Circuit Lab (B) SSSS 2020 Test

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**** DO NOT WRITE FINAL ANSWERS ON THIS TEST - ALL ANSWERS GO ON ANSWER SHEET ****

Part I: Important Figures

Match the Number to the Letter
(1 point each)

1. Alessandro Volta	**A.** Pioneered the identification of the elements in the Sun
2. Georg Simon Ohm	**B.** First to discover and isolate methane gas
3. Nikola Tesla	**C.** Invented a fully radio-controlled boat and remote control
4. Heinrich Hertz	**D.** Discovered electromagnetic rotation using a mercury bath
5. Michael Faraday	**E.** Invented wireless telegraphy through radio waves
6. Charles Coulomb	**F.** Found that electricity acts similar to water within a pipe
7. Gustav Kirchhoff	**G.** Invented the torsion balance to measure small charges

True or False
(1 point each)

1. Nikola Tesla invented LED lights _____
2. Georg Simon Ohm invented the hair dryer _____
3. Alessandro Volta created the first drone _____
4. Heinrich Hertz invented the simplest antennas _____
5. Gustav Kirchhoff discovered caesium and rubidium _____
6. Michael Faraday made the second electric motor _____
7. Charles Coulomb discovered the law of electrostatic force _____

Part II: Properties of Electrical Charges and Fields

Multiple Choice

(1 point each)

1. What is used to measure charge?
   a.) Joules
   b.) Coulombs
   c.) Volts
   d.) Ohms

2. In the equation q=ne, what does “e” represent?
   a.) The number of electrons
   b.) The charge on each electron
   c.) The eccentricity of each electron
   d.) The erraticity of each electron

3. What is used to measure electrical fields?
   a.) Ohms per volts
   b.) Coulombs per newton
   c.) Newtons per coulomb
   d.) Volts per amperes

4. What is the number of field lines directly proportional to?
   a.) The number of magnets present
   b.) The voltage of the batteries
   c.) The resistance against the current
   d.) The magnitude of the electric charge

5. When the line of force goes out of the charge, what does it mean?
   a.) The charge is positive
   b.) The charge is negative
   c.) The charge is neutral
   d.) The charge can be all of the above

6. When the line of force goes into the charge, what does it mean?
   a.) The charge is positive
   b.) The charge is negative
   c.) The charge is neutral
   d.) The charge can be all of the above

Part III: Coulomb's Law

(Short Answer)

1. The point charge has a magnitude of 4*10^-3 and the second charge has a magnitude of 2*10^-3. The distance between the charges is 0.32m. Determine the electrostatic force that the charges exert on each other and if it is an attractive or repulsive force. Round to the nearest thousandth. (5 points)

2. Name and describe two things that directly affect the magnitude of electric force. (1.5 points each)

3. Two positive charges with the same magnitude are 0.15m apart with a force equal to 19.6 N. Determine the magnitude of charge. (5 points) (**TB1**)

Part IV: Magnetism

Chart - Identify the following characteristics as true (by placing an "x" where the statement is true) for ferromagnetism, paramagnetism, and diamagnetism. (1 point for each correct. 1 point penalty for each wrong)

	Repelled by magnetic fields	Attracted by magnetic fields	Retains magnetic properties after removal of the magnetic field
Ferromagnetism			
Paramagnetism			
Diamagnetism			

Multiple Choice
(1 point each)

1. What is a solenoid?
   a.) Coils that act as a magnet when there's voltage
   b.) Coils that act as a magnet when there's current
   c.) The first solar paneled radio
   d.) A device that turns sunlight into energy

2. What is used to figure out the direction the current is flowing in an electric generator?
   a.) Fleming's Right Hand Rule
   b.) Fleming's Left Hand Rule
   c.) Gauss's Law of Magnetism
   d.) Ohm's Law

3. How do you make an electromagnet stronger
   a.) Increase the amount of coil in a solenoid
   b.) Increase the diameter of the ferromagnetic core
   c.) Increase the voltage traveling through the circuit
   d.) All of the above

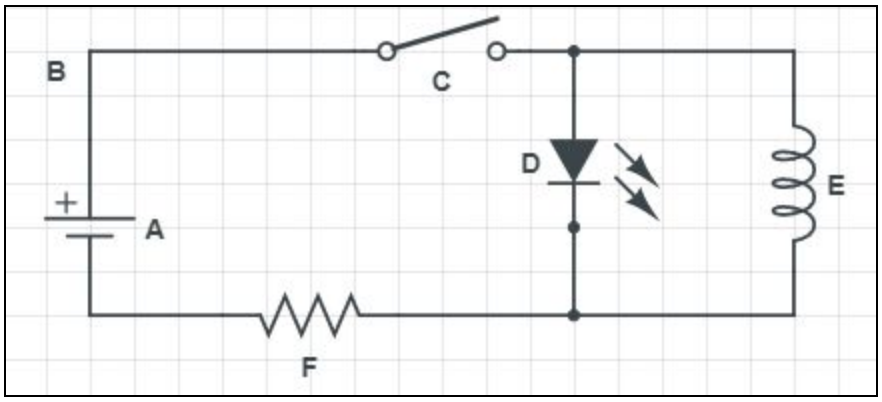
4. What describes the total magnetic field in a given area perpendicular to its direction?
   a.) Magnetic declination
   b.) Magnetic flux volume
   c.) Magnetic flux density
   d.) Magnetism

