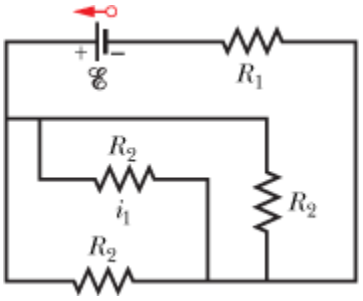
Homework: Ch. 21

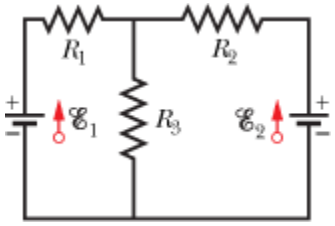
1. Describe the behavior of a capacitor in a series RC circuit both right after a potential is applied across it and the resistor and at steady state.

2. A 120 V power line is protected by a 15 A fuse. What is the maximum number of 500 W lamps that can be simultaneously operated in parallel on this line without "blowing" the fuse because of an excess of current?

3. In the figure below, $R_1 = 6.00\ \Omega$, $R_2 = 18.0\ \Omega$, and the ideal battery has emf $\mathcal{E} = 12.0$ V.
   a. What is the equivalent resistance?
   b. How much energy is dissipated by all four resistors in 1.00 min?

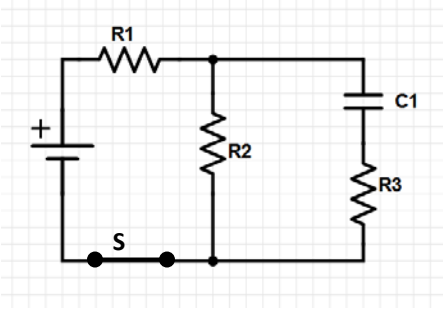


4. In the figure on the right, the ideal batteries have emfs $\mathcal{E}_1 = 10.0$ V and $\mathcal{E}_2 = 0.500\ \mathcal{E}_1$, and the resistances are each 4.00 Ω. What is the current in (a) resistance 2 and (b) resistance 3?



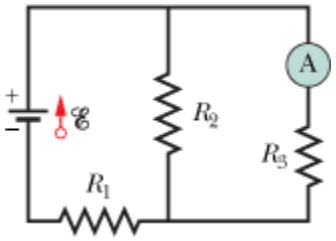
5. What multiple of the time constant τ gives the time taken by an initially uncharged capacitor in an *RC* series circuit to be charged to 99.0% of its final charge?

6. The figure shows an RC circuit with $R_1 = 10.0\ \Omega$, $R_2 = 15\ \Omega$, $R_3 = 5.0\ \Omega$, and capacitance $C_1 = 10.0\ \mu$F. The switch *S* has been closed for a long enough period that the circuit has reached steady state. Assuming that $\mathcal{E} = 25$ V and that the battery is ideal, determine the following:

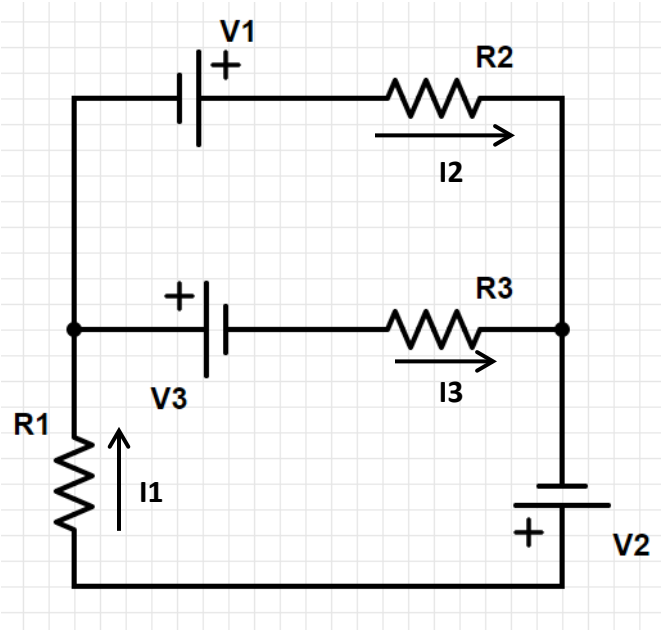


   a. What is the equivalent resistance for this circuit at this time?
   b. What is the voltage and current through R_2?
   c. What is the power dissipated by R_1?
   d. At time $t = 0$, the switch *S* is opened. What is the time constant for this circuit?
   e. How long will it take for the current to drop to 0.5 A?

7. In the figure below what does the ammeter read if $\mathcal{E}$ = 5.0 V (ideal battery), R_1 = 2.0 Ω, R_2 = 4.0 Ω, and R_3 = 6.0 Ω?



8. For the circuit shown below, use Kirchhoff's rules to find the currents I_1, I_2, and I_3. Assume that batteries are all ideal and have potential $V_1 = V_2$ = 10.0 V and V_3 = 15.0 V. Also assume that $R_1 = R_3$ = 10.0 Ω and R_2 = 20.0 Ω.



9. In an *RC* series circuit, emf $\mathcal{E}$ = 12.0 V, resistance R = 1.40 MΩ, and capacitance C = 1.80 μF.
    a. Calculate the time constant.
    b. Find the maximum charge that will appear on the capacitor during charging.
    c. How long does it take for the charge to build up to 16.0 μC?

10. A 15.0 kΩ resistor and a capacitor are connected in series, and then a 12.0 V potential difference is suddenly applied across them. The potential difference across the capacitor rises to 5.00 V in 1.30 μs.
    a. Calculate the time constant of the circuit.
    b. Find the capacitance of the capacitor.