Exercises for EIT circuits review

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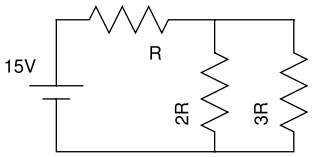
Basics

1. Charges q and $-q$ are separated by distance d and charge Q is placed at distance r from the midpoint, as shown in the figure below. Find the net force on the charge Q by the other charges.
2. Two plates of area A, each carrying charges of $+Q$ and $-Q$ are d distance apart. How much work needs to be done to mave a charge q ($q > 0$) from the negatively charged plate to the positively charged plate?

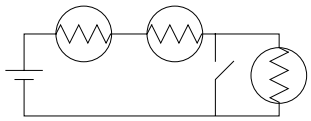
DC circuits

3. $R = 1$ kΩ. Compute the following:



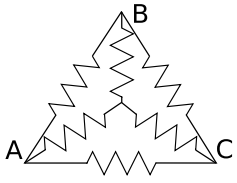
(a) the voltage change across the resistor R, and
(b) the power output of the battery.

4. All light bulbs in the circuit below are identical.



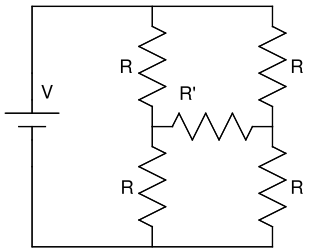
What happens to the following quantities when the switch is closed? (a) current through the battery, (b) brightness of each bulbs, (c) the voltage drop across each bulbs, and (d) total power dissipated by the bulbs.

5. All resistors are 1 kΩ.



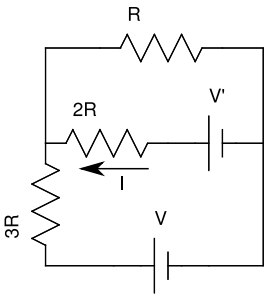
Find the Thevenin equivalent resistance between the points A and B; and B and C.

6. Consider the circuit shown below. V and R are given quantities.



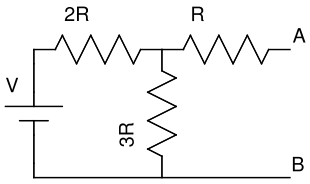
(a) Find the current through the resistor R'.
(b) One of the R resistors is changed to a $2R$ resistor. What is the current through R'?

7. Consider the circuit shown below.



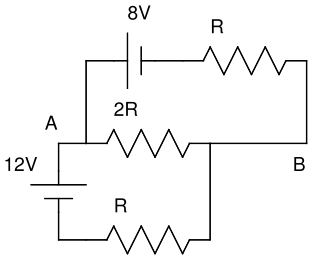
Given the current I through the $2R$ resistor in the direction indicated, find V' in terms of V and R.

8. Consider the curcuit below. Find:



(a) the Thevenin equivalent voltage
(b) Thevenin equivalent resistance between points A and B

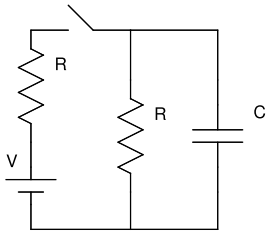
9. Consider the circuit below. $R = 1$ kΩ.



(a) Find the voltage difference between A and B;
(b) find the current through the resistor $2R$.

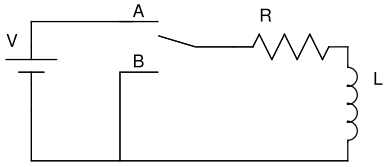
Capacitors and inductors

10. The switch is closed at time $t = 0$.



(a) What is the maximum charge on capacitor C at a very long time after $t = 0$?
(b) Once the capacitor is charged, switch is opened. Capacitor charge after $\Delta t = 2RC$?

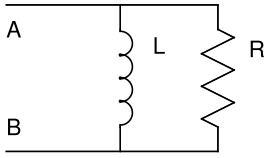
11. At $t = 0$, the switch is closed to terminal A.



(a) At $t = \tau_1$ how much power is being drawn from the battery? How much of that power is dissipated as heat?
(b) The maximum energy stored in inductor L?
(c) When the current through R is I_0, switch is closed to terminal B. How much time passes before the current falls to I_0/e?

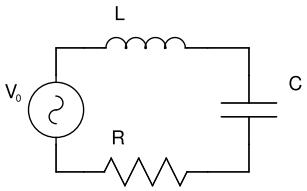
AC circuits

12. Terminals A and B are connected to a signal source.



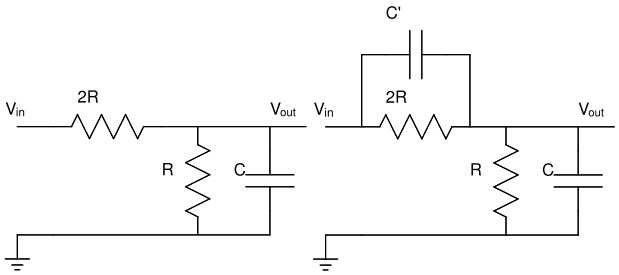
At 60 Hz, the impedance between A and B is $(300 + 60j)$ Ω. Find the inductance L and the resistance R. What is the impedance at 50 Hz?

13. Consider the below circuit with AC voltage source. $V_0 = 10$ V, peak voltage, $L = 1$ H, $C = 100$ μF, and $R = 50$ Ω.



(a) At 60 Hz, how much power is dissipated?
(b) At what frequency is the maximum power dissipated by the resistor, and what is this power?

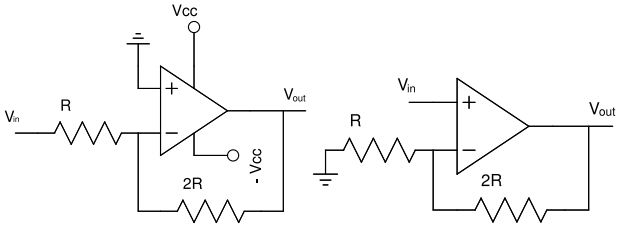
14. *from Physics 111-BSC, Lab 2*



(a) In the circuit above on the left, find the frequency at which $V_{\text{out}} = V_{\text{in}}/4$ (in rms).
(b) By adding a capacitor as shown (above on the right), we can make $V_{\text{out}} = V_{\text{in}}/3$ regardless of frequency. Find the correct capacitance C'.

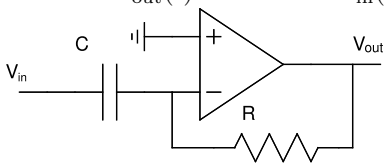
Op Amp circuits

15. *Amplifiers*



(a) For the circuit above on the left ("inverting amplifier"), give V_{out} in terms of V_{in}.
(b) For the circuit above on the right ("non-inverting amplifier"), give V_{out} in terms of V_{in}.

16. (a) Find the $V_{\text{out}}(t)$ in terms of $V_{\text{in}}(t)$, R, and C.



(b) Analyze the circuit in (a) with the positions of capacitor and resistor swapped.