

Circuit Lab

Scarsdale High School 2019-2020

- You have 50 minutes to complete this test
 - You have up to 10 minutes to complete the lab portion of the test, taken out of your 50 min
 - You may have a 3 ring binder and a calculator of any type
 - Show all work, for each calculation question, the answer is 1pt, the initial equation is 1pt, and the units are 1pt. All other points come from the work
 - Report each answer to a reasonable amount of sig figs. Credit only taken off if it is grossly unreasonable.
 - It is unlikely that you will finish the test, pick the parts you are best at
 - Use conventional flow for all circuits
- Any questions to wolfcukier@gmail.com

History	/20
Theory	/30
Fill in the Blank	/20
Calculations	/50
Diagraming	/30
Lab	/50
Total	/200

Part 1: History (20 pts)

Each of the Following Statements describes a scientist listed in the rules. Place a **(O)** for Ohm, a **(V)** for Volta, a **(F)** for Faraday, a **(T)** for Tesla, **(K)** for Kirchhoff, **(C)** for Coulomb, and a **(A)** for Ampere

1. Namesake for the unit of EMF	
2. Calculated the speed of an electrical signal in a resistanless wire is equal to the speed of light	
3. Namesake for unit of Magnetic Flux Density	
4. Namesake for unit of Resistance	
5. Explained the laws of attraction between charges and poles	
6. Published <i>The Galvanic Circuit Investigated Mathematically</i>	
7. Demonstrated that a changing magnetic field produces an electric field	
8. Invented the dynamo	
9. Showed two parallel current-carrying wires attract or repel each other	
10. Invented the induction motor	
11. Inventor of the Radio	
12. Isolated and ignited methane using an electric spark	
13. Invented the Solenoid	
14. Invented the Homopolar Motor	
15. Discovered the Law of Capacitance	
16. Stated that current is inversely proportional to resistance	
17. Believed that attraction and repulsion was due to fluids	
18. Discovered Diamagnetism	
19. Invented the spectroscope along with Bunsen	
20. Stated the sum of currents into a node is the same as the sum of currents out of a node	

Part 2: Theory(30 pts)

21. What is the greatest hazard of static electricity? What are some precautions taken to avoid this? (6)

22. Describe 2 ways to create a charged object. (6)

23. Which is safer, AC or DC, to be electrocuted with at the same voltage? Why? (6)

24. What is a Faraday Cage? What is an application of one? (6)

25. What would one use for transmission of electricity over large distances, AC or DC? Why? (6)

Part 3: Fill in the Blank (20 pts)

26. Kirchhoff's voltage law is based on conservation of _____(2)

27. Kirchhoff's current law is based on conservation of _____(2)

28. In a PN Junction, negative charges are transferred by electrons and positively charges are transferred by _____(2)

29. LED stands for _____(2)

30. At $t=0$ a capacitor is at 0 V, after one time constant, the capacitor is at _____% of the battery's voltage (2)

31. In reality, electrons flow from the _____terminal to the _____terminal of a battery (2)

32. A logic gate that in combination with itself is able to create the AND, NOT, and OR gate is called a _____ (2)

33. An ideal Op-Amp has _____Open-Loop Gain (2)

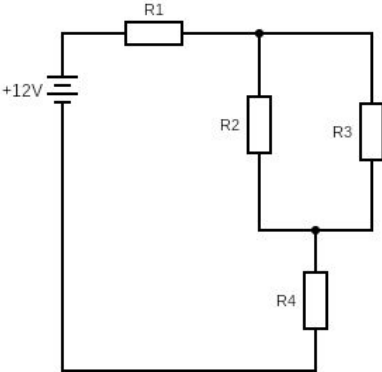
34. The inverse of conductivity is _____(2)

35. SPDT stands for _____(2)

Part 4: Calculations (50 pts)

36. Point charge A has a charge of $+1C$, point charge B, located 2m to the right of point charge A has a charge of $-3C$. What is the force of A on B. Be sure to indicate directions. (5)

37. Given the Circuit below and that $R_1 = 150 \text{ Ohms}$, $R_2 = 650 \text{ Ohms}$, $R_3 = 400 \text{ Ohms}$, and $R_4 = 150 \text{ Ohms}$, complete the table. Remember to show work, there should be at least 3 different equations stated. (17)



