

Unit 22 Homework Problems**Learning Goals:**

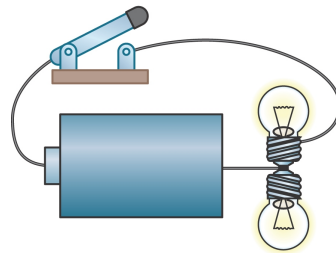
F.22 Draw simple and accurate circuit diagrams of real-life circuits or vice versa (use a circuit diagram to create a real-life circuit) and predict or describe what the circuit will do in practice.
LIST ELEMENTS USED

A.22 Make qualitative predictions about the brightness of bulbs in circuits that may involve series and parallel elements, switches, and short circuits.

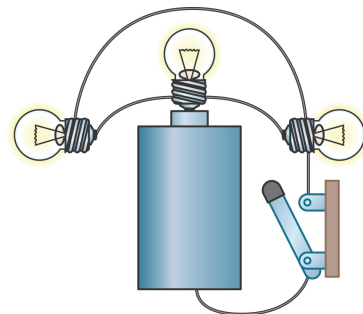
22-1) Consider a 1974 Volkswagen Bug (burgundy with a sunroof – yes, your professor owned one at one time) with a 12 V battery that is rated at 52 ampere-hours. This means the battery is supposed to be able to deliver 1 ampere of current to electrical devices in a car for at least 52 hours, or 2 amperes for 26 hours, and so on. Suppose you leave the car's lights on when you park the car (on those Bugs the lights did stay on after turning off the engine). Each of the two headlights draws 3.33 amperes of current, and each of the two taillights draws 0.50 amperes of current.

- (a) How long before your battery is dead?
- (b) How many Coulombs of charge are drawn from the battery before it dies?
- (c) How many electrons are pumped through the lights by the battery?

22-2) Draw a neat circuit diagram for each of the two circuits shown on the right using the standard symbols for bulbs, batteries and switches.



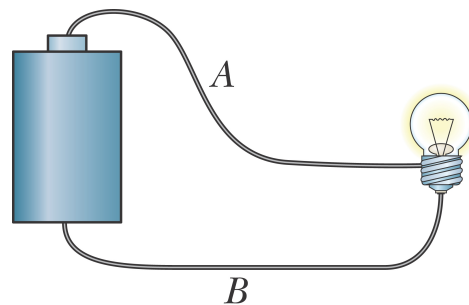
(a)



(b)

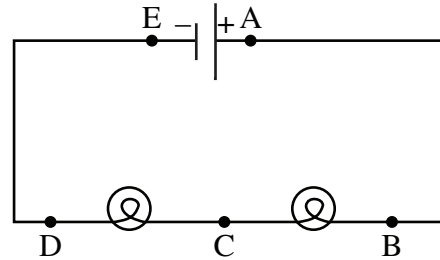
22-3) (a) Copy the sketch of the circuit on the right and indicate the positive terminal of the D-cell with a "+" sign and the negative terminal with a "-" sign and use arrows to indicate the direction of the flow of positive current in wire A and in wire B. If you believe there is no current in either wire A or wire B omit the arrow.

- (b) Draw a neat circuit diagram (using standard symbols) for the sketch on the right with an ammeter hooked up to measure the current in wire B and a voltmeter hooked up to measure the voltage across the light bulb. Also include a switch in the circuit to turn the bulb on and off. Use correct symbols for all circuit elements.



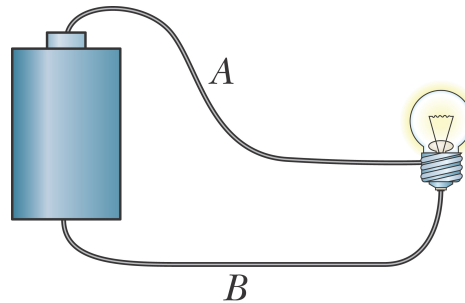
22-4) Suppose the circuit on the right has two identical bulbs in it.

- (a) How do you expect the brightness of the left bulb to compare to that of the right bulb?
- (b) Is the current "used up" in passing from B to C through the bulb on the right?
- (c) How can the observation you made in Activity 22.9 help you answer this question?



22-5) For the circuit on the right, indicate if the statements are true or false. If a statement is false, give a correct statement.

