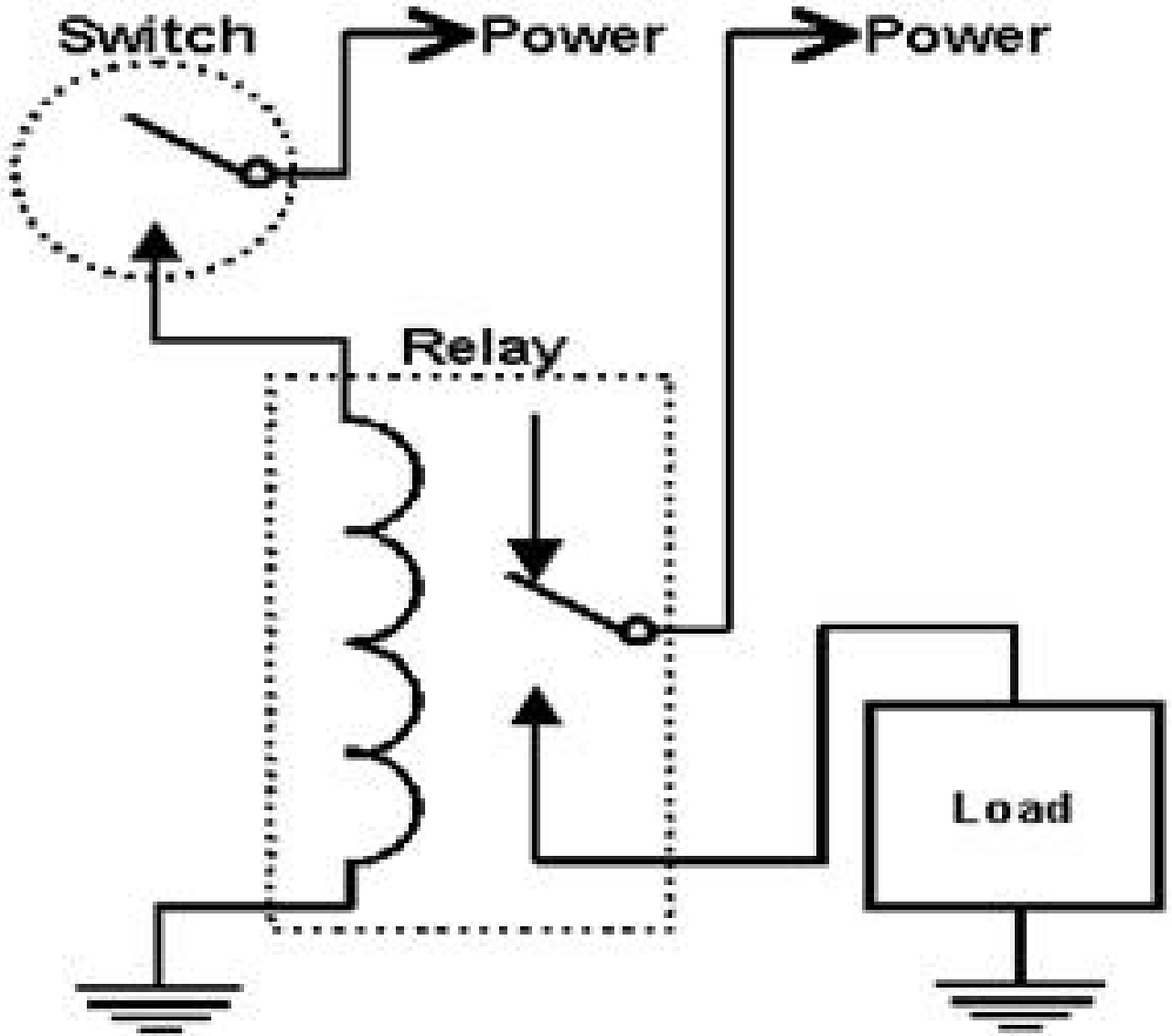
ISO Relay



1/2 ISO



If you were taking notes, they should look like this



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Automotive Schematic Symbols