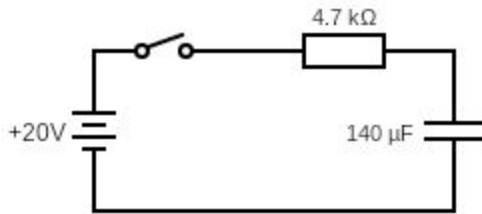
	R	V	I	P
1	150 Ohms			
2	650 Ohms			
3	400 Ohms			
4	150 Ohms			
Total		12 Volts		

38.a. What is the capacitance of a parallel plate capacitor if the plates have an area length of 9 m^2 and are separated by 10^{-9} m ? (4)

38.b. How much charge does it take to charge the capacitor in 38.a from 0V to 12.57V ? (4)

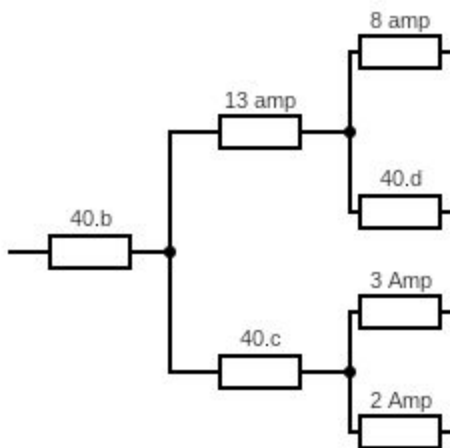
38.c How much energy does it take to charge the capacitor in 38.a from 0V to 12.57V ? (4)

39.a. At $t=0$, the switch is closed. What is the time constant of the following circuit? (4)



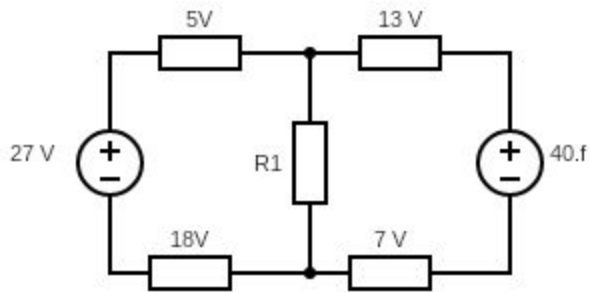
40.a. State Kirchhoff's Current Law (1)

40.b. - 40.d. Calculate the following. No work necessary. (3)



40.e. State Kirchhoff's Voltage Law (1)

40.f Calculate the following. No work necessary. (3)



Part 5 - Diagraming (30 pts)

41.a. Draw a diagram using a single op-amp such that the output voltage, V_3 , is equal to the sum of 2 input voltages, V_1+V_2 . (6)

41.b. What is the name of 41.a? (1)

42. Draw the diagrams for the logic gates corresponding to the following truth tables and name them. Use only one gate. (6)

A	B	Q		A	B	Q
0	0	0		0	0	0
0	1	0		0	1	1
1	0	0		1	0	1
1	1	1		1	1	0

A	B	Q		A	B	Q
0	0	1		0	0	0
0	1	1		0	1	1
1	0	1		1	0	1
1	1	0		1	1	1

A	B	Q		A	B	Q
0	0	1		0	0	1
0	1	1		0	1	0
1	0	0		1	0	0
1	1	0		1	1	1

43. Draw a diagram with a lamp and two switches such that changing the state of either switch changes the state of the lamp regardless of the state of the other switch. (5)

44. Draw a labeled diagram of a PN Junction (not circuit symbols but one that could be used to demonstrate the functionality) (6)

45. Draw the magnetic field between 2 bar magnets of equal strength such that the north ends are facing each other (6)

Part 6: Lab (50 pts)

Using 5 LEDs, a resistor, a battery, and jumper cables, construct a circuit such that:

46.a. In one polarization of the battery, LED 1 and LED 2 are off and LED3 and LED 4 are on (10)

46.b. In the other polarization of the battery, LED 3 and LED 4 are off and LED 1 and LED 2 are on (10)

47. Regardless of the polarization, LED 5 remains on (10)

48. You ensure that none of the LEDs burn out (5)

49. Draw a circuit diagram of what you created(10)

50. State the color code and resistance of the resistor (5)

Task	46.a	46.b	47	48
ES initial				