Dc circuits worksheet answers

Question 1 Don't just sit there! Build something! Typically, students solve sample problems and check and practice answers to questions provided by textbooks and instructors. This is good, but there is a much better way. You learn more by actually building and analyzing real circuits and allowing test equipment to provide answers on behalf of books and others. To successfully practice circuit building, follow these steps: Carefully measure and record all component values before building the circuit. Draws a schematic diagram of the circuit to be analyzed. Carefully build this circuit on breadboards and other useful media. Check the accuracy of the circuit configuration, connect each wire to each connection point, and review these elements one by one. The circuit is analyzed mathematically, and all values such as voltage and current are analyzed. Carefully measure these amounts and verify the accuracy of the analysis. If there are substantial errors (more than a few percent), carefully review the circuit configuration against the diagram, and carefully recalculate and re-measure the values. Avoid very high and very low resistance values to avoid measurement errors due to the load of the meter. I recommend resistance between 1 kΩ and 100 kΩ, but of course, the purpose of the circuit is to explain the effect of meter loading! Alternatively, you can reuse the same components in different circuit configurations. This method does not require multiple measurements of component values. Let the answer reveal the electrons themselves give you an answer to your own practice problem! Note: In my experience, students need to practice to do circuit analysis to become profic up. To that end, instructors typically provide students with many exercises and answers for them to check on their work. This approach makes students proficient in circuit theory, but it is not able to fully educate them. Students do not require mathematical practice. You also need to build circuits and use test equipment to do real hands-on practice. So students need to build their own exercises with real components and try to mathematically predict different voltage and current values. In this way, mathematical theory comes alive and students gain practical abilities that cannot be obtained simply by solving equations. Another reason to follow this method is to teach students how to be scientific.Hypotheses by conducting actual experiments (in this case, mathematical predictions) also allow students to develop real-world troubleshooting skills because they may cause circuit building errors. Before you start, spend time with the class to review some rules. Discuss these issues with students in the same way that you discuss worksheet questions, rather than simply telling them what they should and shouldn't do. I'm no longer surprised as to how poorly the students grasp the instructions when presented in typical lecture (instructor monologue) format! Notes to instructors who may complain about the wasted time required to build real circuits rather than mathematically analyzing theoretical circuits: what is the purpose for students to take your course? If your goal is to educate theoretical physicists, stick to abstract analysis by all means! The wasted time spent building real circuits will pay huge dividends when it comes time for them to apply their knowledge to practical issues. In addition, by building their own practice problems, students can teach them how to conduct primary research and continue electrical/electronic education autonomously. In most science, realistic experiments are much more difficult and expensive than electrical circuits. Professors in nuclear physics, biology, geology and chemistry would like to be able to get students to apply advanced mathematics to real experiments where there is no safety hazard and cost less than textbooks. They can't, but they can. Take advantage of your science-specific conveniences and have your students practice their math on many of the actual circuits! Use your own words to express these rules: in the series circuit, the voltage . In series circuits, the current . In series circuits, resistance. The series circuit explains why it is true for each of these rules. In series circuits, the voltage drop equals the sum is clarified. In series circuits, the current is equal through all components. In a series circuit, the resistance equals the sum, and in a series of circuits, the dissipating of power is equal to the total. Note: A set of rules and parallel circuits is very important for students to understand. However, a trend noticed by many students is the practice of memorizing these rules rather than understanding them. Students often recall or fail because they work hard to memorize rules without really understanding why they are trueSet up the rules appropriately. An example technique that I've come to find very useful is to get students to create their own sample circuits to test these rules. Simple series and parallel circuits work as a great learning tool because they are rarely challenged when building. What could be better or more authoritative than learning the principles of circuitry from actual experiments? The big problem as a