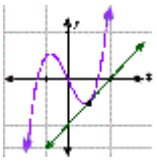


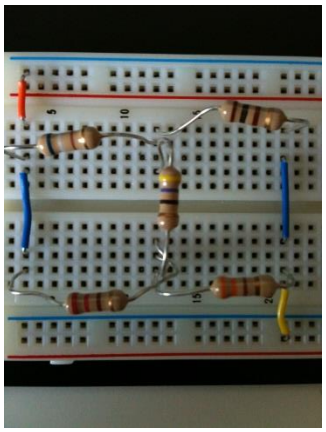
Circuit Lab Test (Key)

Part 1: Circuit Analysis

Use conventional current (top to bottom in pic)

Use this circuit for questions 1-7

Color	Digit	Multiplier	Tolerance (%)
Black	0	10^0 (1)	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	0.5
Blue	6	10^6	0.25
Violet	7	10^7	0.1
Grey	8	10^8	
White	9	10^9	
Gold		10^{-1}	5
Silver		10^{-2}	10
(none)			20

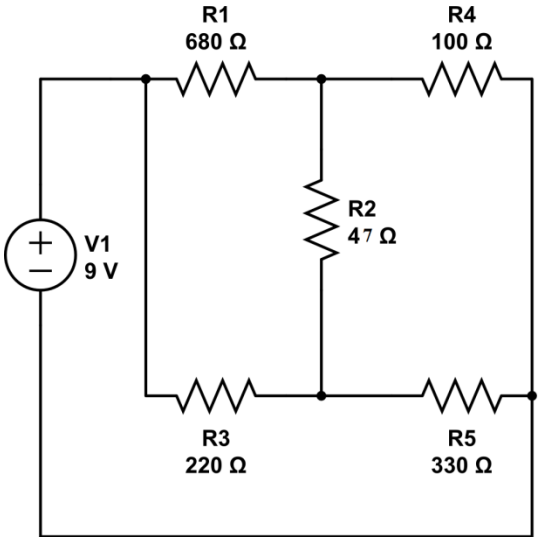


1. What is the name of the circuit displayed? (1)

Wheatstone Bridge

2. Draw a schematic of the circuit connected to a **9V** battery, labeling the resistances (3)

[Note: Top left resistor is blue, grey, brown, gold while the bottom left is red, red, brown, gold]



3. Calculate the equivalent resistance of the entire circuit (3)

254. Ω

4. Calculate the current through the resistor with the smallest resistance (4)

.016 A

5. The middle resistor is replaced with another resistor such that that one resistor dissipates maximum power. What is its resistance (keeping all other resistors in the picture)? (3)

219. Ω

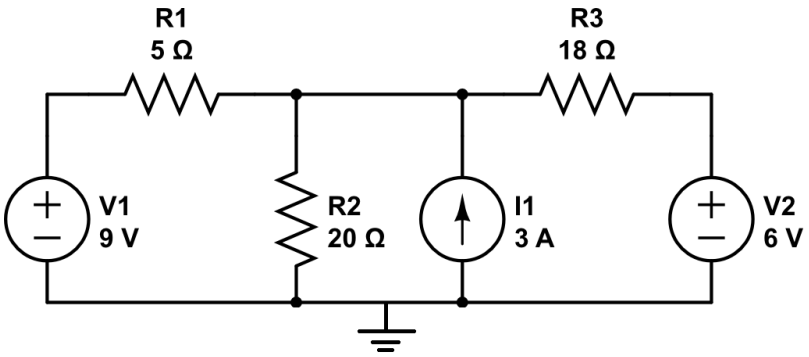
6. The top right resistor in the picture is replaced with one such that there is no current flowing through the middle resistor (keeping all other resistors in the picture). What is its resistance? (2)

1020 Ω

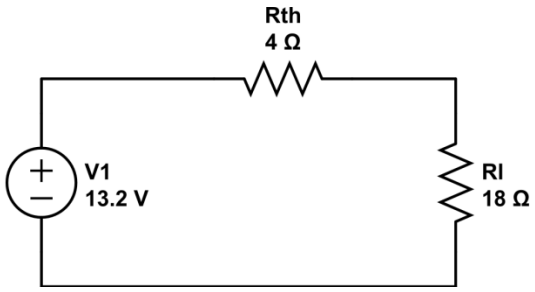
7. If the bottom right resistor was shorted out, what would happen to the current through the top right resistor? (2)

