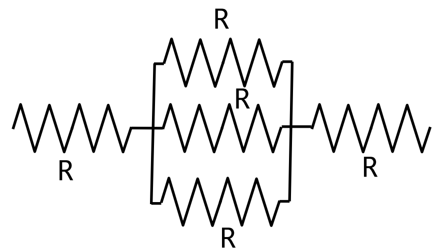
28-Series Problem (DC Circuits)

28.1) The terminal voltage of a 15.0 V battery is 11.6 volts when providing 20.0 watts of power to an external load resistor *R*.

a.) Determine *R*.

b.) Determine the battery's internal resistance.



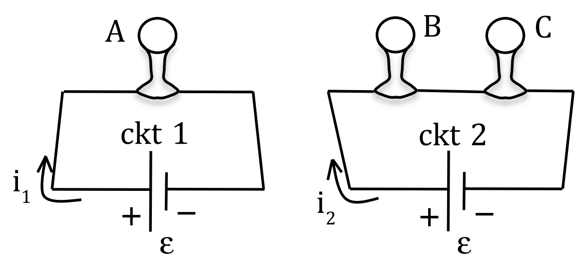
28.5) The resistor combination shown to the right has all identical resistors in it. What is its equivalent resistance?

28.6) An extension cord is made up of two conducting wires, one running from the wall socket (or power supply) to the object needing power, and one running back to the source. Each wire, being a conductor, has resistance associated with it. Consider an extension cord that has $0.80\ \Omega$ s of resistance per wire. It is used to provide power to a lightbulb that is rated at "75 W" when hooked directly across a 120 V source. When hooked up to the wall socket via the extension cord:

a.) Why isn't the bulb getting 75 watts of power in this situation?

b.) Draw a complete and accurate circuit diagram for this situation.

c.) How much power is actually provided to the bulb?

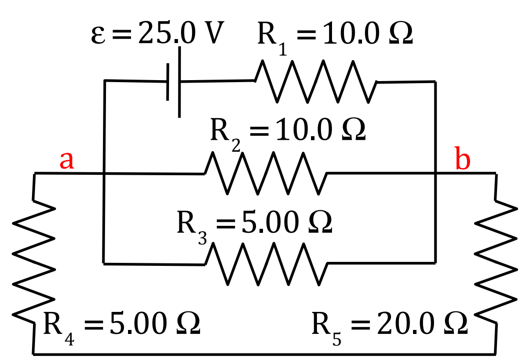


28.8) In the two circuits shown to the right, all the lightbulb resistances are the same (call each *R*), the batteries are the same and we can ignore internal resistance.

a.) How much current is there in each lightbulb?

b.) How does B's brightness compare to C's brightness. Justify your response.

c.) How does A's brightness compare to B and C's brightness. Justify.

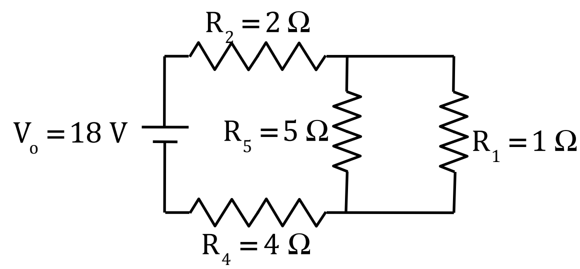


28.9) Examine the circuit to the right.

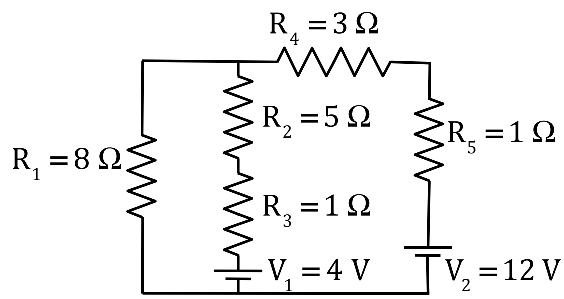
a.) Determine the current in the $20.0\ \Omega$ resistor.

b.) What is the potential difference across *a*-*b*?

28.17) Determine the power dissipated by each of the resistors in the circuit shown to the right.

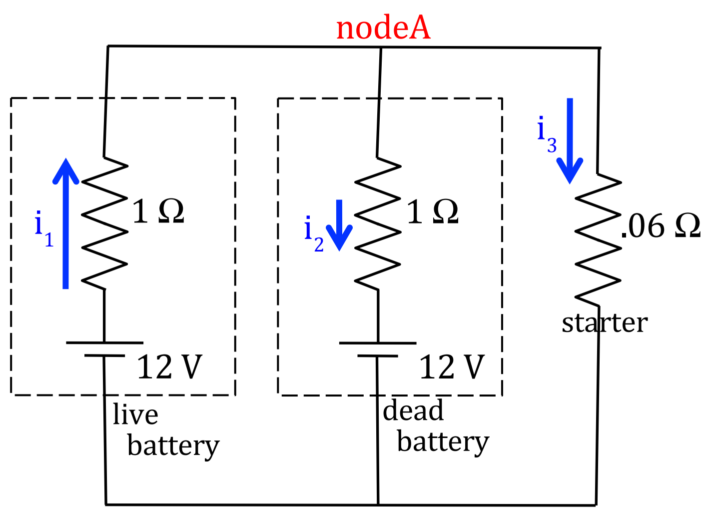


28.21) The circuit shown to the right is allowed to "run" for two minutes.