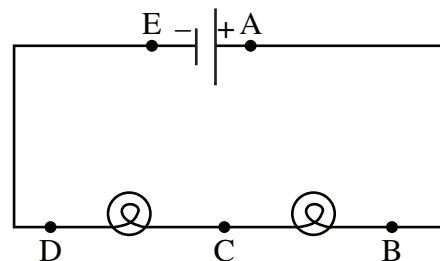
- (a) Positive current flows from the positive terminal of the battery into wire A, through the bulb into wire B and back to the negative terminal of the battery.



- (b) Some of the current is used up when the bulb is lit, since the current flows through the bulb from wire A to wire B, so the current in wire B is smaller than the current in wire A.
- (c) An ammeter will have the same readings if connected to read the current in wire A or wire B.
- (d) The current flows toward the bulb in both wires A and B.
- (e) If wire A is left connected but wire B is disconnected, the bulb will still light.

22-6) (a) For the circuit on the right, at which point (A, B, C, D or E) is the potential the lowest? Explain.

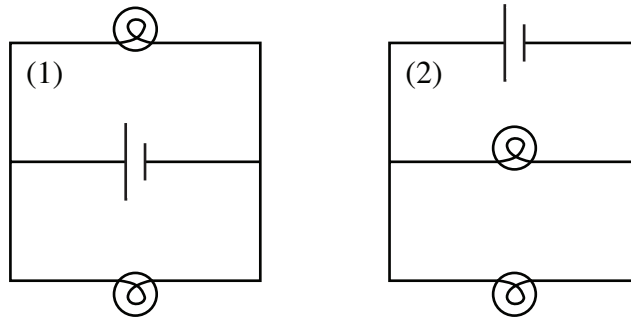
- (b) At which point is the potential energy of a positive charge the highest? Explain.
- (c) At which point is the current the largest? Explain.



22-7) Examine the circuits shown in the diagram that follows on the next page and indicate whether you think each of the following two statements are true or false. Please explain your reasoning.

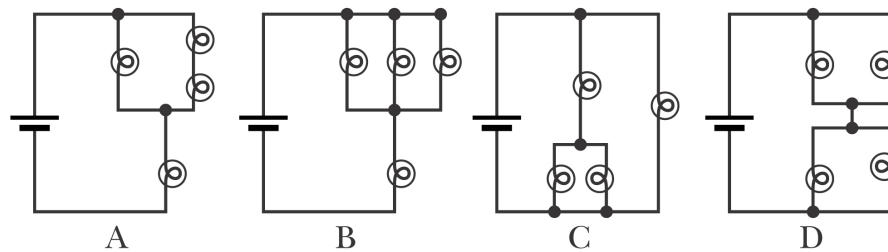
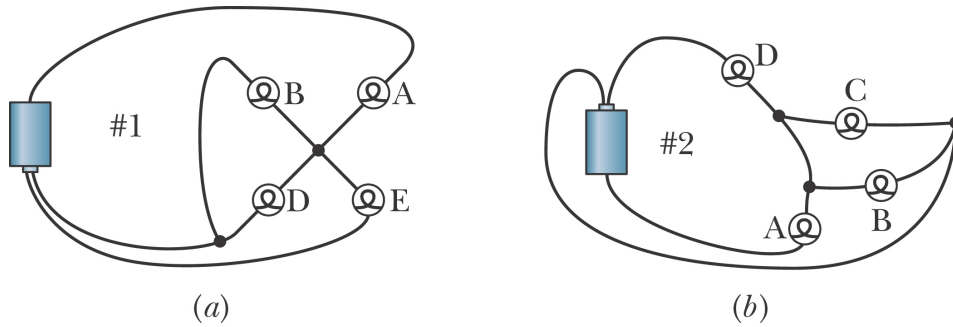
- (a) Circuits 1 and 2 are different. The brightness of the two bulbs in circuit 1 is the same, but in circuit 2 the bulb closest to the battery is brighter than the bulb that is farther away.

- (b) Circuit diagrams only show electrical connections, so the drawings in circuits 1 and 2 are electrically equivalent and the brightness of the two bulbs is the same in both circuits 1 and 2.