Part V: Parts of a Circuit

Fill in the blank
(1 point each)

1. A(An) _____ is a device that holds charge.
2. A(An) _____ is a device that holds voltage.
3. A(An) _____ is a device that converts AC to DC.
4. A(An) _____ is a device that converts DC to AC.
5. A(An) _____ is a device that changes the ratio of voltage to current.
6. A(An) _____ is a switch that opens and closes circuits
7. A(An) _____ is a device that converts chemical energy to electrical energy
8. A(An) _____ is a device that reduces current flow
9. A(An) _____ is a device that conducts current with low resistance in one direction and high resistance in the other.
10. A(An) _____ is a semiconductor that converts electrical energy to light energy.

Label the diagram
(0.5 point each)

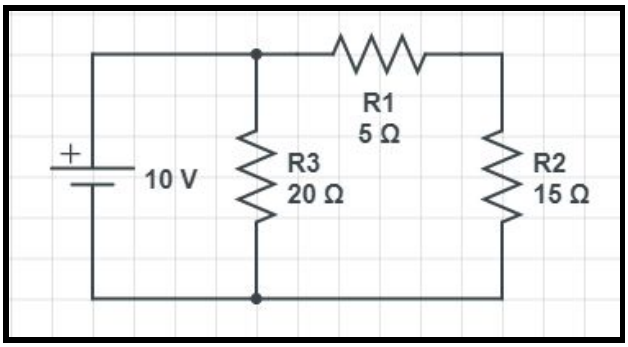


A. B. C. D. E. F.

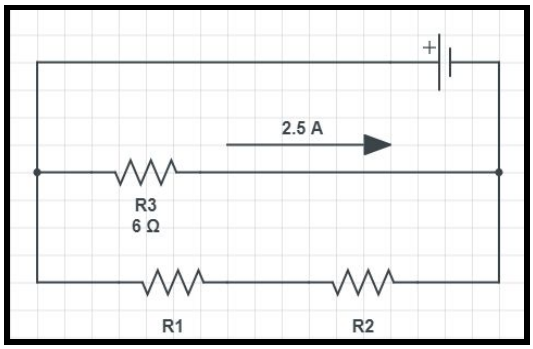
Part VI: Circuit Analysis

Short Answer

A



B

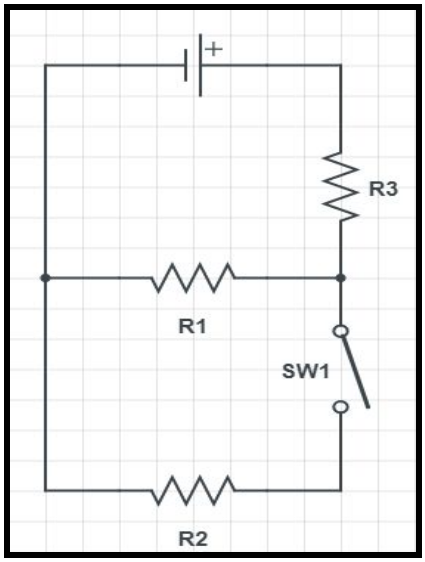


1. Determine the current running through all 3 resistors **in diagram A**. (4 points) (**TB2**)

2. Determine the voltage drop across all 3 resistors **in diagram A**. (4 points)

3. The resistors R1 and R2 have a total resistance of 5. Determine the current running through the battery **in diagram B**. (4 points)

C



4. How would the current change, going through R3, if the switch was closed **in diagram C**? Explain your answer. (4 points) (**TB3**)

5. Explain the difference between calculating the total resistance of resistors in series and calculating the total resistance of resistors in parallel. (3 points)

6. Explain the difference between current and voltage in components in parallel against components in series. (3 points)

7. Name two differences between the functions of capacitors and inductors. (2 points each)

Part VII: Lab Portion

Configuration (20 points)

- In anticipation of the 2021 SciOly competition, the hands-on portion of the test has changed into a configuration type lab.

1. For this portion of the test, you have been provided with 4 different resistors. To score full points for this part, you must configure the resistors in the space given below. Combine the given resistors to provide a total resistance of 100 Ω. Each resistor may only be used once and all resistors must be used. All labels must match the ones provided above.