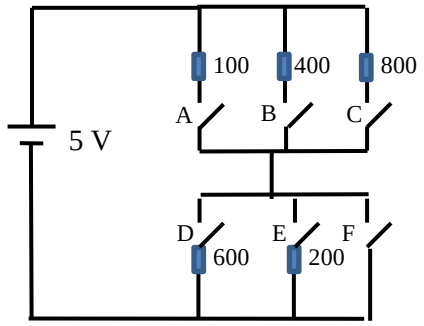
26C – Thinking about Circuits

Consider the following circuit, where the rectangular boxes represent resistors. The resistance for each resistor is given in ohms to the right of the resistor. Switches are labeled with letters.



72.7272

222.7272

150

1) What are the following values when switches A and F are closed with all others open?

Component	Potential across component	Current through component
Battery	5V	50mA
Switch A	0	50mA
Switch B	5V	0
Switch C	5V	0
Switch D	0	0
Switch E	0	0
Switch F	0	50mA
100	5V	50mA
400	0	0
800	0	0
600	0	0
200	0	0

From now on, blank boxes are 0

2) What are the following values when switches A and D are closed with all others open?

Component	Potential across component	Current through component
Battery	5V	7.14mA
Switch A		7.14mA
Switch B	.714V	
Switch C	.714V	
Switch D		7.14mA
Switch E	4.28V	
Switch F	4.28V	
100	.714V	7.14mA
400		
800		
600	4.28V	7.14mA
200		

3) What are the following values when switches A through E are closed and F is open?

Component	Potential across component	Current through component
Battery	5V	22.45mA
Switch A		16.32mA
Switch B		4.08mA
Switch C		2.04mA
Switch D		5.61mA
Switch E		16.83mA
Switch F	3.37	
100	1.63V	16.32mA
400	1.63V	4.08mA
800	1.63V	2.08mA
600	3.37V	5.61mA
200	3.37V	16.83mA

4) What are the following values when all switches are closed?

Component	Potential across component	Current through component
Battery	5V	68.75mA
Switch A		50mA
Switch B		12.5mA
Switch C		6.25mA
Switch D		
Switch E		
Switch F		68.75mA
100	5V	50mA
400	5V	12.5mA
800	5V	6.25mA
600		
200		

26D – Circuit Simulation

You will use the circuit simulator application at the site: https://falstad.com/circuit/ .
Click on the "Circuits" menu and select "Basics". Then select "Resistors".
The circuit should look like the one sketched above!
Select "Show Current", Show Voltage", "Show Power", "Show Values" in the "Options" menu.
It is possible to read the values for the quantities in the table below by hovering your mouse over each component. Record them in the tables below. (Note: the measurement "V" from the cursor in the simulator is the potential relative to ground. The cursor measurement "V_d" is the voltage difference/drop across a device. The potential across a component will correspond to the value of "V_d", which is also equal to the difference of "V" measured on both sides of the component.)

1) What are the following values when switches A and F are closed with all others open?

Component	Potential across component	Current through component
Battery	5V	50mA
Switch A	0	50mA
Switch B	5V	0
Switch C	5V	0
Switch D	0	0
Switch E	0	0
Switch F	0	50mA
100	5V	50mA
400	0	0
800	0	0
600	0	0
200	0	0

From now on, blank boxes are 0

2) What are the following values when switches A and D are closed with all others open?

Component	Potential across component	Current through component
Battery	5V	7.14mA
Switch A		7.14mA
Switch B	.714V	
Switch C	.714V	
Switch D		7.14mA
Switch E	4.28V	
Switch F	4.28V	
100	.714V	7.14mA
400		
800		
600	4.28V	7.14mA
200		

3) What are the following values when switches A through E are closed, and F is open?

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Battery	5V	22.45mA
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Switch C		6.25mA
Switch D		
Switch E		
Switch F		68.75mA
100	5V	50mA
400	5V	12.5mA
800	5V	6.25mA
600		
200		

5) How do your computed values compare with the values found by the simulator?

they're exactly the same. It's just manual math vs computer math.

6) With all switches except F closed, which resistor dissipates the most power? (Remember power is current times potential difference.) Discuss why this is.

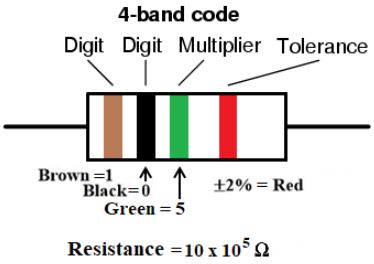
200. lowest resistance with the highest voltage, most current with highest resistance

6) What combination of switches must be open or closed to dissipate the maximum amount of power in the 200 ohm resistor? Discuss why this is.

ABCE open. ABC gets the least resistance at the top and DF closed gets the highest at the bottom (without opening E), leading to the greatest potential across 200

26E – Experimental Measurement of Resistor Networks

Equipment: 3-Resistor Box; Digital Multimeter with Ohmmeter function; 6 banana wires.