teacher is recommending that students take the lead in creating their own demonstration circuits. This is a shame and is not reflected much in the state of modern education. Question 3 From the observation of this circuit (the component is attached to the terminal block), draw the appropriate schematic: reveal the note of the answer: This kind of question is suitable for students who draw the answer on the board in front of the class. The skill of transferring a real circuit to a neatly drawn circuit is a skill that some students struggle with, but it is important. These students will want to know what techniques can be used for transcription. Spatially adept students will probably have several ways to approach such problems. To help you explain the techniques for tracing actual circuit wiring to schematic diagrams to the rest of the class. Giving students the opportunity to teach peers is a powerful teaching method and should always be encouraged! Use your own words to express these rules: In parallel circuits, voltage.parallel circuits, currently.parallel circuits, resistors.parallel circuits, power. For each of these rules, explain why that is true. In parallel circuits, the voltage is equal for all components. In parallel circuits, the current is the same as the total. In parallel circuits, the resistance decreases until it equals the total. In parallel circuits, the dissipating of power is equal to the sum. Note: A set of rules and parallel circuits is very important for students to understand. However, a trend noticed by many students is the practice of memorizing these rules rather than understanding them. Students often can't remember or apply rules properly because they work hard to memorize them without really understanding why they are true. An example technique that I've come to find very useful is to get students to create their own sample circuits to test these rules. Simple series and parallel circuits work as a great learning tool because they are rarely challenged when building. something better or more authoritative than learningOf circuits from actual experiments? The big problem as a teacher is recommending that students take the lead in creating their own demonstration circuits. This is a shame and is not reflected much in the state of modern education. Question 5 Calculate the resistance between points A and B (RAB) in the following resistor network: Obviously answer Figure 1: RAB = 500 Ω Figure 2: RAB = 750 Ω Figure 3: RAB = 1.5 11 kΩ Figure 4: RAB = 940 Ω Figure 5: RAB = 880 Ω Figure 6: RAB = 80.54 Ω Note! Discuss how students have tackled these issues and invite the class to participate in the inference process. The point of this question, like most questions in the Socratic Electronics project, is not just to get the right answer, but to stimulate an understanding of how to solve such problems. Question 6 Complete the table of values for this circuit: Notes on publishing answers: Discuss with students good steps to calculate unknown values for this problem and how to verify their work. Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. At first, it's helpful for you (instructors) to show them, but it's bad for them to stop thinking for themselves and just not follow your lead and show them too often. An educational technique that I found very useful is for students to come before class (alone or on a team) and write problem-solving strategies for everyone else to see. They don't actually have to do the math, but rather outline the steps they take, in the order they take. Having students explain their problem-solving strategies will give everyone the opportunity to see multiple solutions, and you (the instructor) will be able to see how (and if!) students are thinking. A particularly good point to highlight in these open thinking activities is how to check your work to see if there was a mistake. Question 7 Complete the table of values for this circuit: Reveal the answer follow-up question: Do you want to measure the amount of voltage present at the node (junction point) where R1, R2, and R3 are all connected together by a ground reference?Note: The circuit feature of this circuit is how the power connection is displayed. Like many of my schematics, I don't display the battery sign for voltage sources here. Instead, it indicates the rail symbol (flat line and ground symbol) for the power supply. Let students know that this is a very common symbolism in modern schematics.saves without simply drawing a line to the voltage source symbol (and the source symbol itself). Discuss with students a good procedure for calculating unknown values for this problem and how to verify their work. Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. 