Know the Schematic Symbols

Mentally Picture the Component

AUTOMOTIVE ELECTRICAL SYMBOLS			
SYMBOL	REPRESENTS	SYMBOL	REPRESENTS
ALT	ALTERNATOR	HORN	HORN
A	AMMETER		LAMP OR BULB (PREFERRED)
	BATTERY – ONE CELL		LAMP OR BULB (ACCEPTABLE)
	BATTERY – MULTICELL	MOT	MOTOR – ELECTRIC
12V + –	THE LONG LINE IS ALWAYS POSITIVE POLARITY	–	NEGATIVE
+ BAT –	BATTERY – VOLTAGE BOX	+	POSITIVE
	BIMETAL STRIP		RELAY
	CABLE – CONNECTED		RESISTOR
	CABLE – NOT CONNECTED		RESISTOR – VARIABLE
	CAPACITOR	IDLE STOP	SOLENOID – IDLE STOP
	CIRCUIT BREAKER	B SOL STARTING MOTOR	STARTING MOTOR
	CONNECTOR – FEMALE CONTACT		SWITCH – SINGLE THROW
	CONNECTOR – MALE CONTACT		SWITCH – DOUBLE THROW
	CONNECTORS – SEPARABLE – ENGAGED	TACH	TACHOMETER
	DIODE		TERMINATION
HEI	DISTRIBUTOR	V	VOLTMETER
	FUSE	OR	WINDING – INDUCTOR
FUEL	GAUGE – FUEL		
TEMP	GAUGE – TEMPERATURE		
	GROUND – CHASSIS FRAME (PREFERRED)		
	GROUND – CHASSIS FRAME (ACCEPTABLE)		

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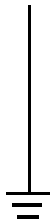
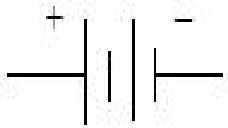


