

SSSS Circuit Lab C Test

by Birdmusic

Use appropriate sig figs for all answers.

Include units for all calculations.

Use the following constants:

Coulomb's constant is $9 \times 10^9 \text{ N} \times \text{m}^2 \times \text{C}^{-2}$

The charge of a single proton is $1.6 \times 10^{-19} \text{ C}$

Constants have unlimited sig figs.

Assume everything is ideal unless otherwise stated.

Team Name and Number:

Names:

Score: ____/69

History ___/4

Circle the correct answer in the parentheses.

1. (1 pts) Tesla encouraged the use of (AC/DC) which (is/is not) commonly used today.
2. (1 pts) Faraday studied (resistance/electromagnetism).
3. (1 pts) Volta invented the (battery/transformer).
4. (1 pts) Ohm had the unit for (inductance/resistance) named after him.

Electric Charges and Fields ___/6.5

1. (1 pts) 3 point charges are arranged as follows. What is the force exerted on the center charge by the other 2 charges? (The line just means they are all in a straight line)



2. (1 pt) What is the electric field felt by the center charge?

3. (0.5 pts) What is the unit used for electric fields?

4. (2 pts) Spheres A, B, and C are made of a conductive metal. Sphere A has a charge of 6C, Sphere B has a charge of 8C, and Sphere C has a charge of 5C. 2 spheres touch, then one of those spheres touches the third one. (Example: A touches B, then B touches C; another possible scenario: C touches A, then A touches B) What is NOT a possible final charge of A?

- a. 6.25C
- b. 6.5C
- c. 6.75C
- d. 7C

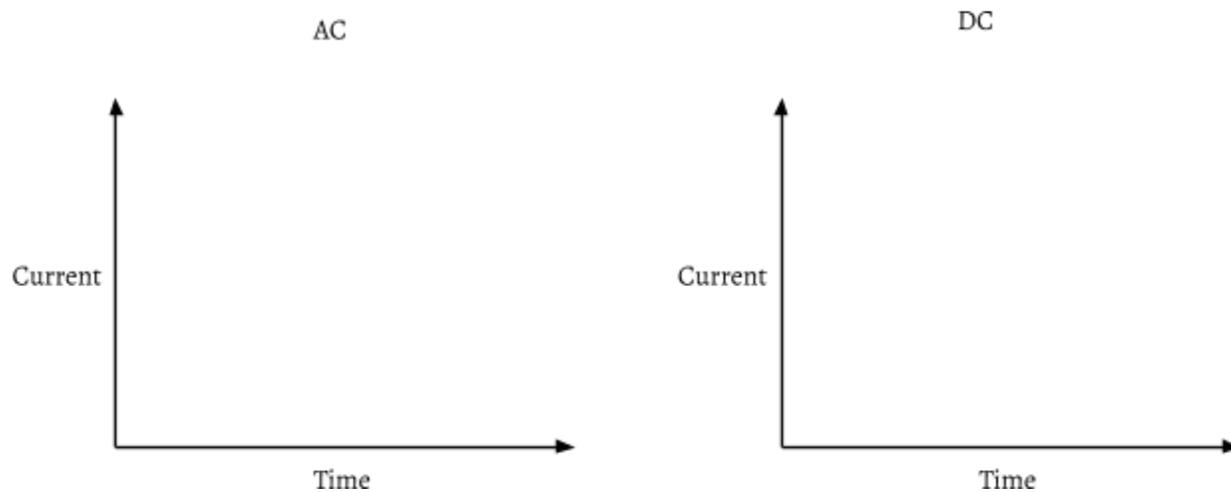
5. A nucleus has 60 protons in it.

- a. (1 pt) What is the absolute voltage at 10 cm away from the nucleus?
- b. (1 pt) If an electron is placed 10 cm away from it with an initial velocity of 0 m/s, what will the speed of the electron when it is 1 cm away from the nucleus? (reminder: kinetic energy is $\frac{1}{2} m v^2$ and the mass of an electron is 9.109×10^{-31})

AC and DC ___/5

1. (2 pts) Is AC or DC more dangerous? List 1 reason.