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Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. At first, it's helpful for you (instructors) to show them, but it's bad for them to stop thinking for themselves and just not follow your lead and show them too often. An educational technique that I found very useful is for students to come before class (alone or on a team) and write problem-solving strategies for everyone else to see. They don't actually have to do the math, but rather outline the steps they take, in the order they take. Having students explain their problem-solving strategies will give everyone the opportunity to see multiple solutions, and you (the instructor) will be able to see how (and if!) students are thinking. A particularly good point to highlight in these open thinking activities is how to check your work to see if there was a mistake. Question 9 Complete the table of values for this circuit: Answer Reveal the challenge question: What circuit parameters will change if the diagonal wire on the right side of the circuit is disconnected? Note: Discuss with students the good steps to calculate unknown values for this problem and how to verify the work. Question 10 Identify which of these components are connected in series and which components are connected in series to each other: The end of the open wirerefers to the power supply. In parallel with R3, answer Figure 1: R2 is clarified. Figure 2: Series R1 with R2. Figure 3: Series R2 with R3. Figure 4: Series R1 with R2; Series R3 with R4. Figure 5: R1 in parallel with R3; R2 runs in parallel with R4. Figure 6: Series R1 with R2. Note: Work with students to clearly identify rules that identify series and parallel connections. This is very important for students if they successfully analyze all kinds of series parallel networks. Referring to series parallelism, the most common problems encountered as electronics instructors are always associated with a lack of ability to consistently distinguish between series and parallel subnetnets in continuous parallel combination circuits. Question 11 Identify the components of these components that are connected in series to each other and in series with each other: Assume that the end of the open wire is the connection point to the power supply. For circuits with ground symbols, think of ground as the other side of the power supply. A series of responses in SW1, Figure 1: R1, is revealed. Figure 2: Series R1 with R2; R3 is done in parallel with R4. Figure 3: R1 parallel to R2. Figure 4: R1 parallel to R2. Figure 5: L1 of the series with C1. FIG. 6: R3 is shown in parallel with R4. Challenge question: By comparing Figure 2 and Figure 6, you can see how the series/parallel relationships of components change by simply changing where the power supply connects to the network. But what exactly does it change? If two components are in a series of each other in a power configuration, can moving the power connection points change the relationship between the series? What about parallel connections? If two components are placed in parallel with each other, can you change their parallel relationship by simply moving the point at which the power supply is connected to the network? Description. Note: Work with students to clearly identify rules that identify series and parallel connections. This is very important for students if they successfully analyze all kinds of series parallel networks. Referring to series parallelism, the most common problems encountered as electronics instructors are always associated with a lack of ability to consistently distinguish between series and parallel subnetnets in continuous parallel combination circuits. Question 12 Identify which of these components are connected in series to each other and which components are connected in series to each other: Battery and R1.Parallel connection: Lamp, C1, D1 Note: You need to have a solid understanding of what constitutes a series and parallel in a real circuit. Here's where some students feel uncomfortable because the definition of the textbook they memorized says more simplyIt is essential that students have a strong working knowledge of the term and simply do not memorize the definition. Question 13 Rank these three bulb assemblies according to their total electrical resistance (from minimum to maximum) and assume that each bulb is of the same type and rating: explain how we determined the relative resistance of these light bulb networks. Revealing the answer • C (minimum total resistance) • A • B (maximum total resistance) Note: I prefer to get into discussions about series and parallel circuits before introducing Ohm's Law. Conceptual analysis tends to be more difficult than numerical analysis of electrical circuits, but it is a skill worth building, especially for effective troubleshooting. However, after a conceptual (qualitative) analysis, it is effective to perform a numerical (quantitative) analysis of such circuits to prove that the concept is correct, in sufficient progress for the student to perform a series parallel resistance calculation at this time. Question 14 Which components are guaranteed to share the exact same voltage by connecting to each other? Which components are guaranteed to share the exact same current by connecting to each other? The battery and R1 are guaranteed to share exactly the same current. Note: This section examines the important relationships between voltage, current, and component connection patterns. This will help you further define what the terms series and parallel really mean in a practical way. Question 15 Which components in this partial schematic are guaranteed to share the exact same voltage by connecting to each other? Which components are guaranteed to share the exact