EE 302, Introduction to Electrical and Computer Engineering

Dr. Archie Holmes, Jr.

Exam #1

Solution

Class Average = _____

Standard Deviation = _____

PROBLEM #1. SHORT ANSWER (10 POINTS)

a) Explain the advantages and disadvantages of protecting intellectual property with a trade secret

Advantages: Protection last forever if secret is not divulged; Do not have to disclosure idea/procedure like in patent

Disadvantages: No protection if independently discovered or reserve engineered

b) Explain the differences between patents and copyrights.

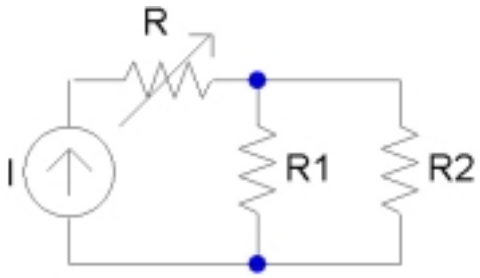
Patents provide protection for an idea while copyrights protect the expression of an idea

c) You have three resistors with values of 500Ω, 600Ω, and 1.2 kΩ. How can these resistors be combined to maximize and minimize the total (i.e., equivalent) resistance? Draw each resistor combination and provide a value for the equivalent resistance.

Minimum: Place resistors in parallel. R_{eq} = 222Ω

Maximum: Place resistors in series. R_{eq} = 2.3 kΩ.

PROBLEM #2. CONCEPTUAL PROBLEMS (15 POINTS)



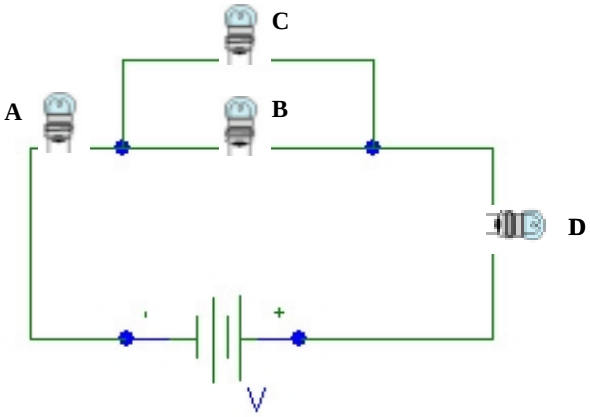
a) When resistor R is increased in the above circuit, determine if the quantities below increases (I), decreases (D), or stays the same (S).

Power dissipated by resistor R1: S

Power dissipated by resistor R2: S

Power supplied by the current source: I

b) The circuit below has four identical light bulbs connected to an ideal battery.



(i) How do the brightnesses of these bulbs compare? **(A=D) > (B=C)**

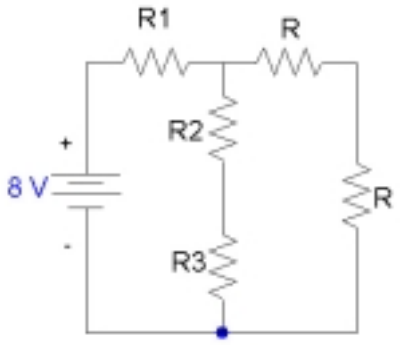
(ii) Which light bulb(s) draws the least amount of current? **C & B**

(iii) What happens to the brightness of the remaining light bulbs when light bulb C is removed **A & D decreases, B increases**

(iv) W What happens to the brightness of the remaining light bulbs when light bulb D is removed. **All go out (decrease) since there is no current flow.**

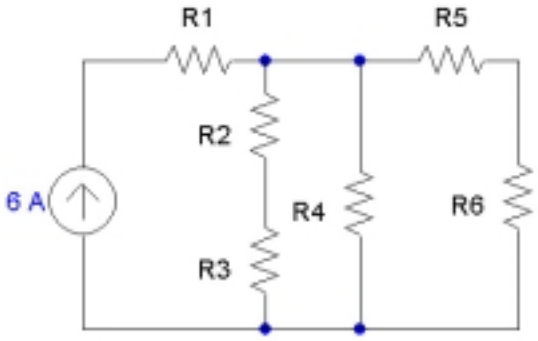
PROBLEM #3. VOLTAGE AND CURRENT DIVISION (20 POINTS)

a) Calculate the value of R in the circuit below so that resistor R1 dissipates 2 mW of power. Assume R1 = 8kΩ, R2 = 4 kΩ, and R3 = 6kΩ in your calculation.



