

## Exploratory Design & Engineering II Review

Exam Format: - 83 Questions ( Multiple Choice / True False / Matching )

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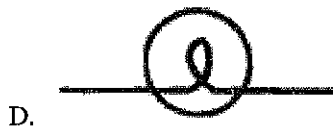
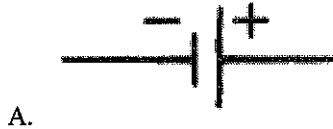
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### **Schematic Diagram Symbols**

*Name the following symbols:*



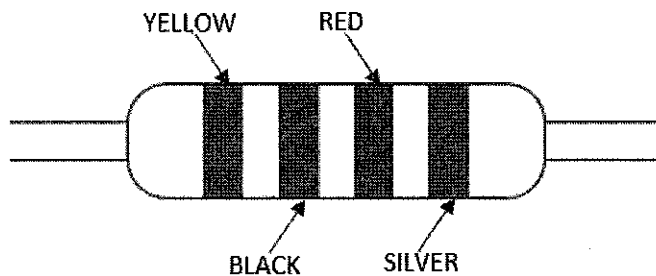
*Resistor Values*

Use the chart below to give the correct value of the following resistors:

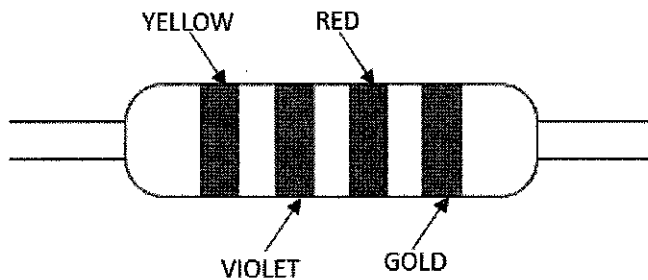
**RESISTOR COLOR CODE**

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER
BLACK	0	0	1
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000 (K)
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000 (M)
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	1,000,000,000

TOLERANCE: NO COLOR  $\pm 20\%$ , SILVER  $\pm 10\%$ , AND GOLD  $\pm 5\%$



A.



B.

***OHM's Law***

*Use the formulas below to answer the following questions:*

Voltage (V) is measured in Volts  
Current (I) is measured in Amps  
Resistance (R) is measured in Ohm's

$$V = I \times R$$

$$I = V / R$$

$$R = V / I$$

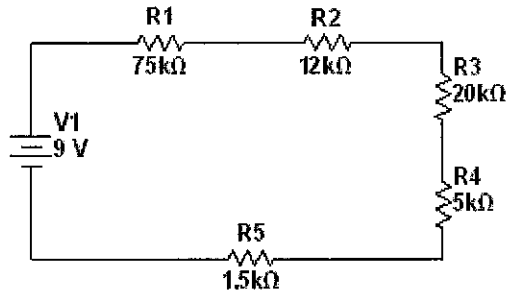
- A. If the current is 15A and the voltage is 45V, what is the resistance?
- B. If the voltage is 30V and the resistance is 100Ω, what is the current?
- C. If the resistance is 1kΩ and the current is 5A, what is the voltage?

***Series Circuit***

*Use the formula below to answer the following question:*

Resistance Total (Rt) in a series circuit = R1 + R2 + R3 .....

- A. What is the resistance total of the circuit below?



**Parallel Circuit**

Use the formulas below to answer the following questions:

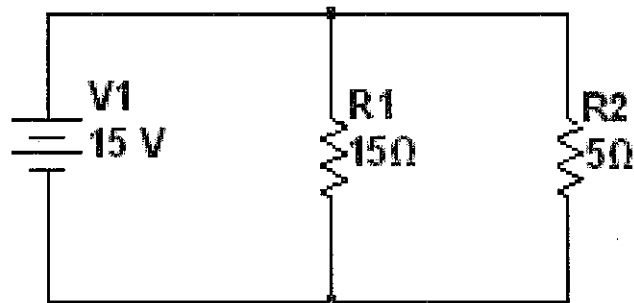
(for only 2 resistors)

