SC-STEM1 Answers to Project Questions

Project 6:
Compare the LED current (measured on the meter) to the current with the lamp (you can also try it with the meter on the 1mA setting instead of the 1A setting). How do they compare?
The LED current is around 10 times less than the lamp current.

Would you rather use incandescent light bulbs or LEDs to light your home?
LED

Notice that white LED has a "+" polarity marking, but the lamp does not. What do you think would happen if you flipped the LED or lamp around in this circuit? (Try it.)
The LED will not light but the lamp (L4) will.

Project 7:
You can swap the location of the lamp with the 3-snap wire or slide switch in this circuit, then measure the voltage across each of those parts and calculate their resistance using Ohm's law. What do you think their resistance will be?
They should be less than a ohm.

Project 8:
Name at least 10 things in your home that use switches.
Lights, Fan, Telephone, TV, Doorbell, AC, Oven, Refrigerator, Hairdyer, Toaster.

Project 11:
Which gave a higher reading on the meter, long narrow shapes or short wide shapes?
The short wide shape.

Project 12:
Calculate the resistance of the motor, with and without the fan. How does your calculation of the motor's resistance compare with its typical resistance? What factors could have caused the difference?
Your calculations should be close to the typical resistance. The fan causes the motor to spin slower.

Calculate the power of the motor, with and without the fan. Does the motor use more power when the fan is on it? Why?
The motor draws more current with the fan attached, using more power. The slower the motor's shaft is spinning, the lower its electrical resistance.

Project 13:
Use Ohm's Law to calculate the resistance of the electromagnet's resistance, and compare with its typical resistance.
The resistance should be appropriately 30 ohms.

Project 14:
How would the current change if you replaced one of the lamps with a 3-snap wire? (Try it.)
The current increases a little.

How would the current change if you replaced two of the lamps with 3-snap wires? (Try it.)
The current increases more than before.

How would the current change if you replaced one of the lamps with the white LED (D6)? (Try it, oriented in both directions.)
When the LED lights the current is very low; no current when the LED is off.

How will the circuit performance change if you rearranged the parts in the circuit? (Try it, but note that the meter and battery holder only fit one way.)
There will be no change since it a series circuit.

Project 15:
How would the voltage change if you replaced one of the lamps with a 3-snap wire? (Try it.)
The voltage would be higher.

How would the voltage change if you replaced one of the lamps with the white LED (D6, "+" on the right)? (Try it.)
The voltage would be higher.

Project 16:
How would the current change if you removed one or two lamps? (Try it.)
The current decreases.

How would the current change if you replaced one of the lamps with the white LED (D6)? (Try it.)
The current decreases. The LED uses very little current.

Project 17:
How would the voltage change if you replaced your batteries with ones that are weaker or stronger? (Try it if you have different batteries available.)
Weaker Battery- The voltage will be lower.
Stronger Battery - The voltage will be higher.

How would the voltage change if you left the switch (and lamps) on for a long time?
The voltage will decrease.

How would the voltage change if you removed one or two lamps? (Try it.)
The voltage will not change, or may rise slightly.

How would the voltage change if you replaced one of the lamps with the white LED (D6)? (Try it.)
The voltage will not change, or may rise slightly.

Project 18:
Give some examples of parallel circuits in your home.
Wall outlets
Room Lights

Project 19:
Give some examples of series circuits in your home.
A wall switch and lamp.

Project 20:
What voltage did you measure in Part A?
Approximately 4.5V.

What voltage did you measure in Part B?
Approximately 3V.

What voltage did you measure in Part C?
Approximately 1.5V.

Project 21:
Does the lamp brightness change like the voltage does (are they proportional)?
Yes and they are proportional.

Project 22:
Does the motor speed change like the voltage does (are they proportional)?
Yes, and it is proportional.

Project 23:
Does the LED brightness change like the voltage does (are they proportional)?
No, the brightness is not proportional.

Project 24:
With both lamps on, what is the voltage measured across the top lamp?
Half the battery voltage, Approximately 2.25V.

With both lamps on, what do you think the voltage across the bottom lamp is? Swap the locations of the meter and press switch to see if you are right, then swap them back.
Same as the top.