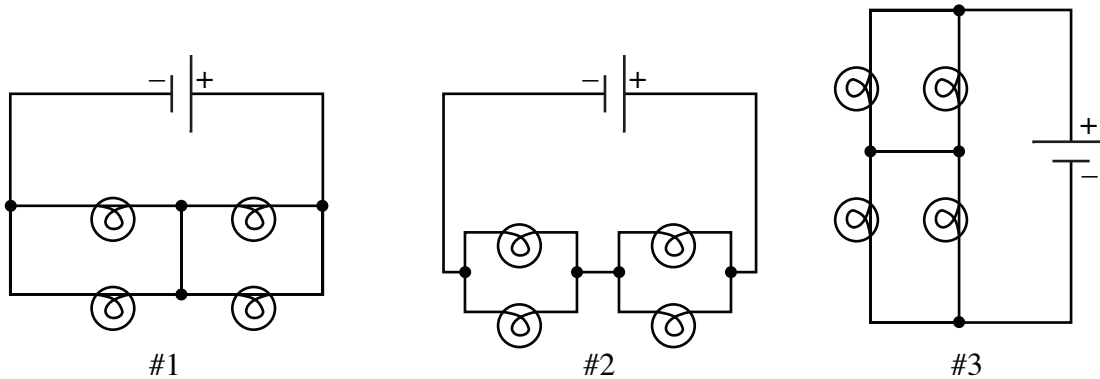


- 22-8) (a) Identify which of the nice, neat circuit diagrams (A,B,C or D) corresponds to messy circuit drawing #1. Explain the reasons for your answer.

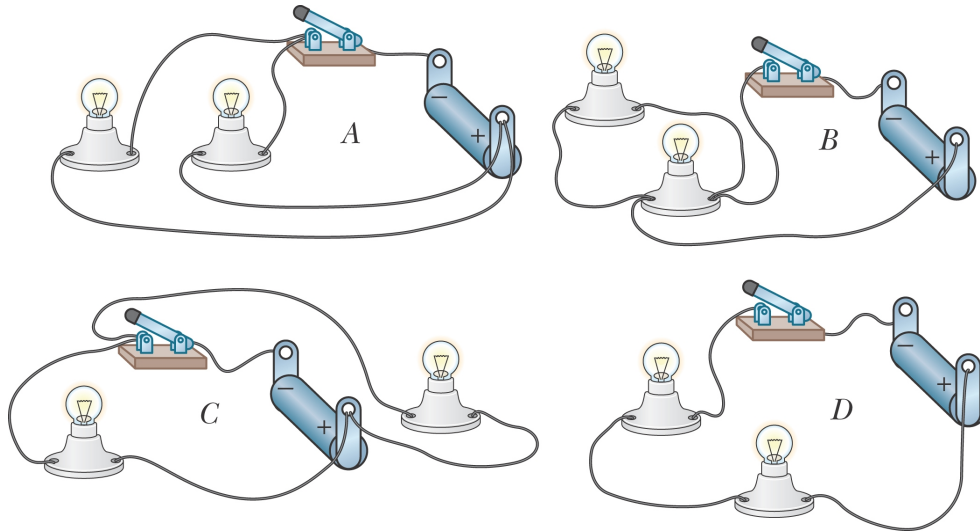
- (b) Which neat circuit diagram corresponds to messy circuit drawing #2? Explain the reasons for your answer.



- 22-9) Which of the three circuits shown below, if any, are electrically identical? Which are different? Explain your answers.



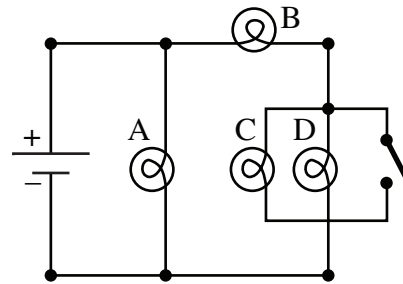
22-10) One of the most confusing things about wiring circuits and figuring out what you've done is that many arrangements are electrically equivalent. Unless you have unusual powers of visualization it is often hard to recognize this. For example, three of the circuits shown below are electrically equivalent and one is not.