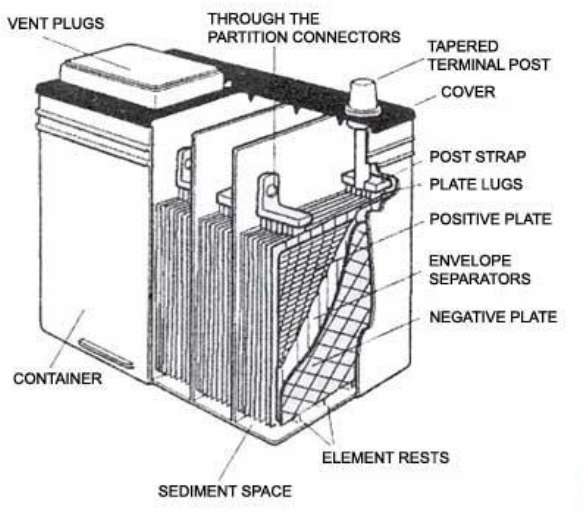
Ground

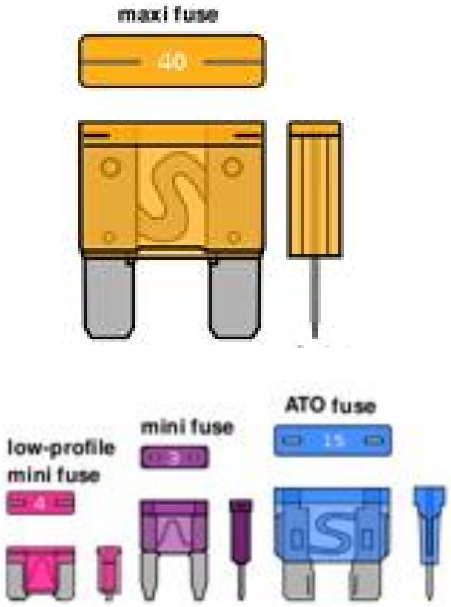


Battery

Fuse

Circuit Breaker





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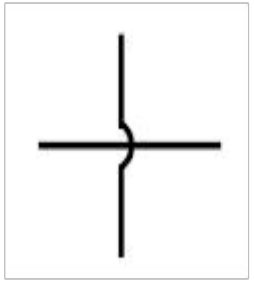
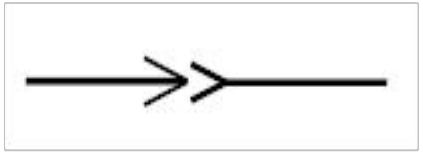
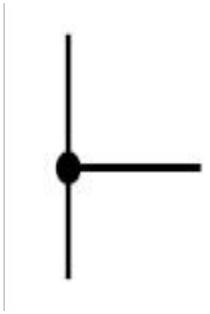
Wire



