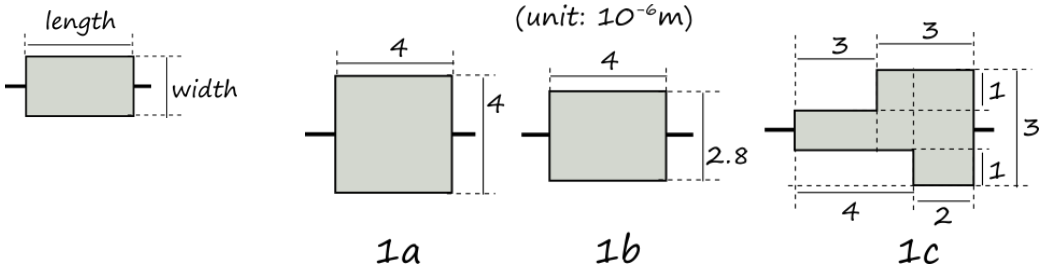
National Taiwan Normal University
Department of Computer Science and Information Engineering

CSU0007 - Basic Electronics

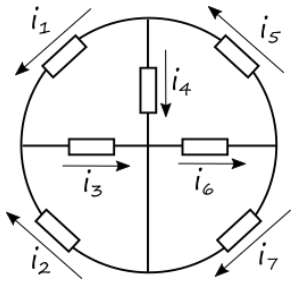
Homework 1

100 points total. Submit your work via Moodle. To receive full score, clearly state each step of your derivation.

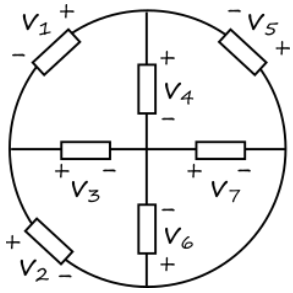
1. (10 points) Let *r* be the resistance of a linear planar resistor with width=length=5×10^{-6}m and thickness of 10^{-6}m. What are the resistance of the following resistors of the same material (and of the same thickness)?
   1a. (3 points)
   1b. (3 points)
   1c. (4 points)



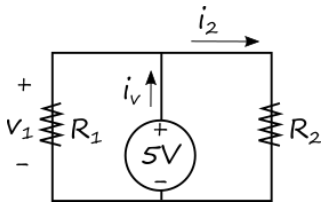
2. (10 points) In the following figure, use KCL to find the branch current with respect to each lumped element. In particular, suppose i_1=2mA, i_2=1mA, i_4=3mA, i_7=-7mA. Determine i_3, i_5, and i_6.



3. (10 points) In the following figure, use KVL to find the branch voltage with respect to each lumped element. In particular, suppose v_1=6V, v_2=3V, and v_6=2V. Determine v_3, v_4, v_5, and v_7.

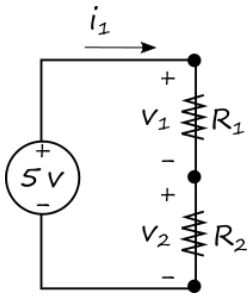


4. (10 points) In Figure 4c, suppose we know i_2=3mA and R_1=10kΩ. Determine v_1, i_v, and R_2.

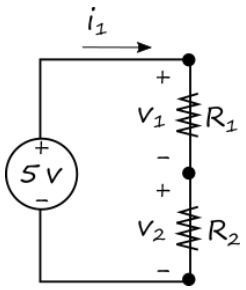


5. (10 points) Consider the following voltage dividers.

   5a. (5 points) Suppose R_1=9kΩ and R_2=6kΩ. Determine i_1 and v_2.



5b. (5 points) In the following circuit, suppose R_1=2.7kΩ. If we want to create a branch voltage of 3.3V across resistor R_2 (i.e., to make v_2=3.3V), what should be the resistance of R_2?



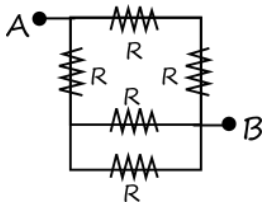
6. (10 points) In class, we have shown that the equivalent resistance of two resistances R_a and R_b in parallel is $R_p=R_aR_b/(R_a+R_b)$.

6a. (5 points) Use mathematical induction (i.e., 數學歸納法) to prove that for *n* resistors connected in parallel, the following equation holds for the equivalent resistance R_p: $1/R_p = \sum_{k=1}^{n}(1/R_k)$

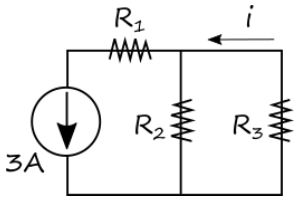
6b. (5 points) Prove that when N resistors, each with resistance R, are connected in parallel, the equivalent resistance is R_p=R/N.

7. (10 points) Use your own words to explain why that, typically, a voltage meter is designed to have a relatively large internal resistance (say, 1MΩ)?

8. (5 points) For the following circuit, find the equivalent resistance from the viewpoint of A-B.



9. (10 points) For the following circuit, determine current i.



10. (15 points) For the following circuit,
    9a. (5 points) use the basic analysis method to find current i.
    9b. (10 points) use the node analysis method to find current i.