$$R_t = \frac{R_1 \times R_2}{R_1 + R_2}$$

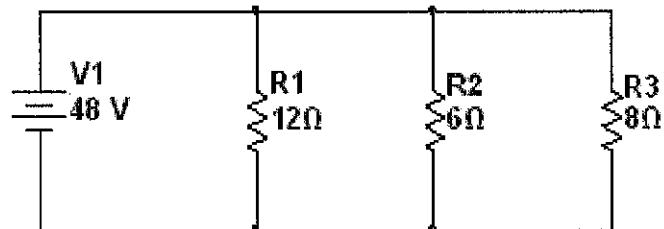
(for more than 2 resistors)

$$R_t = \frac{1}{\left( \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right)}$$

A. What is the resistance total of the circuit below?

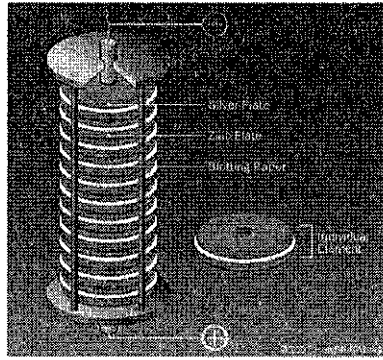


B. What is the resistance total of the circuit below?

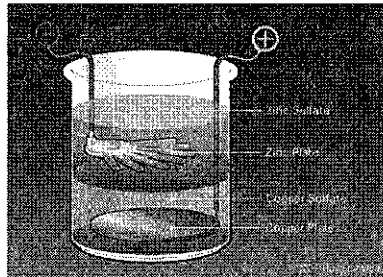


## Battery Unit

- A. Who made a battery by piling up layers of silver, paper or cloth soaked in salt, and zinc?
- B. The \_\_\_\_\_, which produced about 1.1 volts, was used to power telegraphs, telephones, and even to ring doorbells in homes for over 100 years.
- C. Identify the battery in the picture below.

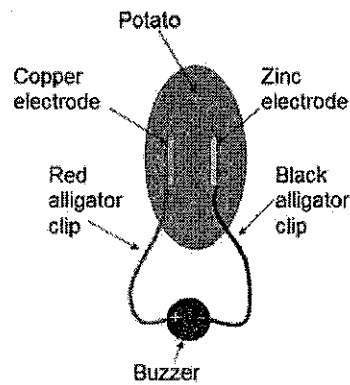


- D. What kind of battery has a reversible reaction making them rechargeable?
- E. Identify the battery in the picture below.



- F. To properly harness the electric charge produced by a battery, you must connect it to a \_\_\_\_\_ which might be something like a light bulb, a motor or an electronic circuit like a radio.
- G. During the lemon battery experiment you put two different metals into the lemon. What do these two metals represent?
- H. The internal workings of a battery are typically housed within a metal or plastic case. Inside this case are a \_\_\_\_\_, which connects to the positive terminal, and an \_\_\_\_\_, which connects to the negative terminal.
- I. Batteries have a positive and negative \_\_\_\_\_?
- J. When a nickel-cadmium battery is recharged before it discharges the majority of its power, it essentially "forgets" that it could fully discharge to begin with. This problem is termed the \_\_\_\_\_.
- K. What was the first accurate electrical measuring instrument?
- L. It is believed that the Baghdad batteries may have been used for \_\_\_\_\_?

