Homework 3   **EE 302: Introduction to Electrical Engineering**   **Fall 2015**

1. [Nilsson & Riedel, Problem 3.19]

    (a) Suppose the voltage divider circuit P3.19(a) is connected to the voltage divider shown in circuit P3.19(b), i.e., *a* is connected to *a'* and *b* is connected to *b'*. Find v_o.

    (b) Now assume the voltage divider shown in circuit P3.19(b) is connected to the voltage divider in circuit P3.19(a) by means of a current-controlled voltage source, as shown in circuit P3.19(c). Find v_o.

    (c) What effect does adding the dependent voltage source have on the operation of the voltage divider that is connected to the 380V source?

    Figure P3.19
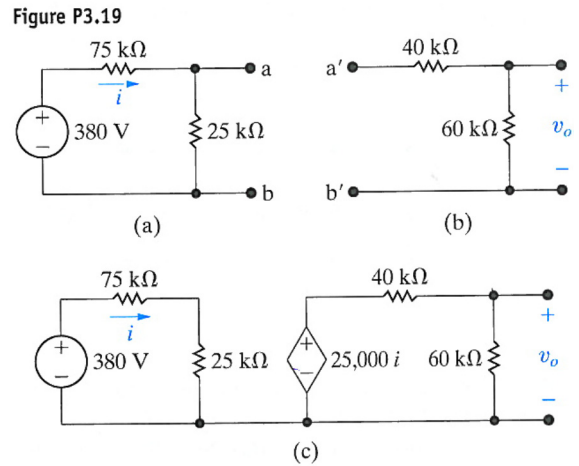
2. Consider the circuit shown at right, with all the switches S_1 through S_{400} initially open. 400 "switch demons" then converge on the circuit and perform the following actions. Switch demon #1 toggles (i.e., closes an open switch, or opens a closed switch) every switch S_1 through S_{400}. Switch demon #2 then toggles every second switch, i.e., switches S_2, S_4, S_6, S_8, etc. Switch demon #3 then toggles every third switch, i.e., switches S_3, S_6, S_9, etc. This continues in analogous fashion for the remaining switch demons #4 through #400, after which all the switch demons leave. Calculate the resulting current *I* in the circuit in its final state. Justify your answer and explain your reasoning in detail.
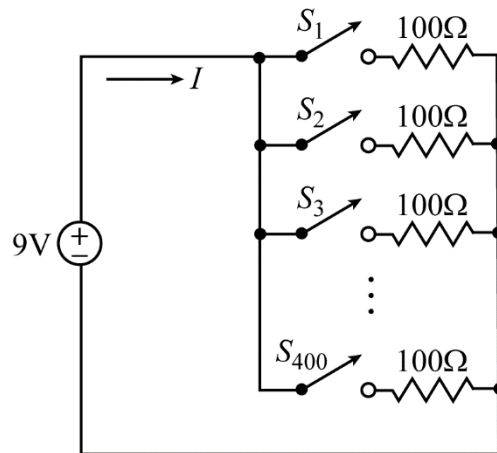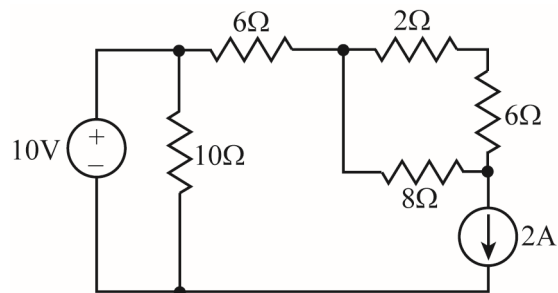

3. Consider the two circuits shown below.

   (a) Calculate the power dissipated in the 2Ω resistor in the circuit below:
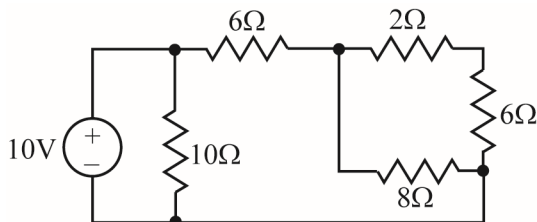
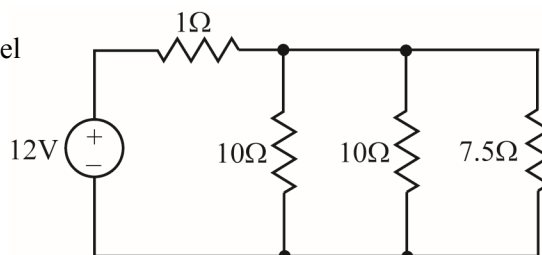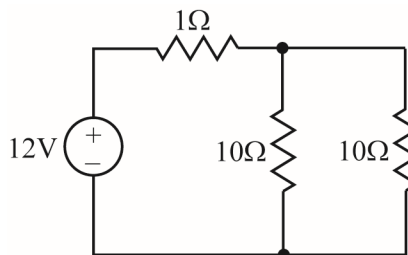   (b) Calculate the power dissipated in the 2Ω resistor in the circuit below:

4. Consider the circuit at right:

    (a) Calculate the current I_1 flowing through the 1Ω resistor that is in parallel with the 15A current source in the circuit.

    (b) Show explicitly that power is conserved, i.e, total power supplied is equal to total power dissipated, in the circuit.
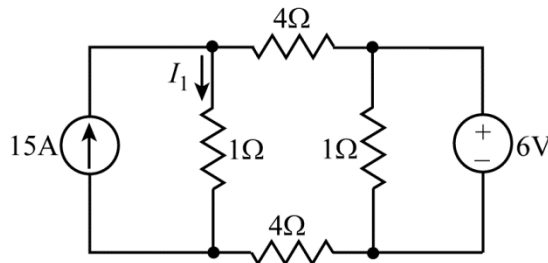
5. Consider the circuit at right, in which the 12V voltage source corresponds to a battery that can provide a total charge of 10A·h before being exhausted:

    (a) Calculate the power supplied to each 10Ω resistor while the battery is still operating.

    (b) Calculate the length of time the battery can provide power to these resistors, assuming the battery supplies the necessary electric current until it is exhausted.

    (c) Suppose an additional 7.5Ω resistor is added in parallel to the 10Ω resistors, as shown at right. Calculate:
    (i) the power supplied to each 10Ω resistor while the battery is still operating, and
    (ii) the length of time the battery can provide power to these resistors, assuming the battery supplies the necessary electric current until it is exhausted.

6. Consider the circuit below:

    (a) Calculate the power associated with the dependent current source in the circuit, (i) when the switch is open and (ii) when the switch is closed. In each case, indicate whether the power is supplied to, or dissipated within, the circuit.

    (b) Calculate the power associated with the 21V voltage source in the circuit, (i) when the switch is open and (ii) when the switch is closed. In each case, indicate whether the power is supplied to, or dissipated within, the circuit.

    (c) Explain the comparison between your results for situations (i) and (ii) in part (b) of this problem, in terms of current flow and/or voltages within the circuit (rather than just via equations).