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Note: Concepts Are Not In Any Particular Order.

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Introduction To Using A Combination Of Constant Voltage Section, Voltmeter and Ohm's Law To Determine A Voltage

In the following circuit voltage drops, as measured by each connected digital meter, are displayed in each meter's respective window. The voltage next to each lamp and resistor is its voltage drop created by the battery pushing current through each of the load's resistance. In the ANSWERS AND EXPLANATIONS column of each Circuit, you will find detailed and diverse reasons elucidating the concepts of the CONSTANT VOLTAGE SECTION (C.V.S.), its SEGMENTS and its IDENTICAL ELECTRICAL POINTS (I.E.P.s).

WHAT TO LOOK FOR WHILE STUDYING THE FOLLOWING FIVE CIRCUITS

1. Begin each Circuit by getting an overview of the circuit's operation.

2. Carefully locate, identify and qualify C.VS.s, their SEGMENTS and their I.E.P.s.

3. Make note of how each load is connected to another and how they are connected to the power supply. In Circuits, loads are in series with each other or are in parallel with each other. Make note of that: is the load or loads in parallel or series with the power supply. Complex circuits are a combination of both series and parallel.

4. Watch for junctions and somewhat subtle connections. Remember, junctions divide current, but voltage remains the same at that point (with respect to ground).

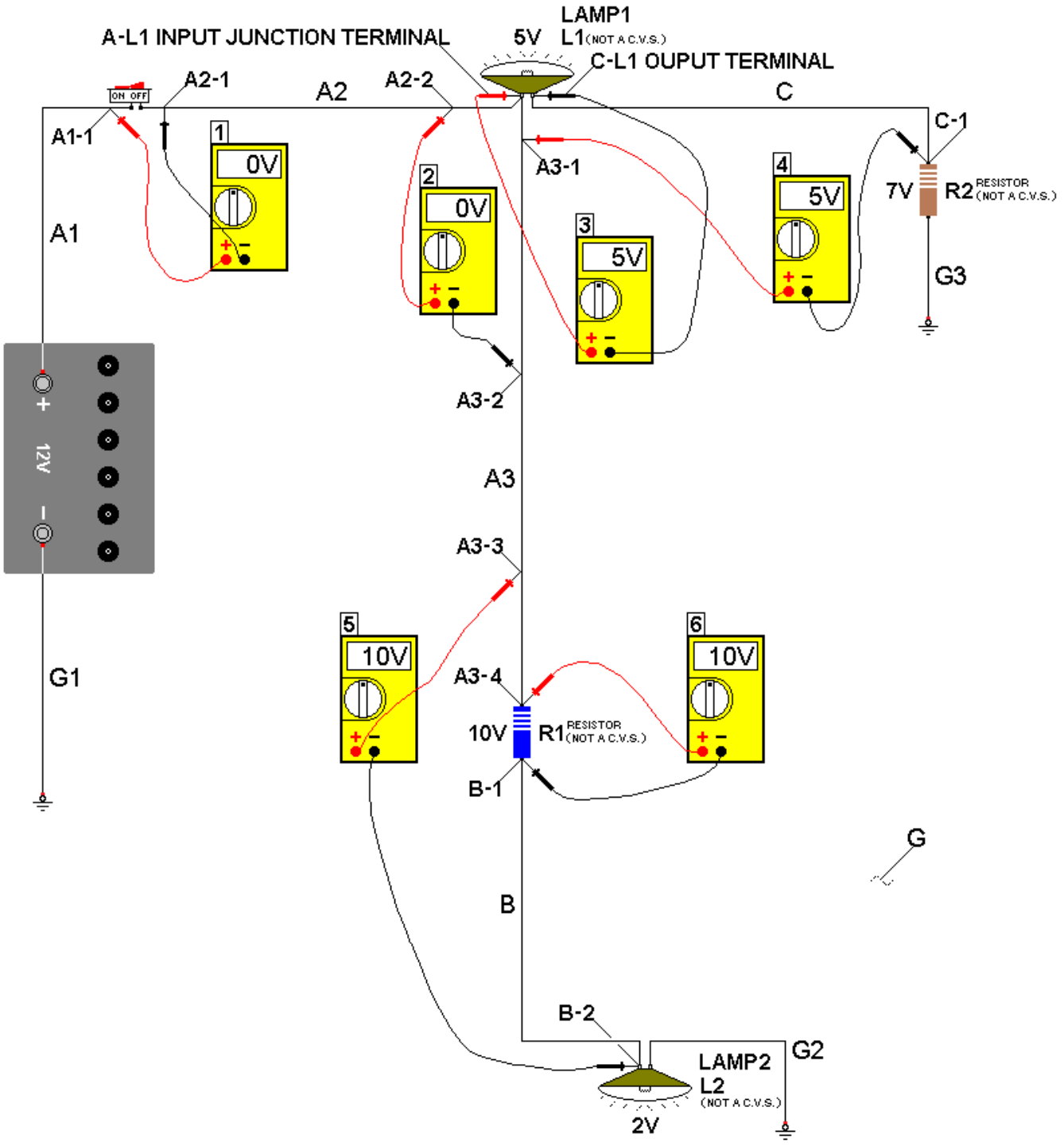
5. Observe where the two test probes of the meter are placed in reference to each load. Are the probes along the load's C.V.S.? This will give you the same answer as if the probes were directly connected across that load. Look at the polarity of the probes with respect to the polarity of the load. Do the probes match or are they reversed with respect to the load's polarity? If the probes are reversed, the meter will display a negative voltage reading. This is not a problem; just reverse the leads.