2. (1 pt) How does the current in an AC circuit differ from that in a DC circuit? Draw a graph (of current vs time) of each. (Do not worry about actual values, just get the general shape down.)

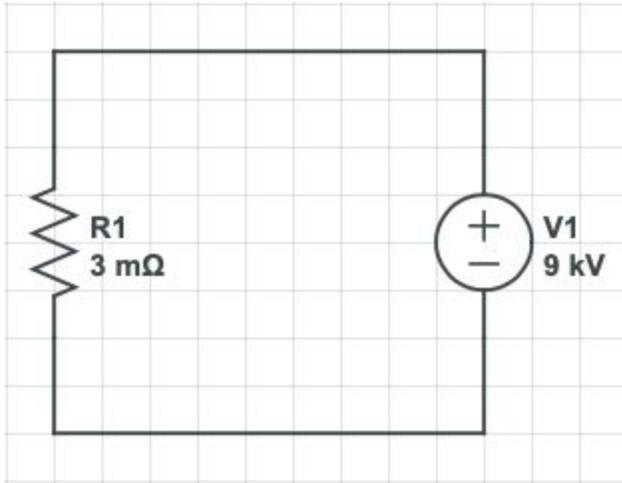


3. (0.5 pt) Name a device that can only use DC.

4. (1.5 pts) An AC circuit has an RMS voltage of 2 mV. What is the highest voltage it supplies?

DC Circuits ___/31

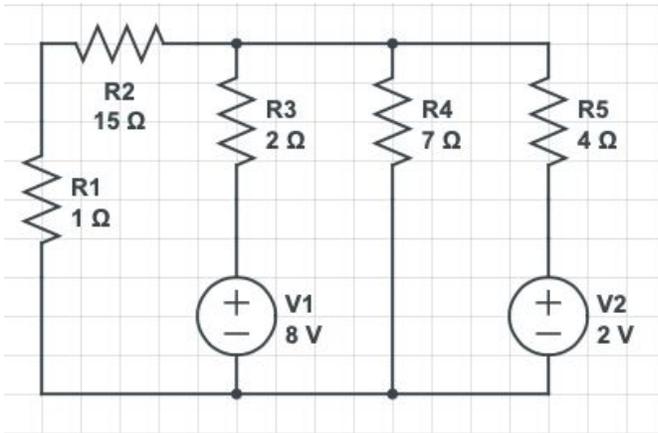
1. (0.5 pts) What is the current passing through the R1?



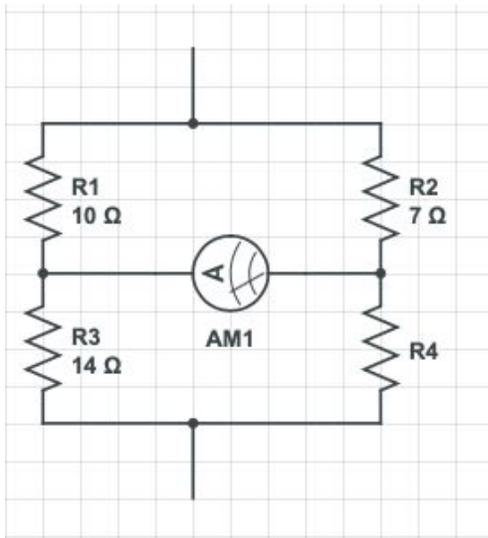
2. For the following circuit: (also assume all numbers on the circuit have 3 sig figs since I can't get them to show up)

a) (3 pts) What is the voltage drop over R3? _____

b) (3 pts) What is the current through R1? Draw its direction as well. _____



3. (1.5 pts) If no current is going across the ammeter, what is the missing resistance (R_4)? (Assume its in a closed circuit.)

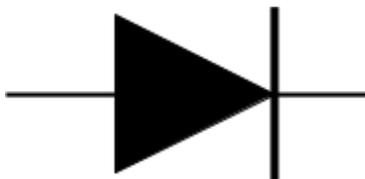


4. (2 pts) Draw the schematic for a 3-way light switch circuit and explain why it is useful.