R = 20Ω

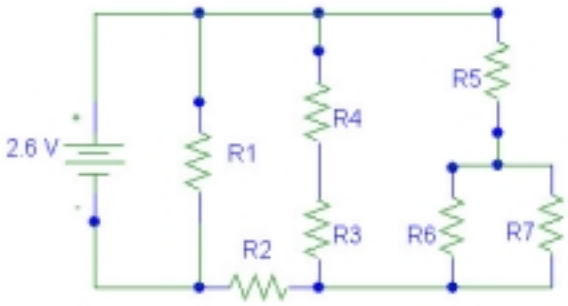
c) Calculate the current through resistor R4 and the voltage across resistor R3 in the circuit below. Assume R1 = 12 Ω, R2 = 7 Ω, R3 = 3 Ω, R4 = 10 Ω, R5 = 6Ω, and R6 = 4 Ω in your calculations. **Make sure** you clearly identify your reference directions for each of these quantities!!



Current throught R4= ± 2 A (depending on direction assumed)

Voltage across resistor R3 = ±6V (depending on direction assumed)

PROBLEM #4. POWER DISSIPATION IN ELECTRIC CIRCUITS (30 POINTS)



a) If all of the resistors in the above circuit have the same value (i.e., R), select the resistance value such that the source provides 1.3 W of power to the circuit. **R = 8Ω**

b) Calculate the power being dissipated by resistors R2, R4, and R7

Power dissipated by R2 = 245 mW

Power dissipated by R4 = 45 mW

Power dissipated by R7 = 20 mW

c) If all the resistors are to have the same power rating, what minimum power rating is required in this circuit. Assume that the power rating can change by 1/8-W increments (e.g., 1/8-W, 1/4-W, 3/8-W, etc.)

R1 dissipates the most power (= 0.845 W). Therefore I need 7/8-W power rating.

PROBLEM #5 THREE-WAY LIGHT BULB DESIGN (25 POINTS)

A light bulb which provides a single intensity of light consists of a single filament as shown above. When a voltage is applied to the leads, the filament dissipates power and this power dissipation leads to light being emitted (measured in watts).

Your task in this problem is to design a three-way light bulb. This light bulb uses two filaments to produce three different levels of light output. Your light bulb is to emit light a 50, 100, and 150 W when a voltage of 120 V is applied. In your design provide the following:

- The resistance value of each filament. **The resistance for 50 W is 288 Ω. The resistance for 100 W is 144 Ω. These are placed in parallel to give the resistance for 150 W.**
- Diagrams showing how the filaments are connected to the 120-V supply (assume an ideal battery) to produce each light output value. **See above.**
- The range of expected annual energy costs of operating this light bulb for 100 hours a month. Assume that the cost of electricity is $0.0355 per kW-hr. **Minimum $2.13; Maximum is $6.39**

Bonus (10 points). If this light bulb is powered by thirteen 9-V batteries, the 50-W setting produces 45 watts of power. How much power is produced in the other two settings?

The batteries have an internal resistance of 0.615 Ω. Therefore the other powers are 85.32 W and 121.5 W.

EXTRA CREDIT (3 POINTS TOTAL)

1) Who are the two major political parties' candidates for Vice President

Dick Cheney and Joe Lieberman

2) Where did your instructor attend college? Graduate school?

University of Texas at Austin; University of California at Santa Barbara