6. Look at the positions of the controls such as switches, rheostats, potentiometers, etc. Remember, it is the position of the controls that will determine the voltage drops in the circuit. For Circuit, if a switch, rheostat, or potentiometer were turned OFF (open), it will change all your answers as compared to their being turned ON.

7. Compare your reasoning for the measured voltage with that stated in the ANSWERS AND EXPLANATION column that follows each of the five circuits. If your answer is not the same as that which is given, it may be because there are a number of different ways these concepts (C.V.S., SEGMENT, I.E.P.) can be explained or justified and still be correct. If your explanation does not match the one given, continue farther down the answer column and you may come across a similar situation, but with a reason that does match yours. More important, it is the <u>essence</u> of your answer that should be similar to mine, not your exact wording. If any of your answers are incorrect—you should redo them.

8. Once you are satisfied that you understand the CONSTANT VOLTAGE SECTION concept and all that it entails from each of the five Circuits, move on to PART 6.

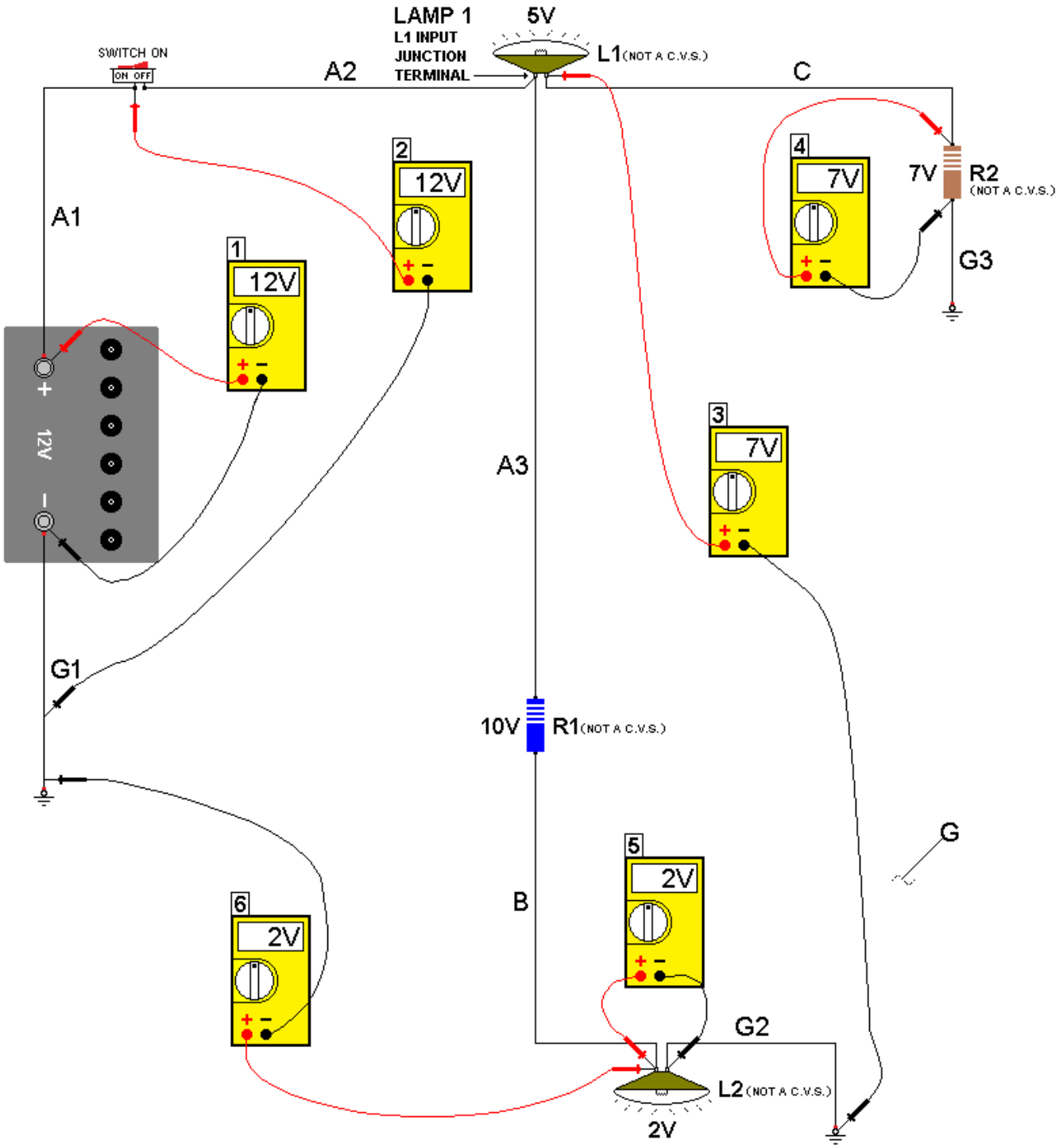
Circuit 5-A1



Meter No.	Voltage Reading	Circuit 5-A1: Answers And Explanations
1	0v	The resistance between the two probes of the meter is zero with the switch ON (closed). If either "I" or "R" were zero, the voltage is zero (E = I x R). Although current is flowing between these two points, there is no significant resistance to create a voltage drop. Since both probes of the meter are located on the same C.V.S. "A" (A1-1 and A2-1), these probes are on Identical Electrical Points; therefore there is no voltage drop between them.
2	0v	The rocker switch and L1's input junction terminal interconnect three "A" sections of wire A1, A2, and A3. They are extensions of the positive terminal of the battery—they act as one with 12v all along their interconnected length with respect to ground. Since the section of wire between the two probes of Meter 2 is part of C.V.S. "A" and it has no significant resistance, the voltage will be zero.
