Exercises and problems for EIT circuits review

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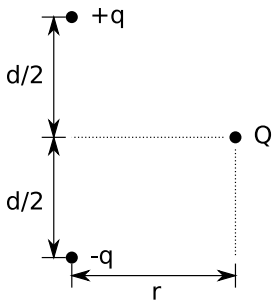
October 14, 2009

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.

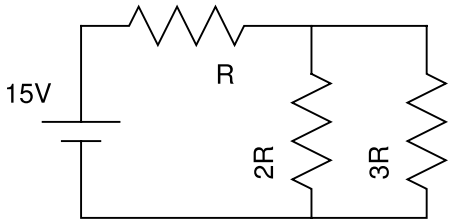


Find the net force on the charge Q by the other charges.

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?

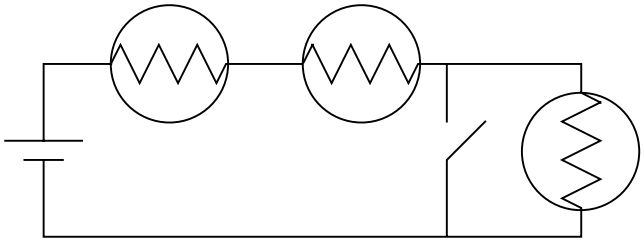
DC circuits

3*. $R = 1$ kΩ.



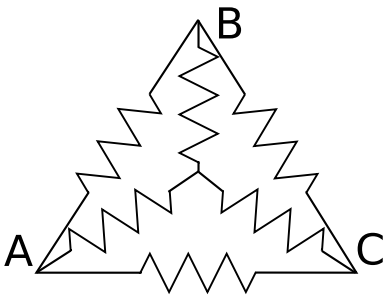
(a) Compute the voltage change across the resistor R, and (b) calculate the power output of the battery.

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



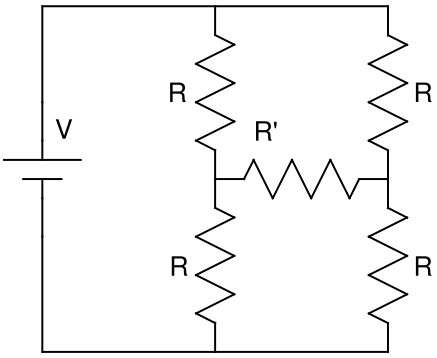
What happens to the following quantities when the switch is closed? (a) current through the battery, (b) brightness of each bulbs, (c) the voltage drop across each bulbs, and (d) total power dissipated by the bulbs.

5. All resistors are 1 kΩ.



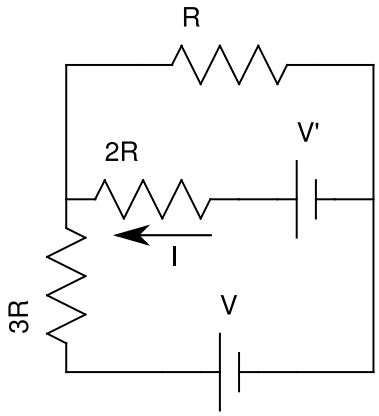
Find the Thevenin equivalent resistance between the points A and B; and B and C.

6. Consider the circuit shown below.



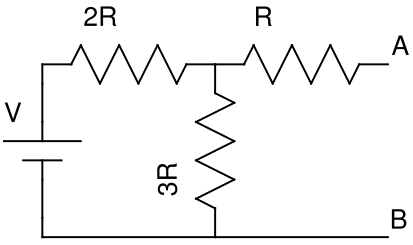
(a) Find the current through the resistor R' in terms of V and R. (b) One of the R resistors is changed to a $2R$ resistor. What is the current through R'?

7*. Consider the circuit shown below.



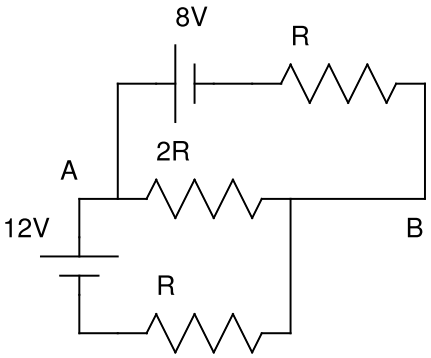
Given the current I through the $2R$ resistor in the direction indicated, find V' in terms of V and R.

8*. Consider the curcuit below.



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

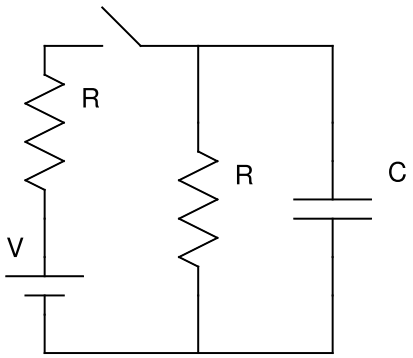
9. Consider the circuit below. $R = 1$ kΩ.