same current by connecting to each other? So do the two brake lights. However, the voltage beyond the brake light may not be the same as the voltage across the headlights. Generators and batteries share roughly the same voltage as long as the movable link is not blown away. Anmeters, readability links, and generators are all guaranteed to share the same current. Note: This section examines the important relationships between voltage, current, and component connection patterns. This will help you further define what the terms series and parallel really mean in a practical way. This question also gives an opportunity to discuss what a mobility link is and how it compares to fuses and circuit breakers as an overcurrent protection device. Question 16 In this series parallel circuit, resistors R1 and R2 are in series with each other, but resistance R3 is not in series or parallel to R1 or R2: The first step in mathematically analyzing such circuits is to determine the total.Resistance. This means that voltage sources in the network formed by R1, R2, and R3 must calculate the degree of resistance that is seen. If the circuit is a simple series configuration, our task is simple: similarly, if the circuit is a simple parallel configuration, it is not difficult at all to calculate the total resistance: the given circuit is not purely series or purely parallel, but the calculation of the total resistance is not an easy one-step operation.

However, there are ways to simplify circuits into simple series or simple parallels. We're going to show you how to do that, and demonstrate it using the resistors R1, R2, and R3 numbers. Obviously we assume that we had these resistance values: • R1 = 3000 Ω • R2 = 2000 Ω • R3 = 5000 Ω In this case the total resistance value would be 2500 Ω. I'll let you figure out how to do this! Tip: 2.5k is just half of a 5k note: figure out how to calculate total resistance in a series parallel network is a problem solving exercise. Students should decide how to convert complex problems into multiple simple problems. This type of exercise can also help students think in terms of problem solving. It is a very important skill in electronics to make it easier and easier to analyze circuits by taking sections of circuits and reducing them to equivalent component values. Question 17 Rank these five bulb assemblies according to their total electrical resistance (from minimum to maximum) and assume that each bulb is of the same type and rating: explain how we determined the relative resistance of these light bulb networks. Reveal the answer • C (minimum total resistance) • D • A • E • B (maximum total resistance) Note: I prefer to enter into discussions about series and parallel circuits before introducing Ohm's Law. Conceptual analysis tends to be more difficult than numerical analysis of electrical circuits, but it is a skill worth building, especially for effective troubleshooting. However, after a conceptual (qualitative) analysis, it is effective to perform a numerical (quantitative) analysis of such circuits to prove that the concept is correct, in sufficient progress for the student to perform a series parallel resistance calculation at this time. Question 18 Determines the amount of electrical resistance indicated by the ohmmeter connected between the following points in this circuit: • Point A and B = • Between points A and C = between points C and D = between points D and B = • Explain whether it makes sense to speak the total resistance of this network between points B and C = . Reveal answers • Point A and B = 2.41 kΩ • Between points A and C = 2.89 kΩ • Between points C and D = 1.32 kΩ • Between points D and B = 2.10 kΩ • Notes between points B and C = 2.75 kΩ: This purpose:The resistance of examining different areas of the resistance network is to make students aware that those areas depend on what they are. Question 19 Calculate the voltage drop across resistor R2: Also note the direction of the current through it and the polarity of the voltage drop across it. Answer VR2 = Reveal 12.11 volts,Positive value on top and negative value at bottom. According to the conventional flow notation, the current decreases through resistor R2. However, the actual flow of electrons through R2 is up. Note: Discuss how students got answers to this question. Inferences and procedures are much more important than the actual answer itself. Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. At first, it's helpful for you (instructors) to show them, but it's bad for them to stop thinking for themselves and just not follow your lead and show them too often. An educational technique that I found very useful is for students to come before class (alone or on a team) and write problem-solving strategies for everyone else to see. They don't actually have to do the math, but rather outline the steps they take, in the order they take. Having students explain their problem-solving strategies will give everyone the opportunity to see multiple solutions, and you (the instructor) will be able to see how (and if!) students are thinking. A particularly good point to highlight in these open thinking activities is how to check your work to see if there was a mistake. Question 20 Antique