3	5v	There will be a voltage drop, since there is resistance between the two probes (points) of the meter, in this case 5v. Because of this resistance, the two points are **not** identical. Since current is flowing through the resistance of lamp L1, a voltage drop is created. If current and resistance are both something other than zero, a voltage drop is formed (E = I x R). In addition, the probes of the meter are on two different C.V.S.s, ("A" and "C"), which is caused by the lamp's resistance. Consequently, the meter will read the potential difference between these two points.
4	5v	The **positive** probes of Meters 3 and 4 are located on common Identical Electrical Points (I.E.P.s) of C.V.S. "A"—there is no resistance between these two points, they are the same. Using the same reasoning, the two **negative** probes of Meters 3 and 4 are also located on common electrical points of C.V.S. "C"—there is no resistance between them also. Since the probes (positive and negative) of Meter 4 are located on the same two I.E.P.s as Meter 3's probes (positive and negative), both meters will read the same 5v across lamp L1's resistance.
5	10v	The **positive** probes of Meters 5 and 6 are located on common Identical Electrical Points of C.V.S. "A"—there is no resistance between those two points, they are the same. Using the same reasoning, the two **negative** probes of Meters 5 and 6 are also located on common electrical points of C.V.S. "B"—there is no resistance between them also. Consequently, since the probes of Meter 6 are located on the same two points as the probes of Meter 5, both meters will read the same voltage.
6	10v	Since there is resistance between the two probes of Meter 6, there will be a voltage drop, in this case 10v. Because of this resistance created by the resistor R1, the two points where the probes are located are **not** identical. Since current is flowing through this resistance, a voltage drop is created. If current and resistance are both something other than zero, a voltage drop is formed (E = I x R). In addition, the meter probes are on two different C.V.S.s; the meter will read the potential difference between C.V.S. "A" and C.V.S. "B".

Identifying Voltages Through The Combined Use Of C.V.S.s, Their Segments, The I.E.P.s And A Voltmeter: Circuit 5-A2

Circuit 5-A2



Meter No.	Voltage Reading	Circuit 5-A2: Answers And Explanations
1	12v	The meter's positive and negative probes are directly connected to each of the battery's positive and negative terminals, respectively; therefore the meter measures 12v.
