DLS/Stevenson East Side Science Olympiad Invitational

Saturday, January 26, 2013

Circuit Lab – Practical

Team Number: _____ Team Name: _____

Team Members: _____

1. Please record your answers in the space provided. If you fail to record an answer, you will not get any credit for that question.
2. You may separate the pages but they ALL must be re-stapled in the correct order at end of the test.
3. You have 8 minutes at each station. Use your time wisely.
4. **Failing return the complete exam (all four pages) will disqualify you from the event.**
5. Voltage or current sources are as labeled. If they are not labeled you need to measure these.
6. Read all the instructions before you begin at any station.
7. You will be experimenting with fragile circuits. Be careful when you take measurements. **Damaging the circuits will disqualify you from the event.**

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO!

Score: _____ Rank: _____

Station 1

1. Observe the circuit at the station.
2. It has a voltage source, three resistors, a light bulb, two capacitors, and a current source, and a switch.
3. Draw the circuit diagram and label all circuit elements with numerical value.
4. Measure the voltage source.
5. Read the resistors and capacitors.
6. Make sure the switch is in off position.
7. An identical bulb is provided. Use it to measure the resistance of the bulb.
8. Measure the current source using the open terminals A & B.
9. Turn the switch to on position.
10. Measure the voltage across all resistors and the bulb.
11. Turn the switch off.
12. Label the voltage drops across all resistors and the bulb as well as the current through these.

Circuit Diagram

Station 2

1. Calculate the time constant for the circuit shown if a Capacitor with Capacitance "C" is connected across terminals A & B.
2. Show all intermediate steps and measurements.
3. Draw the Thévenin equivalent circuit with respect to terminals A & B. Label the circuit appropriately.
4. Calculate the time constant for the circuit shown if a Capacitor with Capacitance "C" is connected across terminals C & D.
5. Show all intermediate steps and measurements.
6. Draw the Norton equivalent circuit with respect to terminals C & D. Label the circuit appropriately.

Station 3

The circuit at Station 3 was recovered by the spy agency and handed over to Science. Your mission is to gain the insight on the circuit design by analyzing it. The documentation found with circuit has revealed the following clues. Use them wisely. Show your work and results!

1. The circuit is connected to a current source. What is the current when the switch is position D?
2. The switch on the current source discharges or charges the capacitors if thrown to D or C position.
3. The voltage across the alligator clips ramps up when the switch is thrown to charge position.
4. The time it takes to reach 10 volts is of particular interest. Use the timer provided to measure the time.
5. What did the voltage stabilize to?
6. How do you relate the current measured to the rate of voltage ramp up?
7. What will be the equivalent capacitance of the capacitors used?
8. Are these capacitors in series or parallel?
9. Since commercial capacitors are used, can you identify the capacitance for each using the table of commercially available capacitance at the Station?
10. Draw the circuit diagram. Show the switch in the discharge position.
11. Does polarity matter on how the capacitors are connected? Why or Why not?