

**Science Olympiad
Region Ten**

Electrical Circuits Questions

Western Michigan University

Solutions!!!

Scoring Summary

Number	Score	Possible
1		15
2		15
3		20
4		18
5		14
6		64
7		29
Total		175

Problem One

Using the standard resistor color codes, determine the resistance of each of the following resistors. Be sure to include units!

A.

B.

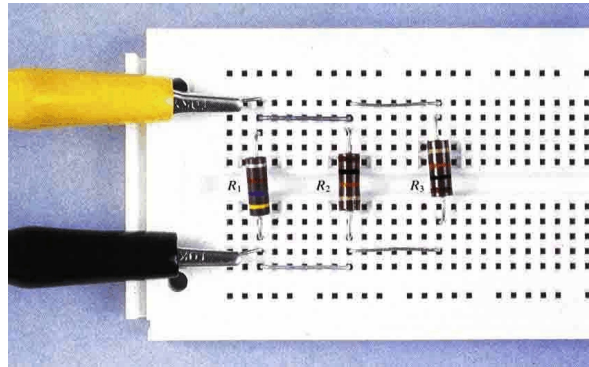
C.

Resistor color code

	Digit	Color
Resistance value, first three bands	0	Black
	1	Brown
	2	Red
	3	Orange
	4	Yellow
	5	Green
	6	Blue
	7	Violet
	8	Gray
	9	White
Tolerance, fourth band	5%	Gold
	10%	Silver
	20%	No band

Problem Two

Observe the circuit implemented on the solderless breadboard connected to a 9 Volt power supply as shown. In this problem we are concerned only with the resistor R_3 shown on the far right. For your convenience, an identical resistor is also placed on the breadboard. The intent of this problem is to deduce the current flowing through R_3 .



- A. Measure the resistance of R_3 .

- B. Measure the voltage across R_3 .

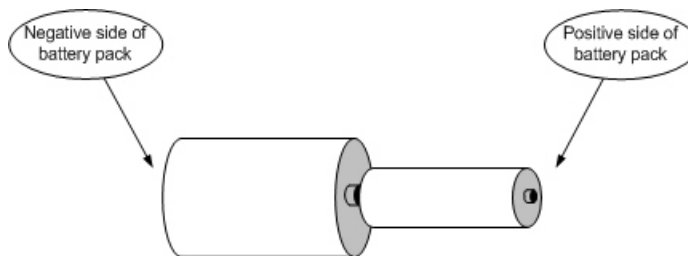
- C. Find the value of the current flowing through R_3 ?

Do not remove or change any of the components on the breadboard! Upon completion, be sure to turn the multimeter OFF!

Problem Three

Answer the following questions, being careful not to forget your units!

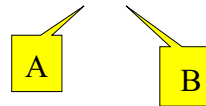
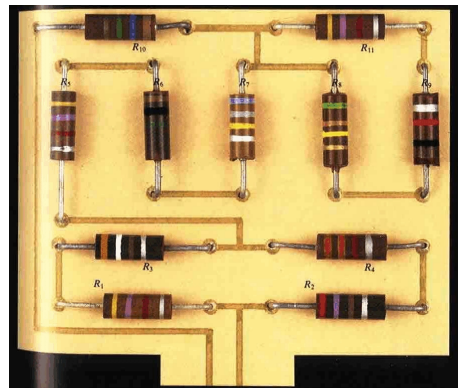
- A. What is the nominal voltage for a standard Alkaline D-cell battery?
- B. Measure, using the hand-held multimeter provided, the voltage produced by each of the batteries.
1. Large (D-cell):
 2. Small (AA-cell):
- C. Without further measurement, if the cells were placed in a battery-pack configured in series (as shown), what voltage would be produced by the battery pack?



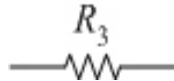
Upon completion, be sure to turn the multimeter OFF!

Problem Four

Consider the following printed circuit board (PCB) layout of a resistive network.



- A. Draw the equivalent circuit schematic diagram using symbols and labels (for example, to indicate resistor R_3 , R_3 Do not simplify!

