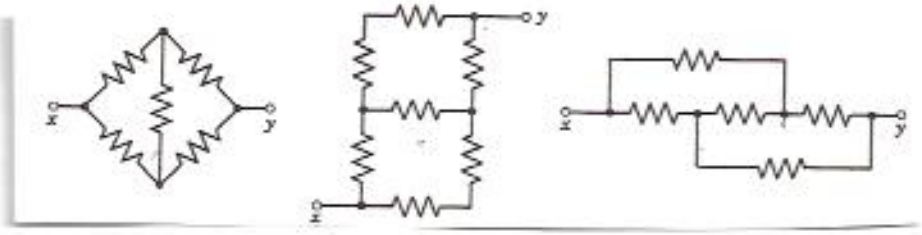
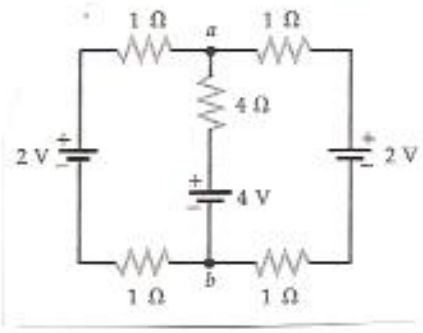
Problem Set 5 – Direct Current Circuits

1. What is the equivalent resistance between the terminal points x and y for the three circuits shown. Assume each resistor is R.

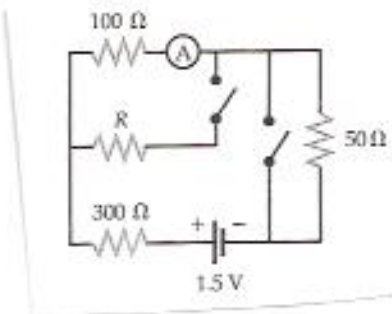


2. Twelve resistors, each of resistance R, form a cube as shown. Find the equivalent resistance of (a) an edge, (b) the body diagonal

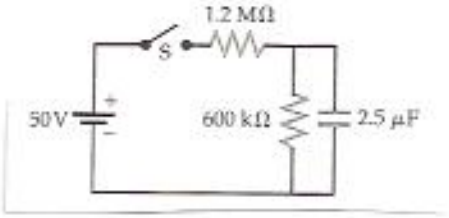
3. For the circuit shown, find the potential difference between points a and b.



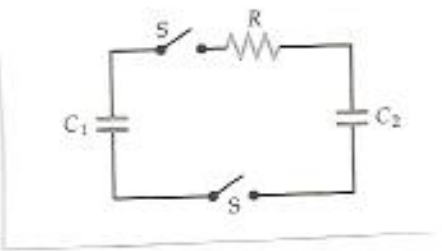
4. In the circuit shown, the reading of the ammeter is the same with both switches open and both closed. Find the resistance R



5. Two batteries with emfs $\mathcal{E}1$ and $\mathcal{E}2$ and internal resistances r1 and r2 are connected in parallel. Prove that the optimal load resistance (for the delivery of maximum power) connected in parallel with this combination is R = r1r2/(r1 + r2)
6. For the circuit shown below find
    a. The initial battery current immediately after switch S is closed.
    b. The battery current a long time after switch S is closed.
    c. The current through the 600 Ω resistor as a function of time.



7. Capacitors C1 and C2 are connected in parallel by a resistor and two switches as shown in the diagram. Capacitor C1 is initially charged to a voltage Vo and capacitor C2 is uncharged. The switches are then closed.
    a. What are the final charges on C1 and C2
    b. Com[pare the initial and final stored energy of the system
    c. What caused the decrease in the capacitor-stored energy?



8. An RC circuit is discharged by closing a switch at time t = 0. The initial potential difference across the capacitor is 100V. If the potential difference has decreased to 1 V after 10 seconds,
    a. What will the potential be at t = 20s?
    b. What is the time constant of the circuit?