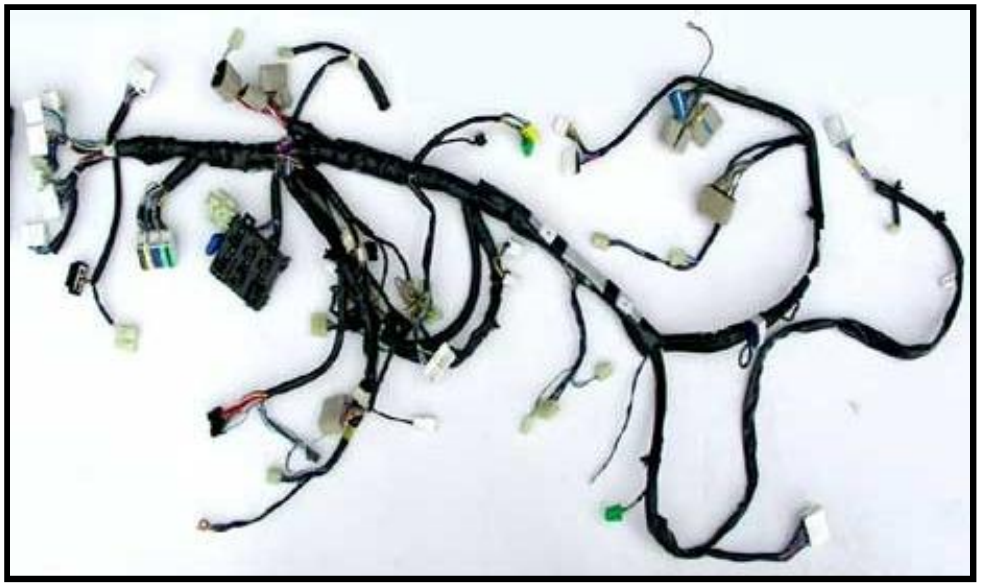
Wires Crossing

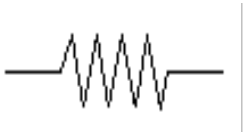


Wire Connector



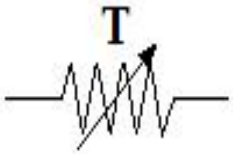
Wire Splice



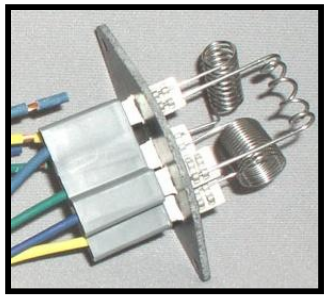


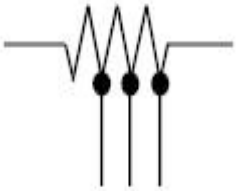
Resistor

Variable Resistor

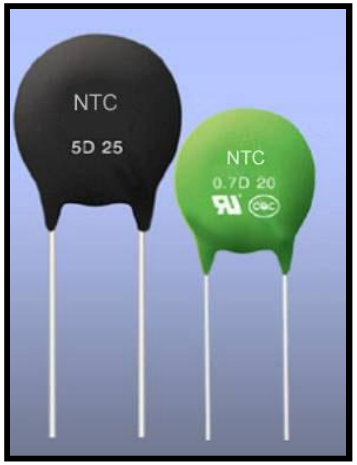


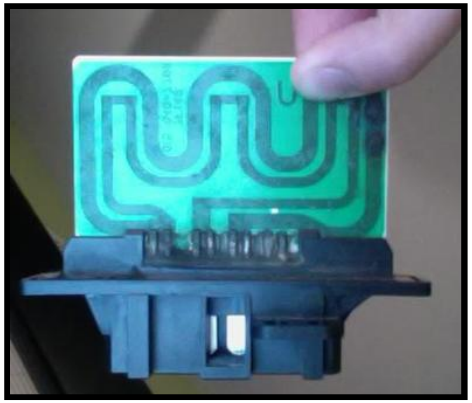
Thermistor

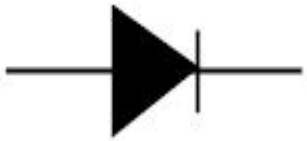




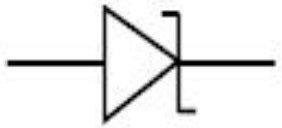
Stepped Resistor



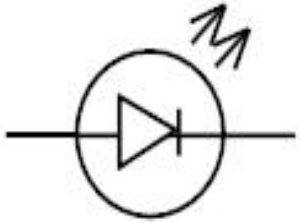




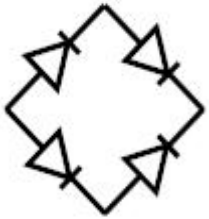
Diode



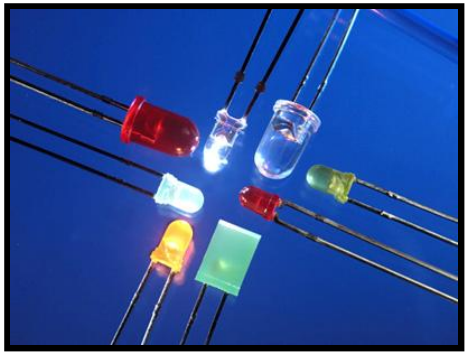
Zener Diode



Light Emitting Diode



Rectifier Bridge



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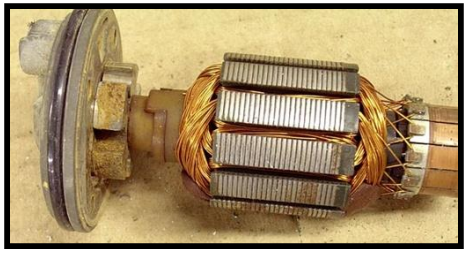

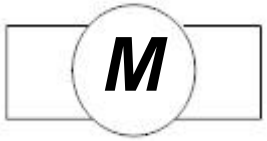

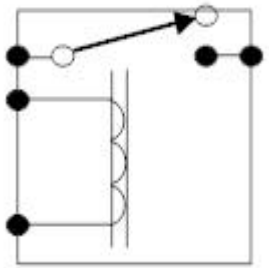

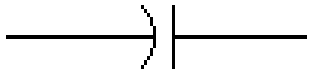

Motor

Generator

Relay

Capacitor

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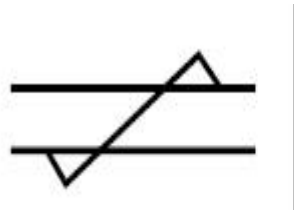
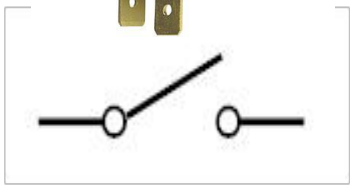
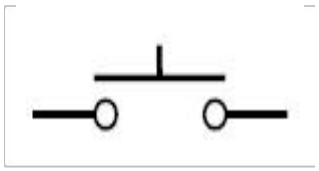


