

Reading & Using an Electrical Diagram to Solve Problems

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Reading an electrical diagram is like reading a roadmap. On a roadmap the lines indicate roadways. On an electrical (schematic) diagram the lines indicate wires which are roadways for electrons. On a roadmap symbols are used to indicate bridges, schools, airports, tunnels, parking-lots and the like. On a schematic diagram symbols indicate resistors, lamps, motors, batteries, switches, transistors and other related items. Once you become familiar with the electrical symbols, reading a schematic diagram is not any more difficult than reading a roadmap.

Look over the drawing of the commonly used symbols (next page). Most of these symbols are somewhat logical. To me, the only exception is the resistor symbol. It does not resemble a resistor but it is very distinctive and this helps to keep it from being confused with the other symbols.

On Schematic Diagram A there is a drawing that represents an electrical circuit for a heater (resistor) controlled by a switch; a 10 volt battery; a 6 volt incandescent lamp with a series resistor and switch plus another heater-resistor - except that this one is controlled automatically by a thermal-switch such as would be used in cold climates to keep water pipes from freezing. This switch will open at 2°C so that whenever the temperature is more than 2°C . above freezing, the switch will open and stop the flow of current through the heater-resistor. When the temperature falls below 2°C . the switch closes and

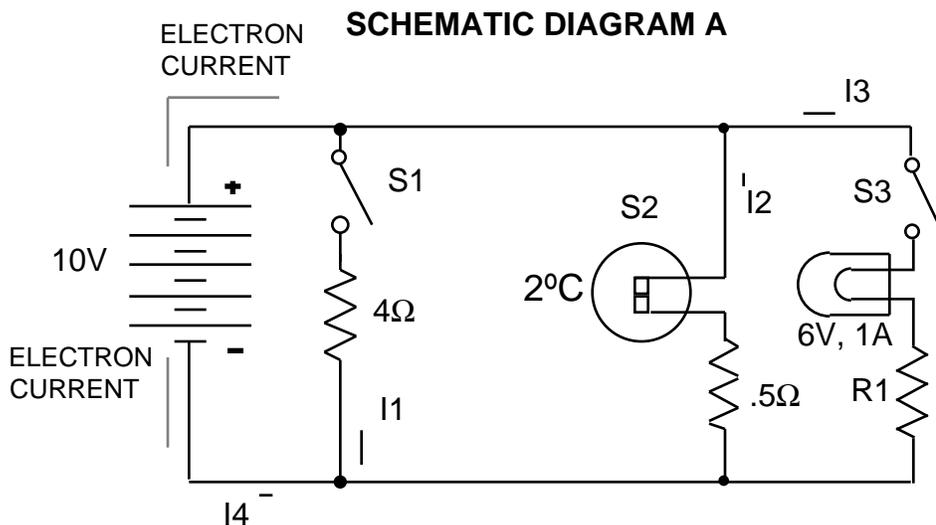
the heater-resistor will draw current and dissipate heat into the pipes.

Here are some questions about Schematic Diagram A:

1. How much current (I_1) flows through the 4Ω resistor when S_1 is closed ?
2. If the lamp shown is rated at 6V, 1A, how many ohms is needed for R_1 ?
3. Find I_2 when the ambient temperature is 0°C and also the power dissipated by the $.5\Omega$ resistor.
4. Find I_3 , and I_4 when the ambient temperature is 25°C , S_1 is closed and S_3 is open.
5. What is the largest possible current that could be drawn from the battery?

Solutions:

1. Using $I=E/R$: $I_1=10\text{V}/4\Omega = 2.5\text{A}$.
2. The lamp needs 6V. The battery provides 10V which is 4V



Basic Electricity

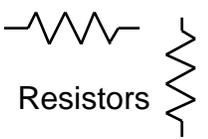
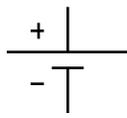
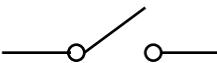
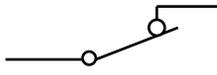
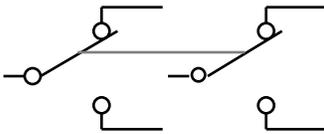
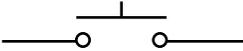
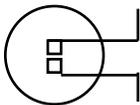
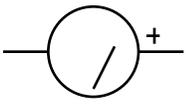
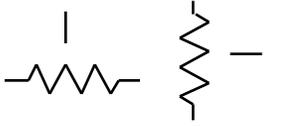
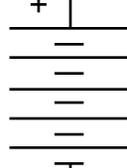
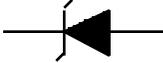
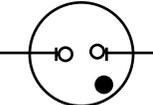
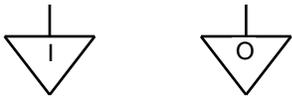
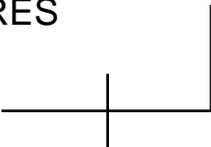
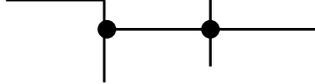
too much. So 4V must be wasted in R1. The current that flows in R1 is the same as current in the lamp: 1A. Using $R=E/I$: $R1=4V/1A = 4\Omega$.

3. The thermal-switch will be closed at 0°C. So current will be flowing in the .5Ω resistor. Using $I=E/R$: $I2=10V/.5\Omega = 20A$. The power dissipated can be found by using $P=IE$: $P=20A \times 10V = 200 \text{ watts}$.

4. If S3 is open then I3 must be zero. At 25°C, S2 is also open so I2 is also zero. The only current that can flow must

pass through S1 which was previously found to be 2.5A.
5. If S1, S2, and S3 were all closed, the total current would be $2.5A + 20A + 1A = 23.5A$

Commonly Used Symbols On Schematic Diagrams

 <p>Incandescent Lamps</p>	 <p>Resistors</p>	 <p>Single-Cell Battery</p>	<h3>SWITCHES</h3>  <p>Single Pole, Single Throw , [SPST], normally open [NO]</p>  <p>SPST, normally closed [NC]</p>  <p>Single Pole, Double Throw [SPDT]</p>  <p>Double Pole, Double Throw [DPDT]</p>  <p>Momentary contact, normally open [a "push-button" switch]</p>  <p>2°C Thermal Switch, NC The temperature rating of this one is 2°C. This means that it opens when the temperature rises above 2°C</p>
 <p>1mA METER</p>	 <p>Adjustable Resistors [Also called Potentiometers or Rheostats]</p>	 <p>Multi-Cell Battery</p>	
<h3>DIODES</h3> <p>BLOCKS ELECTRON FLOW IN THIS DIRECTION</p>  <p>Diode / Rectifier</p> <p>ELECTRON FLOW</p>  <p>Zener or Voltage Breakdown Diode</p>		 <p>Neon or Argon Lamp</p>	
<h3>"GROUNDS"</h3>  <p>Chassis Ground</p>  <p>Circuit- Common Ground</p>  <p>Earth Ground</p>  <p>For Complex Circuits That Have More Than One Circuit-Common [like an Input common and an Output common]</p>	<h3>WIRES</h3>  <p>WIRES THAT CROSS BUT ARE NOT CONNECTED</p>  <p>WIRES THAT CROSS THAT ARE CONNECTED [SOLDERED]</p>		