- (a) Which circuit is not like the others? Explain why it's different.
- (b) Which circuits represent parallel arrangements for the bulbs? Which represent series arrangements?
- (c) Draw circuit diagrams for each of the arrangements and label each diagram as A, B, C, or D.
- (d) Examine your diagrams. Is it possible for neat circuit diagrams which look superficially different to represent the same set of electrical connections?

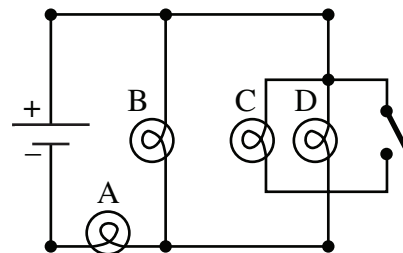
22-11) Examine the circuit shown on the right.

- (a) Assume that the switch is *closed*. State which bulbs or combination of bulbs in the circuit are arranged in series and which are arranged in parallel.
- (b) Assume that the switch is *open*. State which bulbs or combination of bulbs in the circuit are arranged in series and which are arranged in parallel.

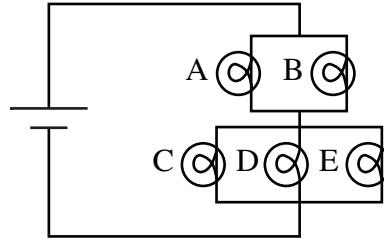


22-12) Examine the circuit shown on the right.

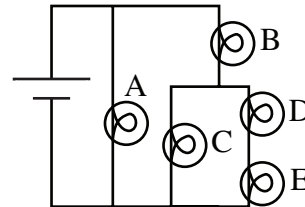
- (a) Assume that the switch is *closed*. Rank the bulbs according to brightness and explain your reasoning.
- (b) Assume that the switch is *open*. Rank the bulbs according to brightness and explain your reasoning.



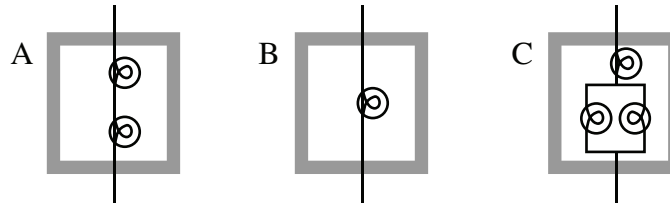
- 22-13)** (a) Are the bulbs C, D and E in the circuit to the right connected in series, parallel, or neither?
- (b) Rank the bulbs in the circuit above in order of brightness. Use the symbols "=", "<" and ">". Explain your ranking.
- (c) How will the brightness of bulbs A and B change if bulb C is unscrewed? Will the result be different if bulb D or E is unscrewed instead? Explain.



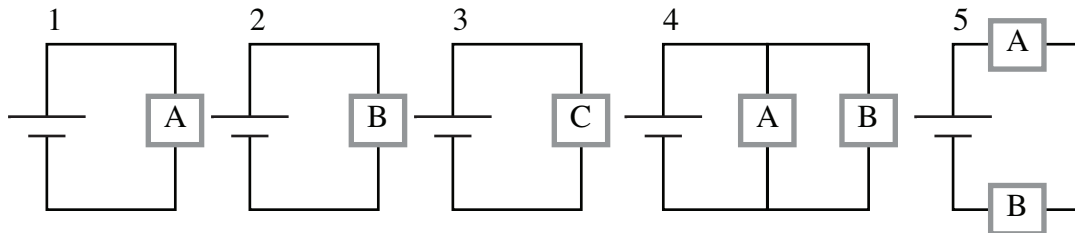
- 22-14)** Rank the brightness of the bulbs in the circuit to the right. Use the symbols "=", "<" and ">". Explain the reasons for your ranking.



- 22-15)** Suppose you had three boxes, labeled A, B, and C, each having two terminals. We put the arrangement of bulbs in the boxes shown below



Consider the five circuits shown below, each made up from combinations of the three boxes, in completing the following questions.



- (a) For each of the circuits 1 through 5, sketch a standard circuit diagram showing all the bulbs in the circuit. In each diagram number the bulbs and describe which bulbs or combination of bulbs are in series and parallel connections with each other.
- (b) Rank the networks 1 through 5 by their resistances. Which has the most resistance? The least resistance?
- (c) Rank each of the circuits according to the total current through the battery. Explain your reasoning!