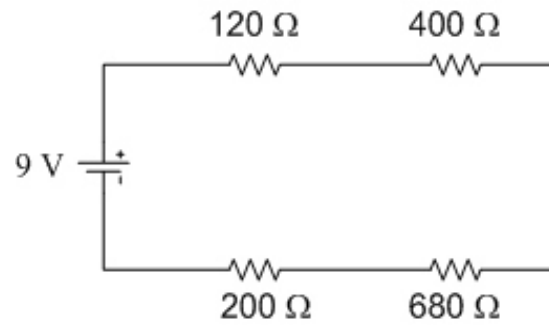


- B. Now simplify the schematic diagram produced in part (A)

- C. Find an algebraic expression for the total resistance for this network between terminals A and B?

Problem Five

Given the following circuit schematic, calculate the voltage across and the current through the $400\ \Omega$ resistor. Be sure to include your units!

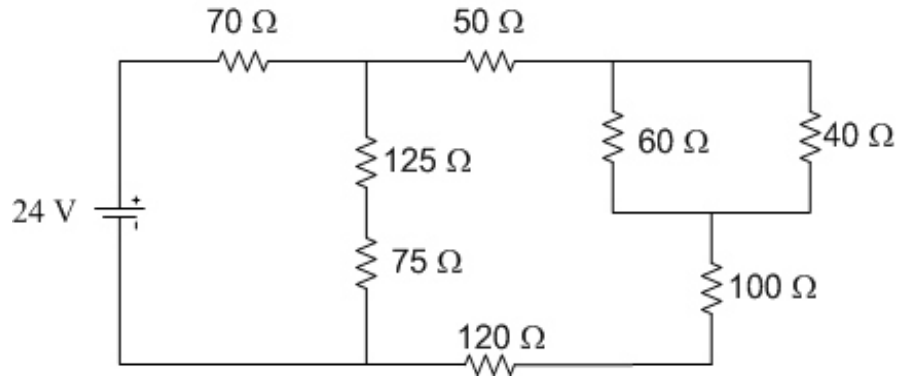


A. Voltage across the $400\ \Omega$ resistor:

B. Current through the $400\ \Omega$ resistor:

Problem Six

Consider the circuit schematic shown below. Calculate the voltage across and current through each resistor, being careful to remember the units!



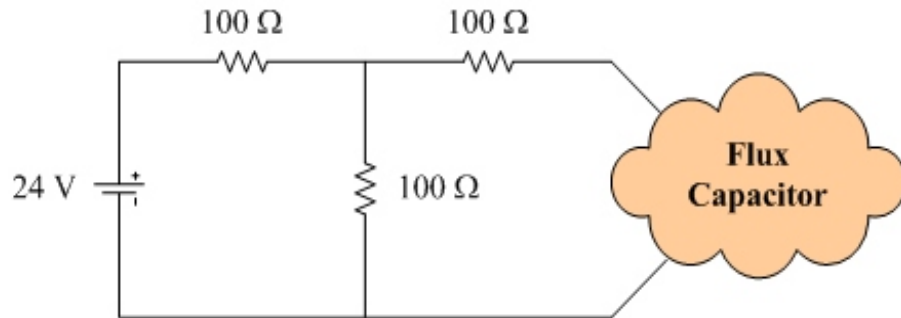
Note, you may ignore the signs (+ or -)!

Resistor	Voltage across	Current through
70 Ω		
50 Ω		
125 Ω		
75 Ω		
60 Ω		
40 Ω		
100 Ω		
120 Ω		

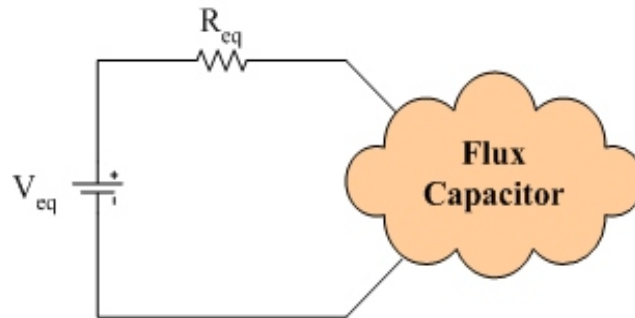
Problem Seven - Tie-breaker!!!

Simplify the following circuit to one with a single voltage source and a single resistor so that the flux capacitor (a fictitious object, to be sure!) still sees the same voltage and resistance as per the original circuit.

Original circuit:



Simplified circuit:



A. Find the equivalent voltage V_{eq} .

B. Find the equivalent resistance R_{eq} .