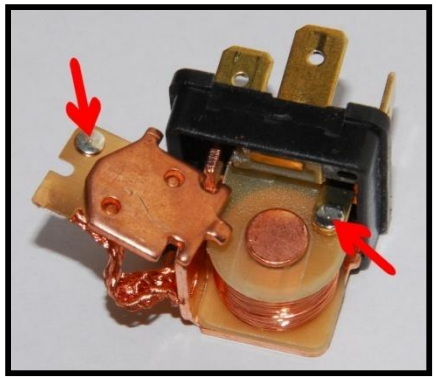
Twisted Pair of Wires

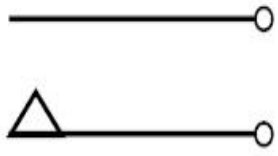


Switch

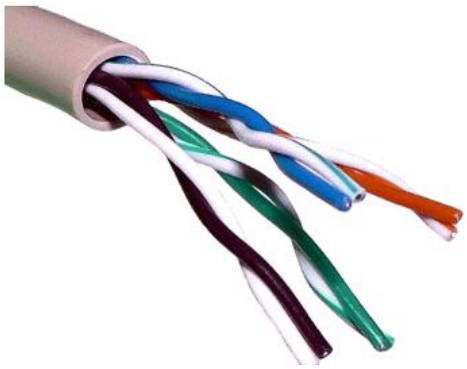


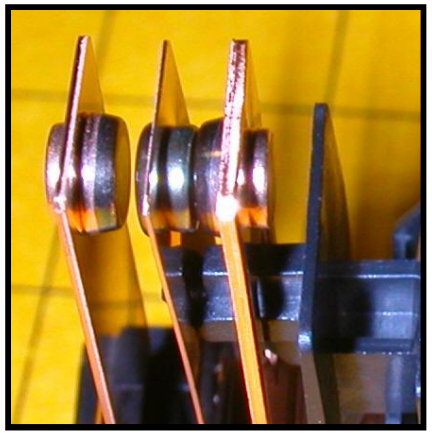
Momentary Switch





Contacts





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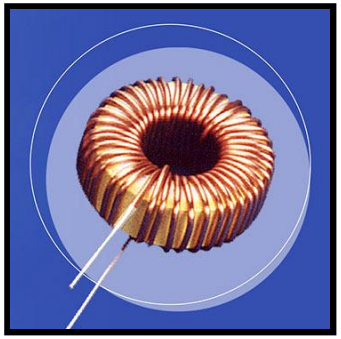
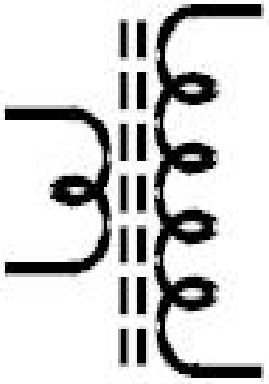
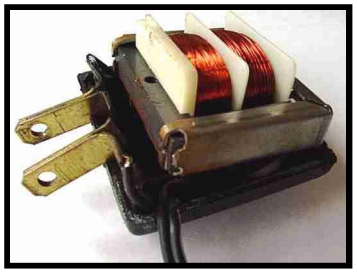
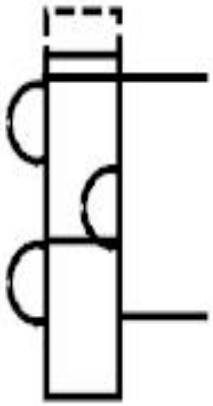
Coil of Wire