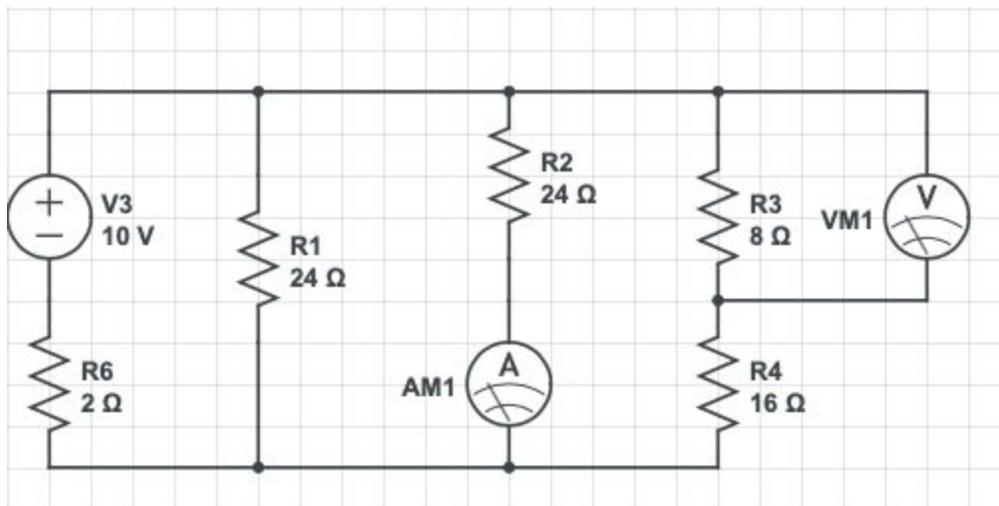
5. (0.5 pts) Classify the switch below based on the number of throws and poles.



6. (1 pt) What circuit component does this represent? Where might you use it in real life?

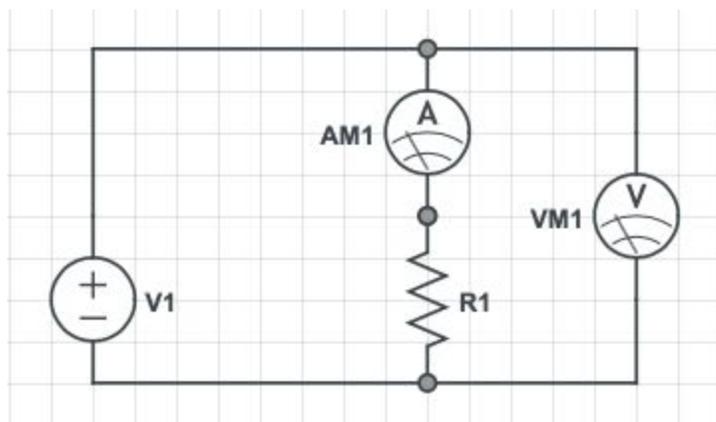


7. (4 pts) In the circuit below, what does the ammeter (AM1) read? What does the voltmeter (VM1) read? (Assume 3 sig figs for all numbers)



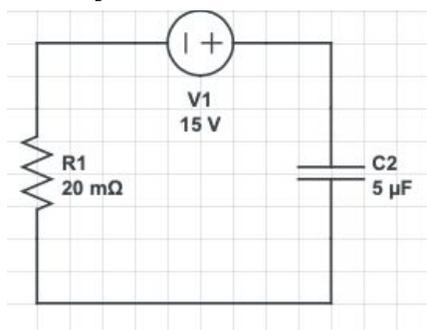
8. (2 pts) What would happen if the ammeter was placed in parallel with the resistor in the diagram below? (ignore voltmeter)

9. (1 pt) What would happen to the voltmeter's reading when it is put in series with the resistor in the below circuit? (ignore ammeter)

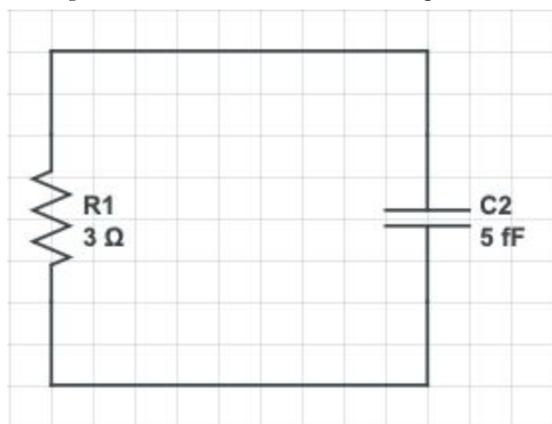


For 8 and 9

10. (0.5 pts) What is the time constant of the circuit below?