With the press switch pushed, what is the voltage measured across the top lamp?
The battery voltage, approximately 4.5V.

Is it double the voltage measured across the top lamp when both lamps were on?
Yes

Why did the voltage change?
The S2 shorts the bottom lamp so all the voltage is across the top lamp

Is the top lamp brighter now?
Yes

Project 25:
With all three lamps on (both switches off), what is the voltage measured across the top lamp?
Approximately 1.5V.

With all lamps on, what do you think the voltage across each other lamp is? Swap the location of the meter with either switch to see if you are right, then swap them back.
Approximately 1.5V.

Turn on one or both switches, and compare the voltage measured with one, two, or all three lamps on.
The voltage increases to 3V with one lamp off and 4.5V with two lamps off.

Why did the voltage change?
The voltage divides evenly, because the lamps all have the same characteristics and in series.

Project 26:
With all three lamps on (both switches off), what is the current?
Approximately 200mA.

Turn on one or both switches, and compare the current measured with one, two, or all three lamps on.
The current should be higher.

Why did the current change?
Turning a switch on shorts the lamp, decreasing the circuit's resistance. The lower the resistance, the higher the current.

Project 27:
Are the currents through circuit branches B, C, and D the same or different?
The currents should be the same.

Add up the currents through circuit branches B, C, and D. How does the total compare to the main circuit current (part A)?
The total current through circuit branches B, C, and D should be the same as the main circuit current.

Project 29:
Are the three switches connected in series or in parallel?
The three switches are connected in series.

Give an example of an AND circuit in your home.
Fuse box switch and wall switch controlling a lamp.

Project 30:
Are the three switches connected in series or in parallel?
The three switches are connected in parallel.

Give an example of an OR circuit in your home.
Several sensors controlling an alarm system.

Project 31:
How much brighter is the right lamp compared to the others?
The right lamp is typically 80% brighter

Why do the two lamps on the left turn on slowly?
Because less current flows through them.

Project 32:
What is the voltage across the top lamp?
Half the battery voltage, approximately 2.25V.

What is the voltage across the lower lamps?
Half the battery voltage, approximately 2.25V.

Remove the top 3-snap wire (which connects to the battery holder) and place the meter there. Set the meter to the 1A setting and measure the circuit current.
Approximately 250mA.

Find a fluorescent or LED bulb and feel the heat coming off it; you won't feel much. Find an incandescent lamp THAT HAS BEEN OFF FOR A WHILE and turn it on. Feel the heat it produces; it soon becomes too hot to touch. How much hotter is the incandescent bulb?
Incandescent bulbs are a lot hotter because most of their energy is being released as heat, not light.

Project 33:
Study the circuit. What will happen to the motor, lamp, and meter if you change the switcher to the bottom position? (Try it.)
The motor spins in the other direction but and the lamp and meter do not change.

Project 34:
When S1 and S6 are off the top lamp should be dim or off, why?
The lamp will be off because the motor has high resistance without the fan, limiting the current.

The motor could not start spinning with the other lamps on, but it will keep spinning as long as you keep pushing S2. Why?
Once the initial friction is overcome, it doesn't take much effort to keep the motor spinning.

Project 35:
Compare the voltage measurements with out the fan to those with the fan.
The voltage will be lower with the fan.

Project 36:
Turn on the slide switch and set the switcher to the right (so both switches are on), and push the press switch to get the fan spinning fast. Now turn off the slide switch and watch how long it takes to light the middle lamp; how long does it take to light, and why?
It takes a few seconds because the current is lower.

Project 38:
Why does the fan affect the lamp brightness?
The motor has low resistance when the shaft isn't spinning fast, allowing a higher current to make the lamps bright.

Project 39:
Remove the fan from the motor and compare the current. Why is it higher or lower?
It takes more current to spin the motor's shaft with the fan on.

Project 40:
Using this and the preceding circuit, compare the current and voltage for each switch. Does the voltage drop more when the current is higher?
Yes, the battery voltage drops slightly due to the high current it is pushing.