M. Using the picture in question below: what represents the load?

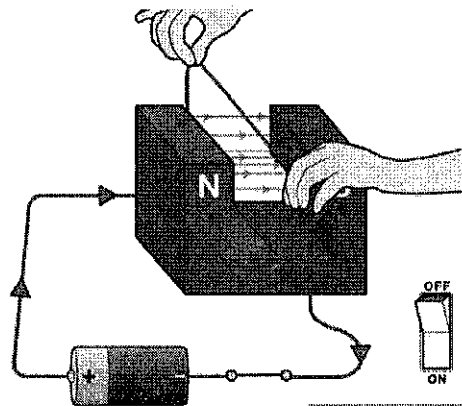


N. Using the picture in question M: what represents the electrolyte?

O. At the most basic level a battery is a device that produces the movement of \_\_\_\_\_?

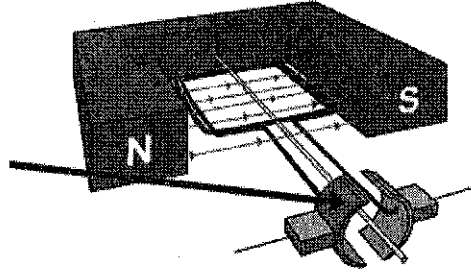
### **Motor Unit**

- A. What will happen if you move a wire through a magnetic field?
- B. What is Flemings Left Hand Rule?
- C. How do power stations turn generators to produce electricity on a large scale?
- D. How can you increase the amount of current generated in an electrical motor?
- E. What will increase an induced current?
- F. Using the picture below: which direction will the wire move?



G. \_\_\_\_\_ is the current produced by most electrical generators.

H. What part of the motor is the line pointing to in the picture below?



I. What type of current is a current that constantly changes direction?

J. \_\_\_\_\_ is a device that converts mechanical energy into electrical energy.

K. What is the part of a motor that enables the coil to rotate using direct current?

L. Most motors are powered using \_\_\_\_\_ which is produced by cells and batteries.

M. What is a current that always flows in the same direction?

N. \_\_\_\_\_ generates a current in a wire by moving the wire in a magnetic field or by moving a magnet inside a coil.

O. \_\_\_\_\_ is the part of a generator that enables the rotating coil to produce alternating current.

P. \_\_\_\_\_ is a device that converts electrical energy into mechanical energy to produce a turning effect.

*Are the following statements true or false?*

Q. The length of wire in a magnetic field has no effect on the size of the force.

R. A current carrying wire held parallel to a magnetic field will experience a force.

S. Reversing the current reverses the direction of force.

T. A generator is similar to a motor except that it converts mechanical energy into electrical energy.

U. A stationary magnet inside a coil of wire does not produce a current.

V. Reversing the magnetic field has no effect on the direction of the force.

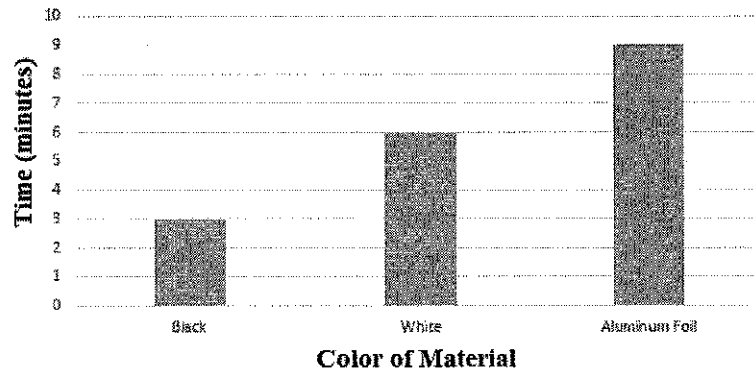
W. You only need to know the direction of the current to predict the direction of the force.

X. Moving a wire inside a magnetic field induces a current in the wire.

Y. Increasing the strength of the magnet or the current will increase the size of the force.

## Solar Unit

- A. What are advantages of solar energy?
- B. What are benefits of solar energy?
- C. What are disadvantages of solar energy?
- D. What two major forms of energy are provided to the earth by the sun?
- E. Using the picture below: how much longer did it take the ice cube on the aluminum foil to melt compared to the ice cube on the black paper?



- F. Using the picture in question E: what material will keep a drink cool in the sun?
- G. Using the picture below: what would happen to the electrical output of the solar cell if there was a reduction in solar radiation?

