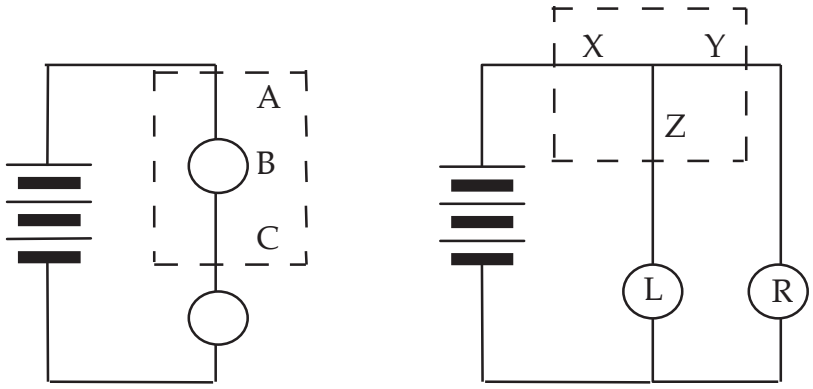
Homework Questions – Section 5

1. For the following questions, consider these circuit diagrams:



(A) How do the flow rates at A, B, and C compare to each other? Explain.

(B) How do the electric pressures at points A and C compare to each other? Explain.

(C) How do the flow rates at X, Y, and Z compare to each other? Explain.

(D) How do the electric pressures at X, Y, and Z compare to each other? Explain.

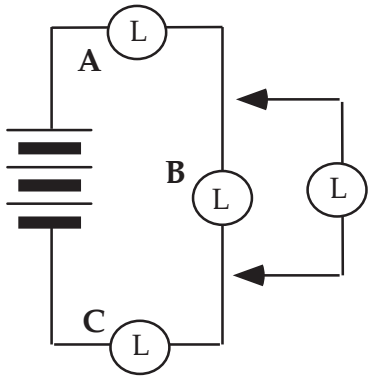
2. The wires that an electric company connects to your house can be pictured as being attached to a very big battery having an electric pressure difference of 120 volts (instead of the 4.5 volts provided by your battery pack). The electric lights and appliances in your house are designed to operate properly only when there is a 120 volt pressure difference across them and they are all connected in parallel. What is the advantage of parallel wiring, rather than series?

3. A typical house has many separate circuits, each of which has multiple parallel branches. In each circuit, the trunk leading to the parallel branches is wired in series with a fuse or a circuit breaker. A fuse melts or a circuit breaker opens if the current through it becomes greater than a certain value (typically 20 amperes). The purpose is to prevent the wires from overheating and possibly starting a fire when too many appliances are connected in parallel. It is also to prevent appliances from being damaged if voltage from electric lines to the house increases dramatically due to lightning or some other accident. How is a fuse or a circuit break able to "save" the wires and appliances from harm?

4. In the space below, draw a schematic diagram of a house circuit containing a TV, a computer, and a microwave oven; show the switches that control each appliance; and show a fuse or a circuit breaker designed to protect the circuit.

5. In a house, the branch wires may be attached to appliances and bulbs of different resistance. What is the relationship between the flow rate of charge in the main trunk wire of a house (coming in from outside) and the flow rate of charge in the branch wires?

6. A battery is connected to three long bulbs in series. After a steady state condition is reached, a fourth identical bulb is connected in parallel to bulb B. What effect does adding the bulb have on:



(A) the pressure difference across bulb B?_____

(B) the flow rate through bulb B? _____

(C) the pressure difference across bulb A? _____

(D) the total or net resistance of the circuit?_____

Be certain to construct the circuit to test the accuracy of your answers.

7. Refer to the circuit in question #6. Instead of adding a long bulb parallel to bulb B, consider adding a wire. What effect does adding a wire have on:

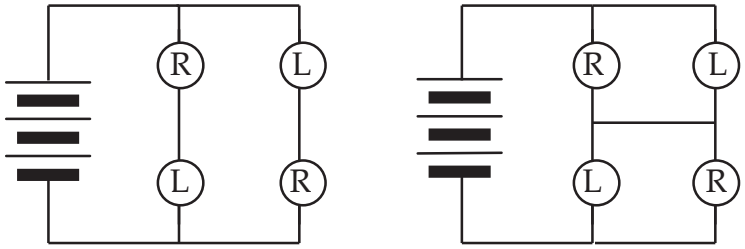
(A) the pressure difference across bulb B? _____

(B) the flow rate through bulb B? _____

(C) the pressure difference across bulb A? _____

(D) the total or net resistance of the circuit? _____

8. (A) Color code the circuit diagrams below.



A. BEFORE ADDING WIRE **B. AFTER ADDING WIRE**

(B) Which way will conventional charge flow in the added wire at the moment the wire is connected – to the right or to the left? Explain why.

(C) Which way will charge flow in the added wire when a final steady state condition is reached – to the right or to the left? Explain why.

(D) Describe the changes in bulb brightness that occur when the wire is added in (B). Explain the change in brightness in terms of the change in pressure difference across each bulb.

9. (A) Is a battery a device which supplies a constant current to a circuit? Explain.

(B) Is a battery a device which supplies a constant electric pressure to a circuit? Explain.

10. Color code both Figures 10a and 10b once the circuits have reached a steady state.

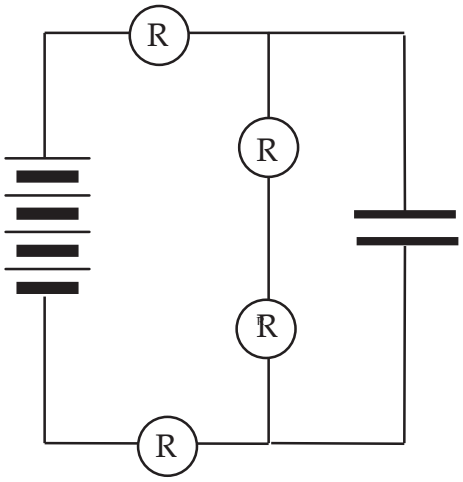


Figure 10a

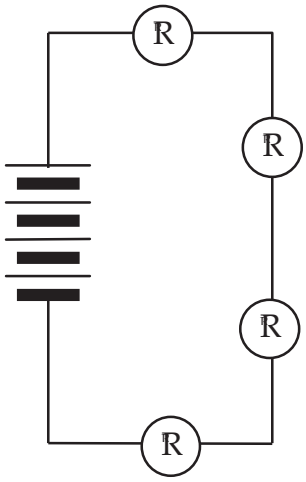


Figure 10b

Explain why the circuit in Figure 10b requires very much less time to reach the final steady state without a capacitor in the circuit as it is in Figure 10a.