Project 41:
How do you think the measured voltage in the top circuit would be affected if you added 100 more lamps to the circuit?
Adding more lamps overloads the battery so the voltage drops a little.

Project 46:
Name some items that use magnets:
Audio speaker, electric fan, alarm system, refrigerator door, washer and dryers,

Project 47:
Names some advantages and disadvantages of electronic magnets compared to permanent magnets.
The strength of an electromagnet can be adjusted, while a permanent magnet is fixed. A permanent magnet does not require a electric current. A permanent magnet losses its magnetic properties when over heated.

Project 52:
How could you make this electromagnet more powerful?
Adding more loops of wire to a coil.

Project 53:
How does the build-your-own electromagnet used here compare with the wire magnet used in the preceding project? Which is more powerful?
The build-your-own electromagnet is more powerful because it has more loops of wire.

How does it compare to the M3 electromagnet used in project 49?
The build-your-own electromagnet is less powerful because it has fewer loops of wire.

Project 59:
Compare the electrical energy produced by the generator (the motor): Is the voltage higher with or without the fan?
The voltage is lower with the fan on.

Is the current higher with or without the fan?
The current is higher with the fan on.

Does the voltage/current last longer with or without the fan?
The voltage/current lasts longer with the fan on.

Project 60:
If you replace the white LED with the lamp (L4), how bright will the lamp get? (Try it, both with and without the fan.)
The lamp will not light.

Project 64:
How bright will the white LED flash if you remove the 2-snap wire from the circuit (to disconnect the electromagnet? (Try it.)
The LED will not light with the two snap removed.

Project 65:
Replace the relay (S3) with the lamp (L4). Does the white LED flash?
No, because the lamp does not have a coil or magnetic field.

Project 66:
What could you use a reed switch for?
Alarms- Window and door sensors

Project 69:
List some devices in your home that use relays.
Refrigerator, Oven, Thermostat

What is the main reason to use a relay?
Allow low voltage devices to control high voltage devices.

Project 70:
What will happen if you remove the 2-snap wire that connects the points marked A & B, and instead connected the red jumper wire between points B & C? (Try it.)
Nothing will happen.

Project 71:
Why is the meter current lower when the relay is buzzing?
The current through the coil is not continuos because relay S3 opens and closes.

Project 72:
In project 85 and others the LED only works in one of the switcher (S6) settings, but in this circuit it works in either the top or bottom S6 setting. Why?
Because the relay coil is producing voltage in both directions.

Project 75:
Why is the lamp off until you push the press switch?
There is no power to the lamp untill you press S2.

Why does the lamp stay on after you release the press switch? (Look at the explanation of how the relay works in project 8, and note that when the relay is on contacts 1 and 3 on the relay symbol in the drawing are connected.)
Relay's 1 and 3 contacts are connected so current flows through the lamp and coli.

Project 76:
Name an appliance in your home that uses a relay to switch lights or motors on and off.
Refrigerator

Project 85:
Decode this Morse Code message:
. . . . . _ . . . _ _ . _ _ . . . _ _ . .
HELP ME

Project 88:
For each component, select how they work when the electricity is reversed:

LED: A. 1 direction only B. effects unchanged C. effects reversed

Lamp: A. 1 direction only B. effects unchanged C. effects reversed

Motor: A. 1 direction only B. effects unchanged C. effects reversed

Electromagnet: A. 1 direction only B. effects unchanged C. effects reversed

TEST YOUR KNOWLEDGE ANSWERS

1. Electric current is the movement of subatomic charged particles through a material due to electrical pressure across the material.
   TRUE or FALSE?
2. Voltage is a measure of the electrical pressure to push electric current through a circuit.
   TRUE or FALSE?
3. Voltage is measured in watts.
   TRUE or FALSE?
4. An advantage of electricity is that it makes it easier to transport energy over distances.
   TRUE or FALSE?
5. Resistance can be thought of as electrical friction, resisting the flow of electricity through a circuit.
   TRUE or FALSE?
6. Resistance is measured in ohms.
   TRUE or FALSE?
7. Resistance is calculated as voltage divided by current.
   TRUE or FALSE?
8. Electrical Power is a measure of how fast energy is moving through a wire.
   TRUE or FALSE?
9. When clothes cling together in the dryer, it is because they have an electric current flowing through them.
   TRUE or FALSE?
10. A switch turns a circuit on or off by connecting or disconnecting wires in a circuit.
    TRUE or FALSE?
11. Batteries produce electricity using a biological or nuclear reaction.
    TRUE or FALSE?
12. The electric current from a battery is alternating current.
    TRUE or FALSE?
13. A short circuit is better than a normal circuit because it takes up less space.
    TRUE or FALSE?
14. A fuse shuts down a circuit if the current is abnormally high.
    TRUE or FALSE?
15. Insulators have very low resistance to the flow of electricity.
    TRUE or FALSE?
16. An incandescent light bulb makes light by heating a filament to be glowing hot.
    TRUE or FALSE?
17. Incandescent light bulbs are more energy efficient than LED bulbs.
    TRUE or FALSE?
18. An incandescent light bulb filament has more resistance when it is cold than when it is hot.
    TRUE or FALSE?
19. When several lamps are connected in series, if one burns out then the others will still light.
    TRUE or FALSE?
20. The two basic ways of connecting parts in a circuit are in series and in parallel; all large circuits are made of combinations of these.
    TRUE or FALSE?
21. In a parallel circuit, the circuit branch with the lowest resistance will have the most current flowing through it.
    TRUE or FALSE?
22. If you want a switch to turn a lamp on and off, you should connect the switch and lamp in parallel.
    TRUE or FALSE?
23. The voltage is the same across all components that are connected in parallel.
    TRUE or FALSE?
24. An LED works the same when connected in either direction.
    TRUE or FALSE?
25. The current through an LED is always proportional to the voltage across it.
    TRUE or FALSE?
26. Connecting several batteries in series reduces the total voltage.
    TRUE or FALSE?
27. Connecting several components in parallel increases the total resistance.
    TRUE or FALSE?
28. Reducing the resistance of a circuit will reduce the current through it.
    TRUE or FALSE?
29. When several components are wired in series with each other, all will have the same electric current flowing through them.
    TRUE or FALSE?
30. Reversing the current to an electromagnet does not change the direction of its magnetic field.
    TRUE or FALSE?
31. If a battery cannot supply as much current as a circuit needs, the voltage produced drops.
    TRUE or FALSE?
32. The faster a motor's shaft is spinning, the higher its electrical resistance.
    TRUE or FALSE?
33. A motor has the same electrical resistance when its shaft turns in either direction.
    TRUE or FALSE?
34. Decreasing the number of windings in an electromagnet increases the power of its magnetic field.
    TRUE or FALSE?
35. Electricity and magnetism do not affect each other.
    TRUE or FALSE?
36. A small electric current flowing in a wire has a magnetic field.
    TRUE or FALSE?
37. The magnetic field of a magnet is weakest at the ends of the magnet.
    TRUE or FALSE?
38. Most magnets are made of copper.
    TRUE or FALSE?
39. Placing an iron rod inside a coil of wire with an electric current through it increases the magnetic field produced.
    TRUE or FALSE?
40. You can reverse the direction of the magnetic field from an electromagnet by reversing the direction of the electric current through it.
    TRUE or FALSE?
41. If you want to be able to turn a magnetic field on and off, you should use an electronic magnet instead of an ordinary magnet.
    TRUE or FALSE?
42. An electronic magnet stores energy in an electric field.
    TRUE or FALSE?
43. In a generator, electricity is used to produce mechanical motion.
    TRUE or FALSE?
44. It takes more energy to spin the motor shaft when the fan is not on it.
    TRUE or FALSE?
45. A reed switch is a magnetic switch controlled by an electric current.
    TRUE or FALSE?
46. Distilled water can power a clock better than cola soda.
    TRUE or FALSE?
47. A relay allows a low-voltage to control a high-voltage circuit.
    TRUE or FALSE?
48. A relay uses magnetism to open or close a mechanical switch.
    TRUE or FALSE?
49. Transformers allow circuits to be electrically isolated from each other.
    TRUE or FALSE?
50. Snap Circuits® is fun.
    TRUE or FALSE?