

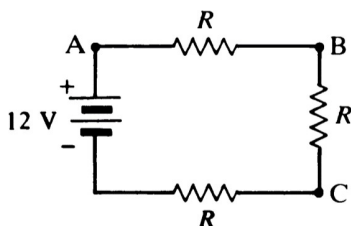
# Physics 4700 HOMEWORK 1

Due: January 18

1. Calculate how many electrons flow per second past a fixed point in a wire carrying 10 mA of current. If the current moves from left to right, which way do the electrons move?

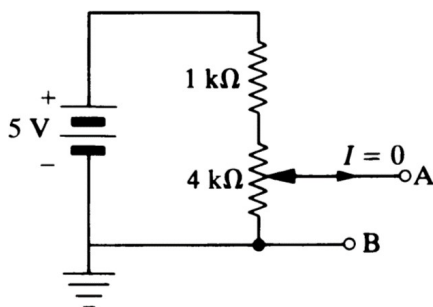
Hint: Draw the picture for each setup before calculating the voltage at A, B and C. How do you calculate potential difference between two points?

2. Calculate the voltage at points A, B, and C, if
  - a. A is grounded
  - b. B is grounded
  - c. C is grounded

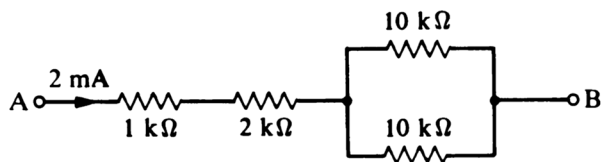


Hint: What is a potentiometer and how does it work?

3. A fixed  $1.0 \text{ k}\Omega$  resistor and a  $4.0 \text{ k}\Omega$  potentiometer are connected in series across a 5 V battery of negligible internal resistance. Calculate the maximum and minimum values of  $V_{AB}$  as the potentiometer shaft is rotated.



4. Calculate the voltage between A and B. What is the polarity of  $V_{AB}$ ?

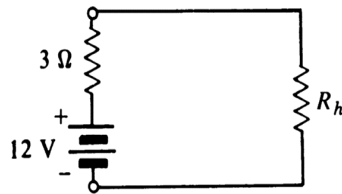


Hint: Draw the circuit setup for the battery connection to the starter. Where do you place the starter in the circuit?

5. An automobile battery has a terminal voltage of 12.8 V with no load. When the starter motor (which draws 90 A) is being turned over by the battery, the terminal voltage drops to 11 V. Calculate the internal resistance of the battery.

Hint: How can you determine maximum power?

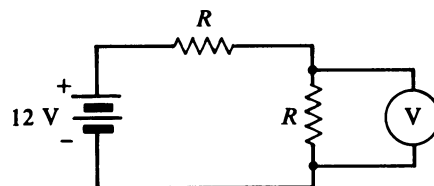
6. How large should the heater resistance  $R_h$  be to draw maximum power from a 12 V battery with an internal resistance of  $3\ \Omega$ ? Calculate the power dissipated in the heater and in the battery under such conditions.



Hint: Is the voltmeter resistance placed in series or parallel to  $R$ ?

7. Calculate the voltmeter reading for  
a.  $R = 1\ \text{k}\Omega$   
b.  $R = 1\ \text{M}\Omega$

You may assume the voltmeter is an oscilloscope with a  $1\ \text{M}\Omega$  input resistance. What's the largest value  $R$  can be if we want the voltmeter to always be within 10% of the correct voltage?



Hint: Use KCL, KVL to solve the problem.

8. Find the current going through each resistor and the voltage drop across each resistor. The resistor values are in Ohms.