2	12v	The switch's input terminal, where the meter's positive probe is connected, is an extension of the battery's positive terminal, and it is an Identical Electrical Point (I.E.P.) of C.V.S. A1. The ground connection is an extension of the battery's negative terminal, and it is an I.E.P. of C.V.S. G2.
3	7v	Meters 3 and 4 are both measuring the same resistor R2. Even though the probes of Meter 3 are physically located elsewhere on the circuit, electrically Meter 3's probes are located on the same two C.V.S.s as Meter 4's. The **positive** probes of Meters 3 and 4 are located on identical electrical points of C.V.S. "C"—there is no resistance between these two points, therefore they are the same. Using the same reasoning, the two **negative** probes of Meters 3 and 4 are also located on common C.V.S.s G3 and G4—there is no resistance between them also. Consequently, since the probes (positive and negative) of Meter 3 are located on the same two C.V.S.s as the probes (positive and negative) of Meter 4's, Meter 4 will read the same voltage.
4	7v	Since there is resistance (R2) between the two probes of the meter, there will be a voltage drop, in this case 7v. Because of this resistance, the two points where the probes are located are **not** identical. Since current is flowing through this resistance, a voltage drop is created. If current and resistance are both something other than zero, a voltage drop is present. E = I x R
5	2v	There will be a voltage drop, since there is resistance between the two probes of the meter, in this case 2v. Because of this resistance created by the filament, which is located between the probes of the meter, the two points are **not** identical. Since current is flowing through a resistance, a voltage drop exists. If current and resistance are both something other than zero, a voltage drop is created. E = I x R
6	3v	Meters 5 and 6 are both measuring the same lamp, L2. Meter 6's positive probe is located on the same physical and electrical point as meter 5's. Even though Meter 6's negative probe is physically located at the battery's ground, electrically the battery's ground and the lamp's ground are electrically the same point. **Note:** The three grounds in this circuit are connected electrically through the metal structure of the aircraft, G1. The negative terminal of the battery is connected to a heavy cable, which in turn is connected to the metal structure of the aircraft, which now becomes the common return for all currents back to the system's power supply.

Circuit 5-B