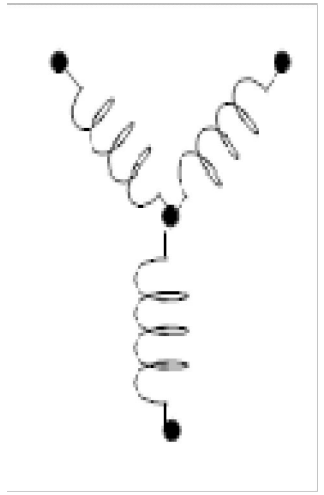


Transformer





Solenoid Coil



Wye- Wound Stator

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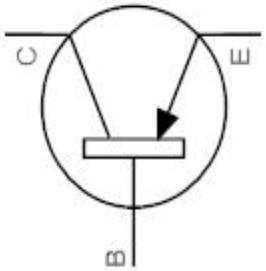
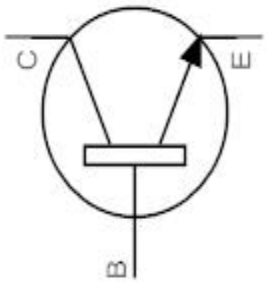
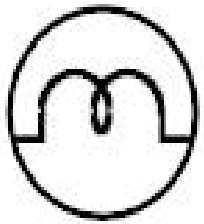