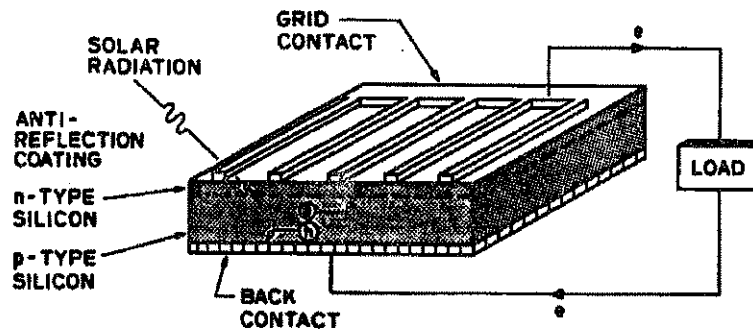


Figure 1. The structure of a solar cell.

- H. Using the picture in question G: why is there an anti-reflection coating on the solar cell?
- I. What would be the best color to wear if you wanted to stay warm?
- J. Where on earth would you expect much of the sun's light to be reflected?
- K. A solar farm is a large land area where multiple ground-mount solar tracking towers are installed. As the earth rotates the solar panels automatically move themselves to track the sun. What is the benefit of this action?



- L. The images below represent the sun's rays hitting a 1.5 v solar cells at two different angles. Which image will produce the most voltage?

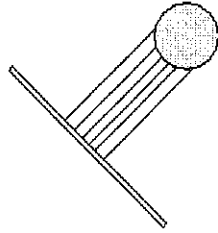


Image A

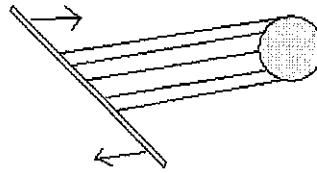


Image B

- M. Using the images in question L which voltage would you expect to measure from the cell in Image A?
- N. What type of current do solar panels produce?

*Are the following statements true or false?*

- O. Satellites in space use solar energy to power their equipment.
- P. Light is a form of energy.
- Q. When light hits an object that energy is absorbed and transformed into heat energy.
- R. Humans started harnessing the power of the sun only within the last 100 years.
- S. The primary barrier to using solar energy in the United States is that it is not economically competitive with other energy sources.
- T. The earth's atmosphere, oceans and land masses absorbs more solar energy in one hour than the world energy consumption in one year.

## Exploratory Design & Engineering II Review Answer Key

### Schematic Diagram Symbols

- A. Battery
- B. Resistor
- C. Switch
- D. Light
- E. Wire

### Resistor Values

- A.  $4K\Omega \pm 10\%$
- B.  $4.7K\Omega \pm 5\%$

### OHM's Law

- A.  $3\Omega$
- B. .3A
- C. 5kV

### Series Circuit

- A.  $113.5k\Omega$

### Parallel Circuit

- A.  $3.75\Omega$
- B.  $2.66\Omega$

### Battery Unit

- A. Alessandro Volta
- B. Daniell Cell
- C. Voltaic Pile
- D. Lithium-iodine
- E. Daniell Cell
- F. Load
- G. Positive & negative terminals and electrolytes
- H. Cathode / Anode
- I. Terminal
- J. Memory Effect
- K. Multi-meter
- L. Electroplating gold into silver
- M. Buzzer
- N. Potato
- O. Electrons

### Motor Unit

- A. It will induce a current
- B. A way to predict the direction of the force acting on a wire- its motion – if the direction of the current or the magnetic field are known.

- C. High pressure steam, wind, and falling water
- D. Increase the number of turns on the coil
- E. Rotate the coils faster, use stronger magnet, and use more coils
- F. Down
- G. Alternating current
- H. Slip ring communicator
- I. Alternating current
- J. Generator
- K. Communicator
- L. Direct current
- M. Direct current
- N. Induction
- O. Slip rings
- P. Electric motor
- Q. False
- R. False
- S. True
- T. True
- U. True
- V. False
- W. False
- X. True
- Y. True

### Solar Unit

- A. Low operating costs and little maintenance
- B. Reduction in pollution and dependence on fossil fuels
- C. High initial costs
- D. Solar and wind
- E. 6 minutes
- F. Aluminum foil
- G. The electrical output would decrease
- H. To stop annoying glare
- I. Black
- J. The polar ice caps
- K. To collect as much light as possible
- L. Image A
- M. 1.5v
- N. Dc
- O. True
- P. True
- Q. True
- R. False
- S. True
- T. True