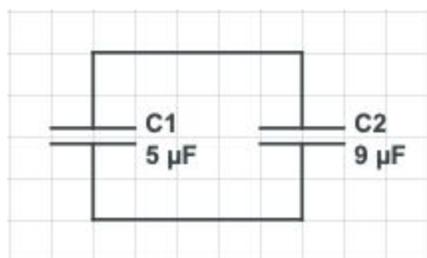


11. (2 pts) The following RC circuit is charged fully. When the RC circuit below is discharging, at 15ms, what percent of the maximum charge is still in the capacitor? (Assume 3 sig figs for all numbers)



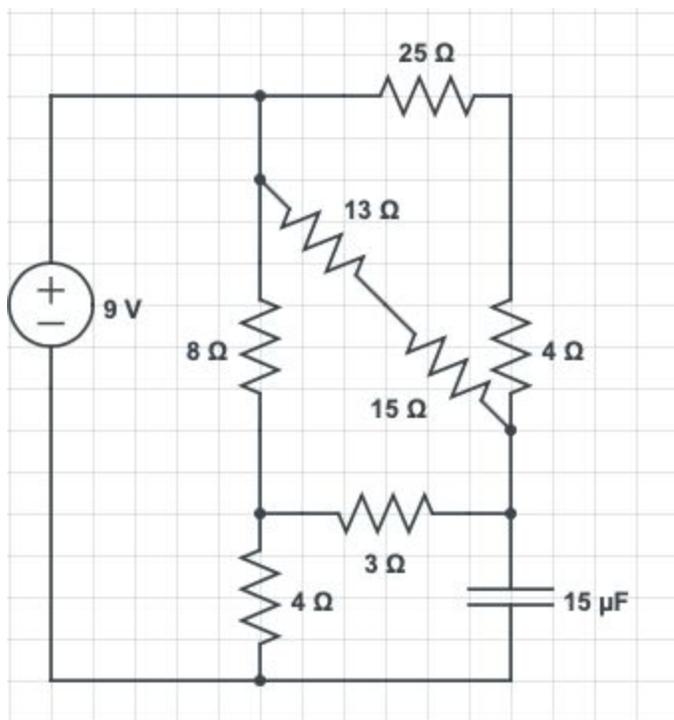
12. (0.5 pts) What is the equivalent capacitance of two 1 uF capacitors in parallel?

13. (2 pts) The 5uF capacitor is fully charged by a battery of 5V and then connected with the 9uF capacitor as shown below. What is the final charge on each?



5uF: _____ 9uF: _____

14. (3 pts) When the circuit is first connected with the battery (not charged at all), what is the current through the voltage source? (Assume at least 2 sig figs for everything.)



Voltage: _____ Capacitor: _____

- b. (2 pts) When the circuit is in a steady state, what is the charge on the capacitor?

15. (1.5 pts) A section of copper wire has length 1 m and a radius of 0.5 mm. A current of 10 A passes through it. How much power is dissipated by the section?

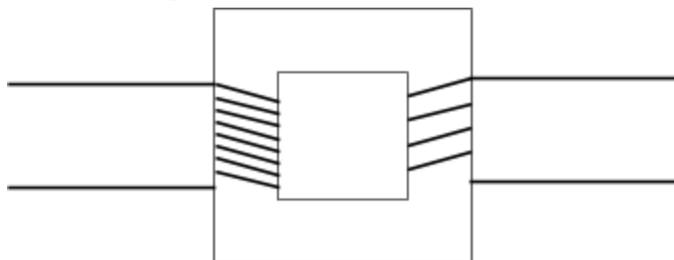
16. (1 pt) How can you connect 5 resistors (all 2 ohms) to have an equivalent resistance of 5 ohms? Draw below.