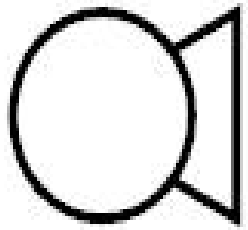
PNP Transistor



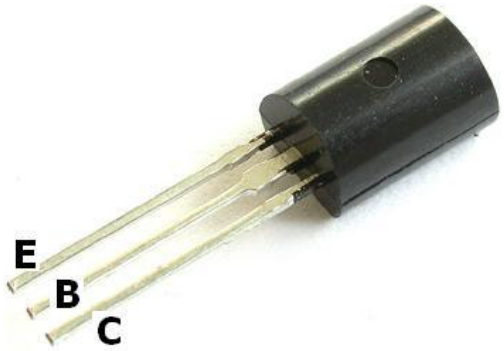
NPN Transistor

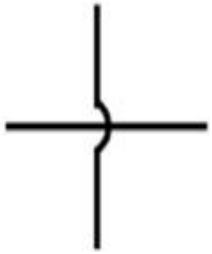


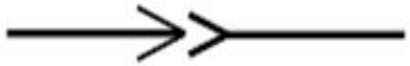
Bulb

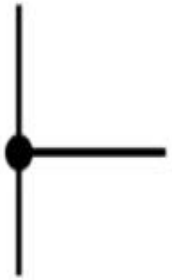


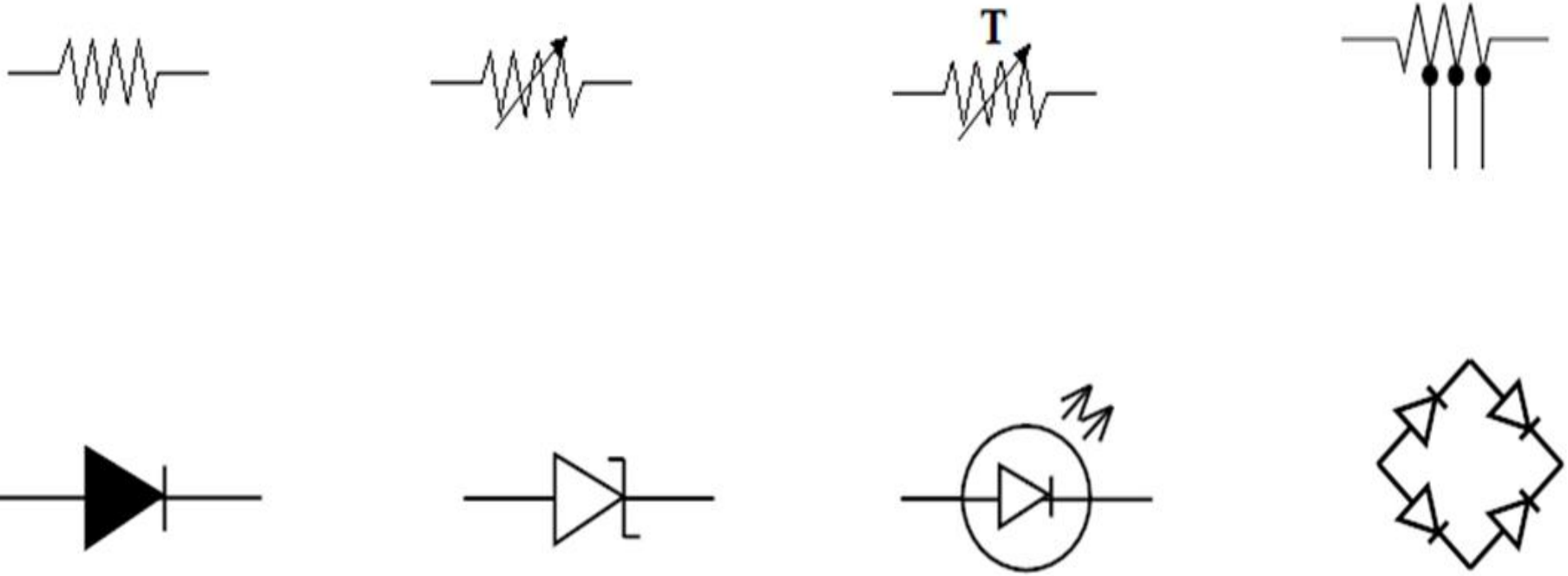
Horn







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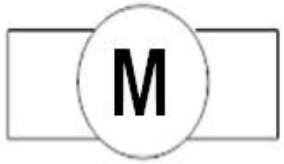
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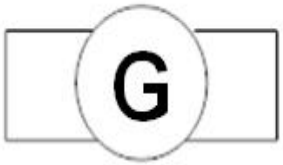
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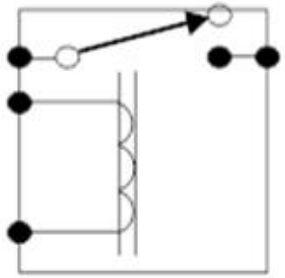

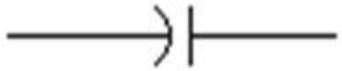

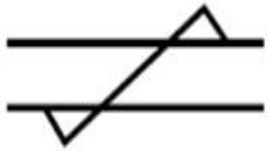

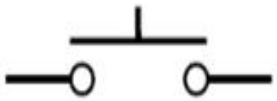

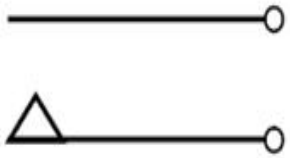

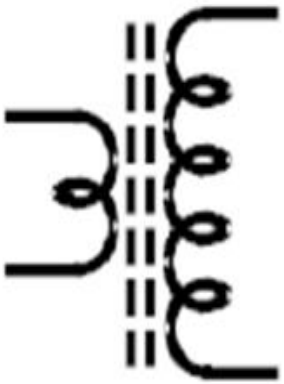

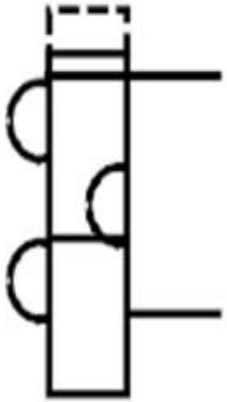

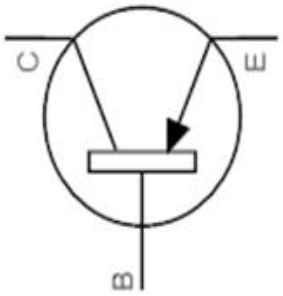
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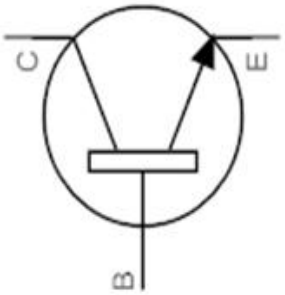
E
B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