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

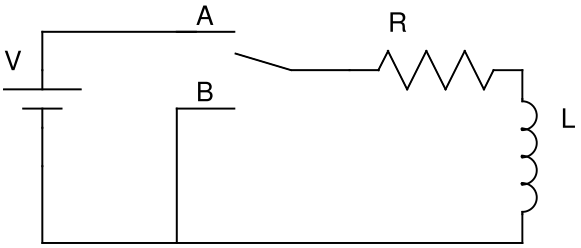
Capacitors and inductors

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 again. How much charge remains on the capacitor after $\Delta t = 2RC$?

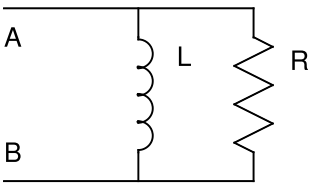
11. At $t = 0$, the switch is closed to terminal A.



(a) At $t = \tau_1$ how much power is being drawn from the battery? How much of that power is dissipated as heat?
(b) What is the maximum energy stored in the 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 approximately one-third of I_0?

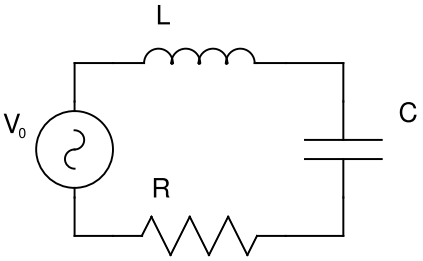
AC circuits

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



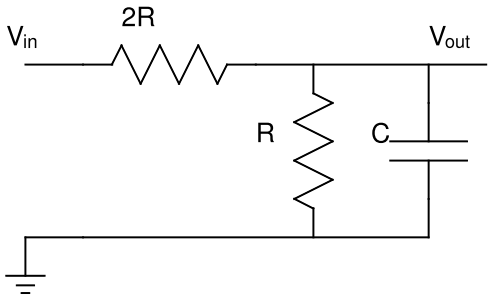
At 60 Hz, the impedance between A and B is $(300 + 60j)\ \Omega$. Find the inductance L and the resistance R. What is the impedance at 50 Hz?

13*. Consider the below circuit with AC voltage source. $V_0 = 10$ V, peak voltage, $L = 1$ H, $C = 100\ \mu$F, and $R = 50\ \Omega$.

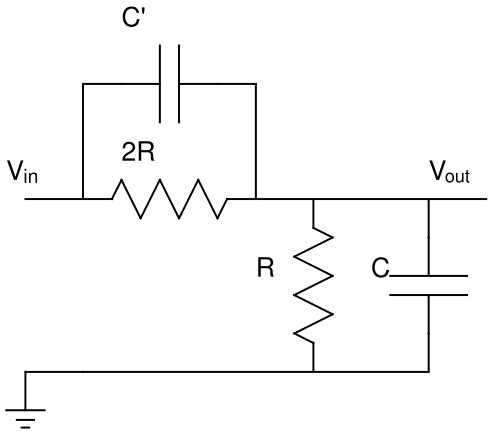


(a) At 60 Hz, what is the power dissipated by the resistor?
(b) At what frequency is the maximum power dissipated by the resistor, and what is this power?

14*. (a) In the circuit below, find the frequency at which $V_{\text{out}} = V_{\text{in}}/4$ (in rms).

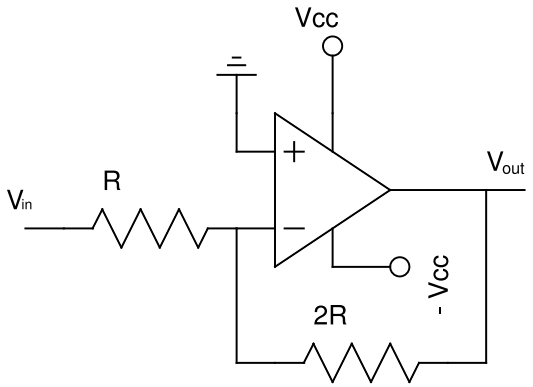


(b) By adding a capacitor as shown, we can make $V_{\text{out}} = V_{\text{in}}/3$ regardless of frequency. Find the correct capacitance C' for that.

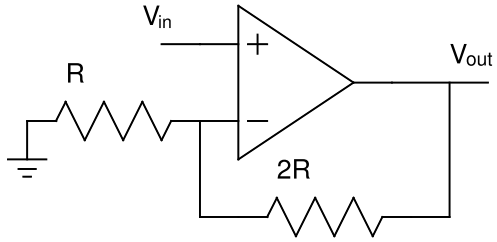


Op Amp circuits

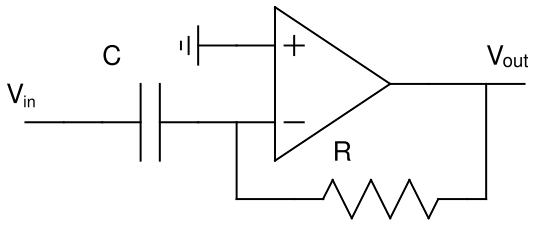
15*. (a) Analyze below circuit, "inverting amplifier". What is V_{out} in terms of V_{in}?



(b) Analyze below circuit, "non-inverting amplifier". Express V_{out} in terms of V_{in}.



16. (a) Analyze the circuit below to 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.