Decrease

Use the following circuit for questions 8-11



8. Draw the Thevenin equivalent circuit with R3 as the load resistor. (4)



9. What is the total energy used by the load in 5 seconds? (3)

32.4 J

10. Calculate the current through R1. (3)

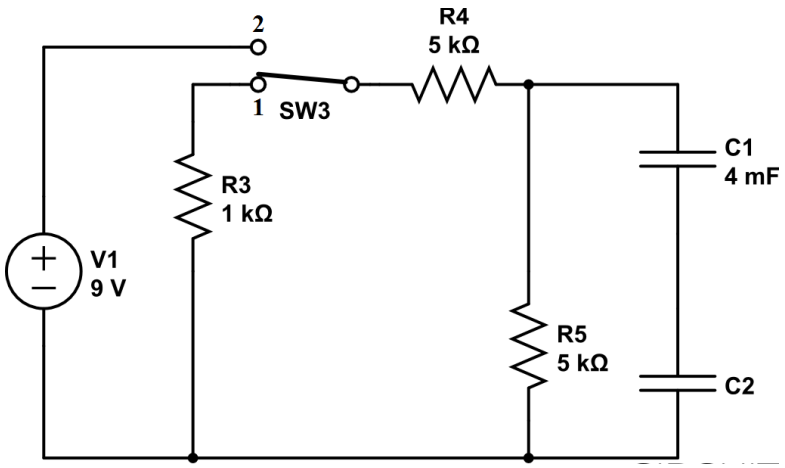
1.56 A

11. Calculate the voltage dropped across the 20 ohm resistor in the schematic. (3)

16.8 V

Part 2: RC Circuits

Use the following circuit for questions 12-16



12. After a very long period of time, the switch is moved from position 1 to position 2 and then after 2 time constants, the voltage across capacitor 1 is .972748 V. What is the time constant? (5)

5 seconds

13. During the first 2 time constants, write a function I(t) where t is in seconds and I is in amps of the current through resistor 4. (3)

$.0018-4.5(1-e^{(-t/5)})/5000$ or equivalent functions

14. As soon as 2 time constants pass, the switch is flipped back to position 1. What is the new time constant? (3)

2.73 seconds

15. In the first 2 seconds after the switch is moved back to position 1, how much energy does capacitor 2 release? (4)

.003 J

16. Bonus: Identify the circuit component "SW3" (2)

SPDT Switch

Part 3: Miscellaneous and Lab

17. Siemens is a unit measuring what? (2)

Conductance

18. A wire has a measure of .6 Siemens per meter. How many Siemens does 2 meters of this wire have? (2)

0.3 Siemens

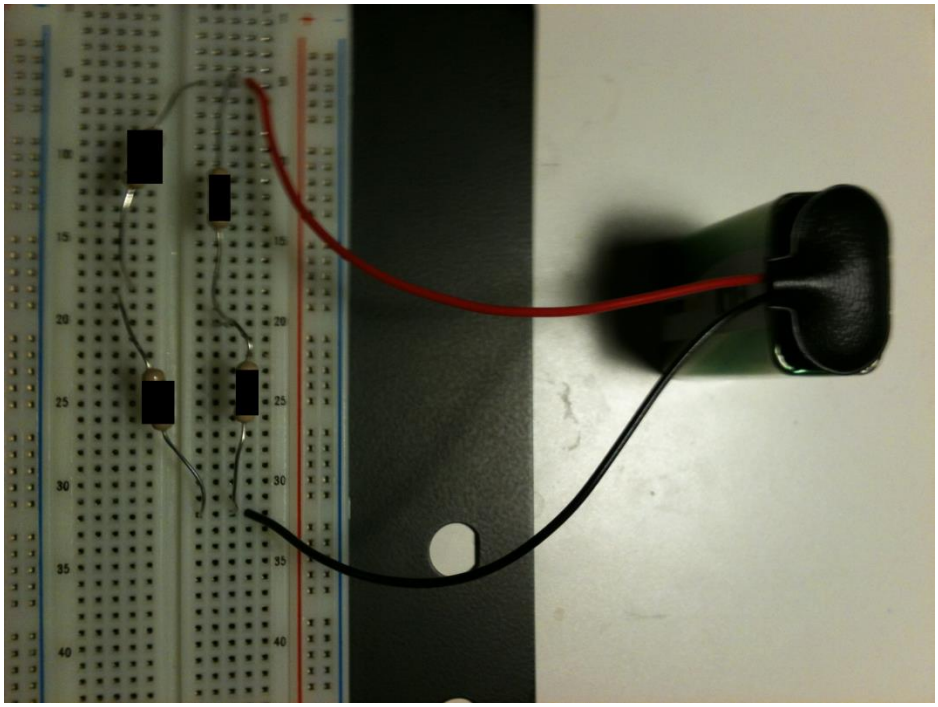
19. What is the SI unit for a Siemen? (2)

$$\frac{S * C^2}{kg * m^2}$$

20. To light an LED, what side of the battery would you connect the cathode to? (2)

Negative

Using a multi-meter, describe how you would measure each of the following quantities (without disconnecting any parts or doing calculations) or explain why you cannot.



21. The voltage between the different sides of line 18. (2)

Set the multimeter to the 20V DC and either put the leads in holes on opposite sides of line 18 or make contact with a resistor in the middle on each side of the breadboard.

22. The resistance between the different sides of line 18. (2)

You cannot and should not. If the power source was not connected, then there is nothing stopping you from making this measurement—however, with it connected it can damage the multimeter / will produce inaccurate readings.

23. The current through the left branch. (2)

You cannot and should not as well. This is one reason why all of my school's multimeters (and the non-AP physics class is the only one to use them) have blown out fuses (as well as the circuits they measure have rather low resistances). You must measure current in series and there is no break in the circuit to do so, measuring in parallel will not only give you the wrong reading, but will short circuit it into your meter. Enjoy.

Part 1		Part 2		Part 3			
1.	/1	12.	/5	17.	/2		
2.	/3	13.	/3	18.	/2		
3.	/3	14.	/3	19.	/2		
4.	/4	15.	/4	20.	/2		
5.	/3	16.	/2	21.	/2		
6.	/2			22.	/2		
7.	/2			23.	/2		
8.	/4						
9.	/3						
10.	/3						
11.	/3						
Total	/31	Total	/17	Total	/14	Total	/62