Electromagnetics, Transformers, Motors/Generators ___/7

1. (1 pt) Draw the electric field around this wire if the current is going in the direction the arrow is pointing.



2. (2 pts) If the difference between the 2 wires of the left side is 10V, what is the difference between the wires of the right side?



3. (1 pt) What does a motor do? What prevents it from being ideal in real life?
4. Determine the force on an electron in a magnetic field of 4T moving out of the page. (The heads of the vector are pointing at you.)
- (1 pt) The electron is not moving.
 - (2 pts) The electron is moving to the right of the page at a speed of 5 m/s.

LEDs and PN Junctions ___/6.5

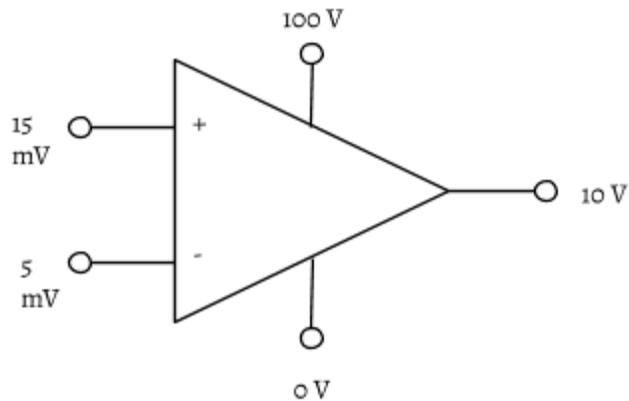
1. (1 pt) What electrical component does a PN junction function as?
2. (3 pts) Why can the PN junction function as this? Draw, label, and explain a diagram to demonstrate.

3. (2 pts) What are 2 ways to identify the positive and negative ends of an LED without testing it in a circuit?

4. (0.5 pt) In a circuit, an ideal LED provides _____ resistance.

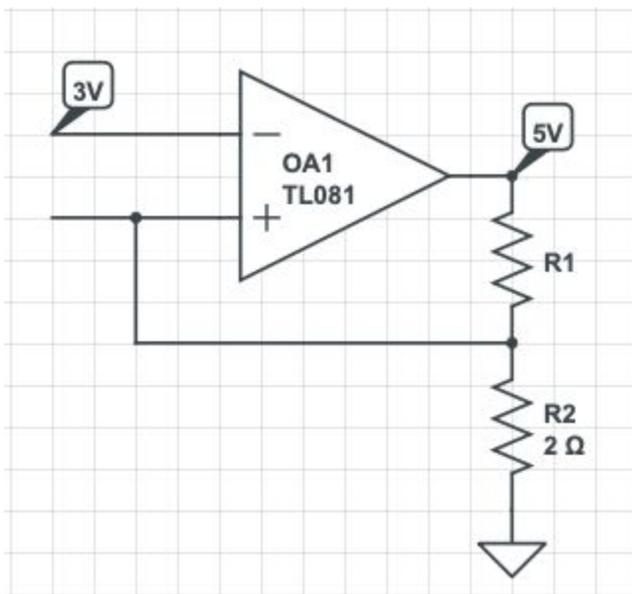
Op-Amps ___/4

1.



- (0.5 pts) Find the gain of this Op-Amp. _____
- (0.5 pts) If the plus terminal was at 10V and the negative terminal was at 5V, what would the output be? _____

2. (2.5 pts) For the following ideal op-amp circuit, what is the value of R1? Ignore the name on the op-amp. Assume all the values have 2 sig figs.



3. (0.5 pts) What is the basic purpose of an op-amp?

Digital Logic ___/5

1. (2 pts) Make a truth table for the following logic gates. (A NAND B) XOR C

A	B	C	Output
0	0	0	
1	0	0	
1	1	0	
1	1	1	

A	B	C	Output
0	1	0	
0	1	1	
0	0	1	
1	0	1	

2. (1 pt) Draw the logic gate represented in this truth table.

A	B	Output
0	0	1
1	0	0
0	1	0
1	1	1

3. (1 pts) What are 2 universal logic gates?

4. (1 pt) What does universal logic gate mean?