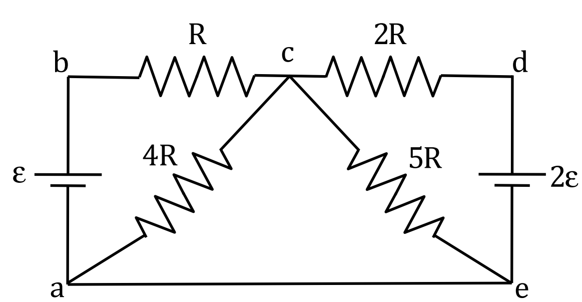
a.) How much current is running through each branch?
b.) How much energy does each battery deliver?
c.) How much energy is "delivered" to each resistor?
d.) Talk about the energy storage transformation that happens in the operation of the circuit.
e.) How much total energy was transformed into internal energy in the system during the two minute period?

28.24) The circuit to the right is of a "dead" 12.0 V car battery hooked across a starter battery. The idea is that when the started is turned on, the live battery will provide current to the system. With that in mind:

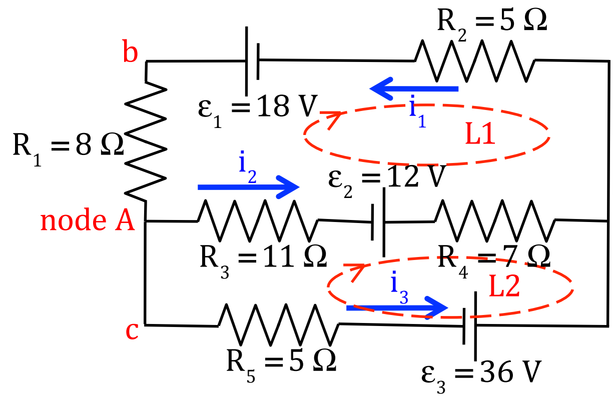


a.) What is the current in the starter branch of the circuit?
b.) What is the current in the "dead battery" branch of the circuit?
c.) Is there charging happening to the dead battery (as suggested by the defined direction of current in that branch) while the switch is closed and the starter is trying to start the car?

28.27) Determine the current between *a* and *e* in the circuit to the right.



28.32) In this problem, you are going to determine the current in each branch the old fashion way. That is, you are going to be asked to write out Kirchoff's Laws for the circuit, then solve for the various *I* values. (Note that on a test, in most cases, the loops, nodes and currents will NOT be defined for you—you'll have to do all that for yourself . . . you'll also be expected to have the wherewithal to know to do *Parts a, b* and *c* below without prompt.)



In all probability, on a test you would probably use a matrix approach and your calculator to do the solving of this problem for the currents. *The old fashioned way does everything longhand.* That's what you are about to experience.

a.) Write out the *loop equation* for the upper loop (that is, use Kirchoff's First Law on Loop 1).

b.) Write out the *loop equation* for the lower loop.

c.) Write out the *node equation* (this may be called a "junction equation" in your book) for *node A* (that is, use Kirchoff's Second Law on Node A).

d.) Solve the *node equation* for I_3.

e.) Use the equation derived in *Part d* to eliminate I_3 from the *loop equation* you determine in *Part b.*

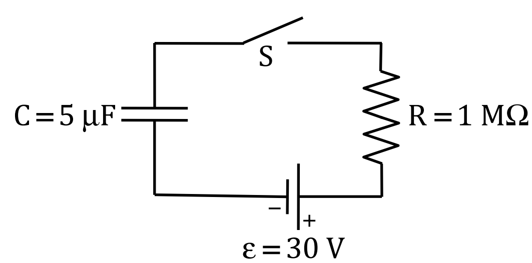
f.) Solve the remaining equations from *Parts a* and *b* simultaneously for I_1 and I_2.

g.) Use the solutions found in *Part f* and the *node equation* from *Part c* to determine I_3.

h.) Speak to the significance of the negative sign you found in front of the I_2 current value.

g.) This is not found in the Solutions, but use the matrix approach (and calculator) we talked about in class to solve for I_1, I_2 and I_3, then marvel at how much easier life is now than it was in the old days of longhand calculations.

28.34) Examine the RC circuit shown to the right (note: the symbol $M\Omega$ stands for "meg-ohm," or one million ohms).



a.) What is the circuit's *time constant*?

b.) How much charge, maximum, will the cap accumulate after the switch is thrown?

c.) What is the circuit's current after 10.0 seconds?

28.42) A 1.50 kW heater, a 750 W toaster and a 1.00 kW grill are hooked together via an extension cord (that means they are in parallel with one another) that is plugged into a standard 120 V household source (a wall socket). The circuit has a 25.0-amp circuit breaker protecting it.

a.) Determine the current each device draws.

b.) Will the circuit breaker be tripped when all the devices are turned on? Justify your response with numbers.