American automobiles used a 6-volt electrical system instead of the 12-volt components often found in more modern cars and trucks. People restoring these old vehicles may have difficulty finding old 6-volt generators or batteries to replace the defective original units. A simple solution is to update the vehicle's generator and battery with the latest (12 volt) components, but then another problem arises. A 12-volt generator and a 12-volt battery overwhelm old 6-volt headlights, brake lights, and other electrical loads in the vehicle. The solution used by antique automotive restorers is to connect a resistor between a 12-volt generator system and a 6-volt load: explain why this solution works, and also discuss the drawbacks of using resistors that adapt new (12 volts) to new (12 volt) components. Obviously the purpose of the resistor is to drop half of the voltage supplied by the generator and battery so that the load (in this case the bulb) receives only 6 volts instead of 12 volts. The disadvantage of doing this using resistors is that the resistor wastes a lot of power in the form of heat. Note: Make sure that students understand the concept of load for electrical or electronic components that use power.Source. Usually, the load is the end-use component of the circuit: light bulbs, motors, solenoids, speakers, etc. In this case, the resistors can be thought of as loads, just like light bulbs, and light bulbs are the only components that do useful work from the power supply, so one example is to think of them when using the word load rather than a resistor. Question 21 Draw a schematic diagram of this breadboard circuit: Reveal notes of the answer: If your students are not yet aware of how the holes in the non-sned breadboard are connected together, a good time to introduce them Question 22 Think about how to rewire this old car's electrical system (with a 6 volt bulb) so that it doesn't require resistance between the circuit load and the generator/battery part (each works at 12 volts). Connect a pair of light bulbs that reveal the answers in series instead of parallel. In this way, each bulb receives 6 volts and the system voltage is a total of 12 volts. Follow-up question: But there is a downside to this strategy, and it is about the safety of operating a car. Let me explain this drawback. Note: This solution only works because the load set is paired and 6 6 = 12. One advantage of this solution is that the more resistors in the circuit that waste power in the form of heat, the more efficient it is. However, as indicated in the follow-up question, there are drawbacks to doing things in this way. Discuss this shortcoming with students to reinforcing the idea that the most efficient engineering solution may not be the best when evaluating it from other perspectives, such as safety. Question 23 Calculating the voltage drop for VAB, VBC, and VCD in the following circuit: Answer VAB = 461 mV VBC = 0 VCD = 1.039 V Follow-up question: Explain why the voltage between points A and B (VAB) increases when the 1200 Ω resistor is shorted. Tip: Imagine a jumper wire connected across that resistor to simulate a short-circuited fault. Challenge question: Learn how to calculate these same answers without calculating the total circuit current. Note: Tell students that the VBC must be zero just by examining the circuit (without math). If some students have difficulty answering this question, ask them to convert the drawing to the appropriate schematic. Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. At first, it's helpful for you (instructors) to show them, but it's bad for them to stop thinking for themselves and just not follow your lead and show them too often. An educational technique that I found very useful is for students to come before class (alone or on a team) and write problem-solving strategies for everyone else to see. They don't really have to do the math.Rather, it outlines the steps they take, in the order they take. Having students explain their problem-solving strategies will give everyone the opportunity to see multiple solutions, and you (the instructor) will be able to see how (and if!) students are thinking. A particularly good point to highlight in these open thinking activities is how to check your work to see if there was a mistake. Question 24 Calculates the magnitude and polarity of the voltage between points A and D of this circuit and assumes that the supply output voltage is 10.5 volts: Also calculate the total current output by the power supply that energizes this resistor network. Answer VAD = 7.31 volts, reveal positive and D negative. The total supply current is 4.36mA. Follow-up question: Explain why the voltage of the 4.7 kΩ resistor is zero if the 1.5 kΩ resistor does not open. Note: Some students may not realize it at first, but there is no series parallel analysis required to obtain a voltage drop VAD. Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. At first, it's helpful for you (instructors) to show them, but it's bad for them to stop thinking for themselves and just not follow your lead and show them too often. An educational technique that I found very useful is for students to come before class (alone or on a team) and write problem-solving strategies for everyone else to see. They don't actually have to do the math, but rather outline the steps they take, in the order they take. Having students explain their problem-solving strategies will give everyone the opportunity to see multiple solutions, and you (the instructor) will be able to see how (and if!) students are thinking. A particularly good point to highlight in these open thinking activities is how to check your work to see if there was a mistake. As a follow-up to the follow-up question, ask students that the open fault of the 1.5 kΩ resistor causes the other resistors in this circuit to completely lose voltage. Question 25 Calculating the output (total) current of the power supply: Obviously the answer itotal = 4.69 mA follow-up question: Explain why the voltage of the entire 1500 Ω resistor does not change when the 4700 Ω resistor does not open. The question of the challenge: What are the key assumptions underlying the current calculated numbers shown here? In other words, what is the unknown amount that affects the accuracy of the predicted present value? Note: This is an interesting series parallel circuit problem to solve, and by a good understanding of circuit theory, it again shows how to infer unst measured variables. Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. It's useful at first, but (To show them, they stop thinking for themselves and it is bad to show them too often, simply to follow your lead. An educational technique that I found very useful is for students to come before class (alone or on a team) and write problem-solving strategies for everyone else to see. They don't actually have to do the math, but rather outline the steps they take, in the order they take. Having students explain their problem-solving strategies will give everyone the opportunity to see multiple solutions, and you (the instructor) will be able to see how (and if!) students are thinking. A particularly good point to highlight in these open thinking activities is how to check your work to see if there was a mistake. Question 26 Complete the table of values for this circuit: View answer notes: Discuss with students good steps to calculate unknown values for this problem and how to verify their work. Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. At first, it's helpful for you (instructors) to show them, but it's bad for them to stop thinking for themselves and just not follow your lead and show them too often. An educational technique that I found very useful is for students to come before class (alone or on a team) and write problem-solving strategies for everyone else to see. They don't actually have to do the math, but rather outline the steps they take, in the order they take. Having students explain their problem-solving strategies will give everyone the opportunity to see multiple solutions, and you (the instructor) will be able to see how (and if!) students are thinking. A particularly good point to highlight in these open thinking activities is how to check your work to see if there was a mistake. Question 27 Complete the table of values for this circuit: View answer notes: Discuss with students good steps to calculate unknown values for this problem and how to verify their work. Question 28 Complete the table of values for this circuit: Publish answer Note: Ask students to identify components of this series parallel circuit that are guaranteed to share the same voltage without reference to calculations, and components that are guaranteed to share the same current. This is a good practice for identifying parallel and series interconnections, respectively. Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. At first, it's helpful for you (instructors) to show them, but it's bad for them to stop thinking for themselves and just not follow your lead and show them too often. Educational techniques that I have knew are very usefulStudents come to the board (alone or in teams) before class to write their problem solving strategies for everyone else to see. They don't actually have to do the math, but rather outline the steps they take, in the order they take. Having students explain their problem-solving strategies will give everyone the opportunity to see multiple solutions, and you (the instructor) will be able to see how (and if!) students are thinking. A particularly good point to highlight in these open thinking activities is how to check your work to see if there was a mistake. Question 29 What happens if a voltage drop occurs for each resistor in this circuit, and resistance R1 is difficult to open? Obviously the answer if resistor R1 fails to open (internally), it does not leave a voltage for R2 or R3 and lowers the full battery voltage throughout its terminals. Note: In most DC circuit failure scenarios, you can estimate the impact of an open or short failure or accurately predict it without mathematical calculations. Of course, you can use very large values for open resistors and 0 for short resistors to calculate the effect, but that's an inefficient use of time! Obviously the answer Is that if either resistor R2 or R3 fails to open (internally), both R2 and R3 voltages increase (but the battery voltage does not occur completely) and there