You will be given a set of three mounted resistors with nominal resistances given by the standard color code on the resistors. The resistance is a number given by the first two colors holding 10's and 1's place in order, times 10 to the power of the third color. (For example, the colors [brown, black, green] = $10 \times 10^5\ \Omega$ = 1000 kΩ.

COLOR CODE

Black	Brown	Red	Orange	Yellow	Green	Blue	Violet	Gray	White
0	1	2	3	4	5	6	7	8	9

For this experiment, mentally label the resistors corresponding to the following codes **A** = **C**= Brown, Black, Brown and **B** = Yellow, Violet, Brown.

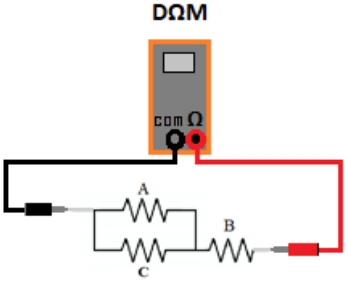
1) What are the nominal resistances of your three resistors using the color codes?
A(Brown, Black, Brown) 100 ; **B**(Yellow, Violet, Brown) 470 ; **C**(Br, Bl, Br) 100

2) Use the ohmmeter function of the DMM to measure the actual resistance of each resistor
A 101 ; **B** 470 ; **C** 100

3) Wire your resistors as directed in the table below and measure the effective resistance using the ohmmeter.

Combination *See below how to use the Ohm meter for combinations**	Measured resistance Give *units*	Resistance computed from the values in questions 2 above and rules for adding resistors
A and C in series	201	200
A and B in series	571	570
A, B, and C in series	671	670
A and C in parallel	51	50
A and B in parallel	83.5	82.45
A, B, and C in parallel	45.7	45.19

4) Wire your resistors as indicated and measure the effective resistance.

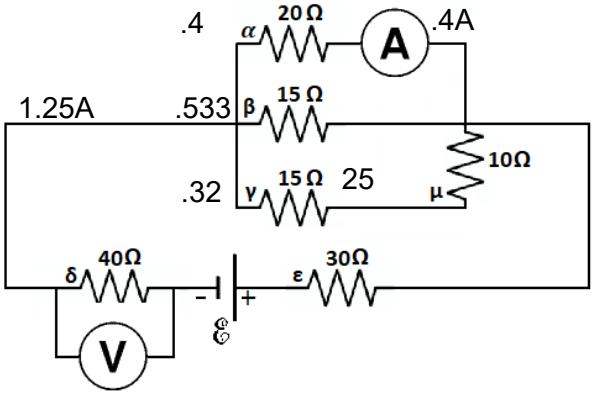


R_{eff}(measured)= 521

R_{eff}(calculated)= 520

26F – Solving Simple Circuits

6.383



For the circuit shown to the right, find the current through every element and potential across every element in the circuit if the current in the ammeter is 0.40 A. The questions below will lead you through stages of the larger problem. For each question, state both the numerical answer and which of the following logical arguments would lead you to that answer using the previous information.

***Arguments*:**

i. The voltage loop rule: $\sum_{j=1}^{N} V_j = 0$.
ii. The current junction rule : $\sum_{j=1}^{N} i_j = 0$
iii. Ohms Law $\Delta V = IR$ if any single one of these rules didn't exist, none of this would work
iv. Ideal wires have no resistance, so all points connected by a wire are at the same potential.

1) What is the potential difference ΔV_α across the 20 ohm (α) resistor? ΔV 8V Rule(s): i ii iii iv

2) What is the potential difference ΔV_{am} across the (ideal) ammeter? ΔV 0V Rule(s): i ii iii iv

3) Is the potential difference ΔV_β across the middle 15 ohm (β) resistor the same as that across the 20 ohm (α) resistor? Give the value(s)!

yes ΔV 8V

4) What is the current i_β through the middle 15 ohm (β) resistor? I 0.533A Rule(s): i ii iii iv

5) What is the total potential difference ΔV across the bottom 15 ohm (γ) and 10 ohm (μ) resistors in series?

Total: 8V
15: 4.8V
10: 3.2V

ΔV 4.8V Rule(s): i ii iii iv

ΔV 3.2V Rule(s): i ii iii iv

6) What is the current i_γ through the bottom 15 (γ) and i_μ 10 ohm (μ) resistors?

I 0.32A Rule(s): i ii iii iv

7) What is the current i_δ through the 40 ohm (δ) resistor? I 1.25A Rule(s): i ii iii iv

.4+.533+.32=1.25A

8) What is the current i_ε through the 30 ohm (ε) resistor? I 1.25A Rule(s): i ii iii iv

R=70.63

9) What is the value of the potential difference $\Delta V_{battery}$ across the battery? 88.28V

10) Resistors are rated by the power they are able to dissipate without damage. Which of the resistors in this circuit must have the largest power rating, and why?

delta and epsilon, they have a full 1.25A and are fairly largeresistors compared to the others, and P=I^2