is less voltage to drop throughout R1. Follow-up question: Explain why it doesn't matter which resistor (R2 or R3) doesn't open - the qualitative result of the voltage (increasing or decreasing the voltage, but not a certain amount) will be the same. Note: I've noticed that many students teach them to hate qualitative analysis because their calculators can't do the thinking for them. However, being able to determine whether circuit parameters increase, decrease, or remain the same after a component failure is an essential skill for skilled troubleshooting. Question 31 What happens to the voltage and current of each resistor in this circuit if resistor R1 does not open? If resistance R1 does not open to reveal the response. . • VR1 increases to full supply voltage, IR1 decreases to zero • VR2 decreases to zero, BUT VR2 decreases to zero - VR3 decreases to zero. Reading from the top of the list down reveals my sequence of inferences. Explain why I come to a conclusion in the order I did. Note: I've noticed that many students teach them to hate qualitative analysis because their calculators can't do the thinking for them. However, it is possible to determine whether a circuit is a circuit.If a component failure is an essential skill to solve a problem, it has been increased or decreased, or kept in the same state. Question 32 What happens when the resistor R2 shorts the voltage and current of each resistor in this circuit? If the R2 resistance is insufficient. • VR2 is reduced to zero. • VR2 increases • VR1 increases to full supply voltage, IR1 decreases to 0 • IR3 decreases to zero , VR4 decreases to zero. Reading from the top of the list down reveals my sequence of inferences. Explain why I come to a conclusion in the order I did. Note: I've noticed that many students teach them to hate qualitative analysis because their calculators can't do the thinking for them. However, being able to determine whether circuit parameters increase, decrease, or remain the same after a component failure is an essential skill for skilled troubleshooting. Question 33 What happens when the resistor R4 shorts the voltage of each resistor in this circuit? It also comments on the practical possibility of running out of resistance rather than failing to open. Clarify the answer when resistance R4 fails to short. • VR4 decreases to zero • VR1 increases • VR2 decreases • VR3 increases follow-up questions: resistance is much less likely to fall short because it actually opens and fails. But this doesn't mean that something else on the circuit board can't make it look as if the resistor has failed to short! Explain what this is and why it can create the same effect as lack of resistance. Note: I've noticed that many students teach them to hate qualitative analysis because their calculators can't do the thinking for them. However, being able to determine whether circuit parameters increase, decrease, or remain the same after a component failure is an essential skill for skilled troubleshooting. Question 34 The student incorporated this resistance circuit into the snedless breadboard, but made an incorrect position resistance R3. One hole should be placed on the left instead of the current position: in this faulty configuration, assuming the battery outputs 9 volts, it determines what the voltage drop is for each resistor. • R1 = 2k Ω VR1 = • R2 = 1k Ω VR2 = • R3 = 3.3k Ω VR3 = • R4 = 4.7k Ω VR4 = • R5 = 4.7 k Ω VR5 = Rather than teaching each voltage drop, give this one hint: This breadboard circuit has only one voltage! Note: Tell students of the disabilities shown in thisVery typical. Because the holes in the endless breadboard are small, it is surprisingly easy to mis-position the components as shown. If you don't need a calculation to answer this question (if you haven't noticed it yet), point it out to your students! Question 35 You are designing a circuit that requires two LEDs to display Power On. The supply voltage is 15 volts and each LED is rated at 1.6 volts and 20 mA. Calculate the size and power rating of the fall resistance: After doing this, your colleagues will look at your circuit and suggest changes. Why not use a single drop resistor on both LEDs to reduce the number of components required? Two resistors reveal the answer: R1 = R2 = 670 Ω, rated for at least 0.268 watts (1/2 watt would be a practical assessment). Using one resistor: R1 = 335 Ω rated for at least 0.536 watts (1 watt would be a practical evaluation). Follow-up question: If you can't (and probably won't) choose a fully sized resistor, is it Ω Ω safer to choose a higher or lower value resistor Ω for these applications? Note: If students do not yet understand the V-symbol used to indicate a positive power connection in this schematic, let them know that it is a very common technique in electronic notation, just as it is common to use ground symbols as power connection symbols. Follow-up questions are very practical questions, and it's rare to have accurate components on hand to match the requirements of the circuit you're building. When you're working on a built design, it's important to know which way it's wrong (too big or too small). Question 36 Calculate all voltages and currents in this circuit: Battery voltage is 15 volts Resistance value is: R1 = 1 kΩ R2 = 3.3 kΩ R3 = 4.7 kΩ R4 = 2.5 kΩ R5 = 10 kΩ R6 = 1.5 kΩ R7 = 500 Ω Clear answer R1 = 1 kΩ ER1 = 4.016 V IR1 = 4.016 mA R2 = 3.3 kΩ ER2 = 6.522 V IR2 = 1.976 mA R3 = 4.7 kΩ ER3 = 6.522 V IR3 = 1.388 mA R4 = 2.5 kΩ ER4 = 4.462 V IR4 = 1.785 mA R5 = 10 kΩ ER5 = 6.5 522 V IR5 = 652 μA R 6 = 1.5 kΩ ER6 = 3.347 V IR6 = 2.231 mA R7 = 500 Ω ER7 = 1.116 V IR7 = 2.2 31 mA Note: Students benefit greatly from working with clean schematics. But don't supply this for them! Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. At first, it's helpful for you (instructors) to show them, but it's bad for you to show them tooAs they stop thinking for themselves and simply follow your lead. An educational technique that I found very useful is for students to come before class (alone or on a team) and write problem-solving strategies for everyone else to see. They don't actually have to do the math, but rather outline the steps they take, in the order they take. Having students explain their problem-solving strategies will give everyone the opportunity to see multiple solutions, and you (the instructor) will be able to see how (and if!) students are thinking. A particularly good point to highlight in these open thinking activities is how to check your work to see if there was a mistake. Question 37 Examine these two variable resistance (rheostat) networks, each with a global potentiometer and a small distance potentiometer: for each network, determine which pot is a coarse adjustment and which pot is the fine-tuning of the total resistance. Answer Series Network 100k = Reveal coarse adjustments; 5k = Fine-tuning Parallel Network 5k = Coarse Adjustments; 100k = Tweak Note: The purpose of this question is for students to identify the dominant resistance values in series and parallel circuits. Inform students as needed that Rtotal > series Rn and Rtotal are Rn< (Rn represents a specific resistance in the network) in parallel. Question 38 Identify the components of these components that are directly connected in series to each other and directly connected to each other: Reveal the directly connected answers for battery, R1, and SW1. Direct connection in parallel: neon lamp and L1. Note: In a real circuit, you should have a solid understanding of what constitutes a series and a parallel. This is where some students feel uncomfortable, because the definition of the textbooks they memorized says more easily than they apply. It is essential that students have a strong working knowledge of the term and simply do not memorize the definition. Question 39 Complete the table of values for this circuit: View answer notes: Discuss with students good steps to calculate unknown values for this problem and how to verify their work. Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. At first, it's helpful for you (instructors) to show them, but it's bad for them to stop thinking for themselves and just not follow your lead and show them too often. An educational technique that I found very useful is for students to come before class (alone or on a team) and write problem-solving strategies for everyone else to see. They don't actually have to do the math, but rather outline the steps they take, in the order they take. By inging students to outline their problem-solving strategies,With the opportunity to see multiple methods of solutions, you (instructors) can see how your students are thinking (and if!, the particularly good thing to highlight in these open thinking activities is how to check your work to see if there was a mistake. Question 40 Complete the table of values for this circuit: View answer notes: Discuss with students good steps to calculate unknown values for this problem and how to verify their work. Students often have difficulty formulating a solution method: determine what steps to take to get the final answer from a given condition. At first, it's helpful for you (instructors) to show them, but it's bad for them to stop thinking for themselves and just not follow your lead and show them too often. An educational technique that I found very useful is for students to come before class (alone or on a team) and write problem-solving strategies for everyone else to see. They don't actually have to do the math, but rather outline the steps they take, in the order they take. Having students explain their problem-solving strategies will give everyone the opportunity to see multiple solutions, and you (the instructor) will be able to see how (and if!) students are thinking. A particularly good point to highlight in these open thinking activities is how to check your work to see if there was a mistake. Question 41 Determine which bulb shines brightly and which bulb shines dimly (assuming all bulbs are the same). The light bulbs A and C that reveal the answer shine brightly, and the bulbs B and D shine dimly. Follow-up question: If the filament of the bulb D fails to open, explain why bulbs A and C become dimmed (low brightness). Note: This question provides an opportunity to discuss the current state of continuous and parallel components. Follow-up questions challenge students to qualitatively analyze circuits. Circuit.

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