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Calculating voltage worksheet

Question 1 Define the following terms: energy, work and power. Revealing the answer work is the force load at a distance. Energy is the ability to do the job. Power is the speed of work performed during unit time. Notes: Students may find basic physics text useful to get these definitions. Work is a complex concept of precise definition, especially for students who are unspeolated in basic physics. Technically, it is a vector point product of force and displacement, which means that the work is equal to the force time distance only if the force and distance vectors are exactly parallel to each other. In other words, if I carry a mass of 10 kg (lifting before the gravity tug) while walking parallel to the ground (without going up or down), the force and displacement vectors are perpendicular to each other, and the work I do while carrying the mass is zero. Only if my strength is directed in exactly the same direction as my proposal will all my efforts be translated into work. Question 2 Voltage is usually defined as electrical pressure. However, a volt unit can be defined as more important physical units. What are these units and how do they relate to the volt unit? Reveal the answer 1 volt is equal to 1 joule of energy, rendered 1 coulomb boot (6.25 ×1018 electrons): $$V= \frac {W}{Q}$$ Where, V = voltage (volts) W = work or potential energy (joules) Q = charging (coulombs) Notes: Note that I use the letter V means voltage, not E, as I usually do. This is because in general physics work E usually means Energy or Electric Field. Some electronic reference books use the letter E for voltage, while others use the letter V or even use two letters alternately. Question 3 The current is measured in the amps or amps unit. What is the actual definition of this unit? What are the main quantities of 1 ampe of electric currents? To reveal the amper of 1 code electric current is the speed of electron motion, equal to 1 coulomb per second: $$I= \frac {Q}{t}$$ Where, I = Electric current (amps) Q = motion charging (coulombs) t = time (seconds) Notes: At this time, it may be useful to view the number of electrons that make up one charging coulomb: 6.25 ×1018 electrons. Technically, the current mathematical definition includes calculation: $$I= \frac {dQ}{dt}$$ But at this stage students may not be ready to explore derivatives yet, so the equation provides an answer for the (medium) current. Question 4 A certain amount of water pressure flowing at higher water speeds: small (limiting) nozzle or large (unfettered) nozzle? Explain how this is related to the study of voltage, current and resistance in a simple electrical circuit. Reveal the answer It is clear that the unrestricted nozzle will pass water rate through it, all other factors are equal. In the electrical circuit, a lower resistance will pass a higher electron (current) flow rate of a certain amount of pressure (voltage). Notes: Water flow is not a perfect analogy for electricity, but is close enough to benefit the main area of electricity education. Be prepared to discuss water deficiencies as an analogy with your students (i.e. How do electrons do not spill the open wire end, for example, water spills from the open hose or the end of the pipe?). Question 5 Let's say that you had to create this circuit and perform current measurements through resistors and voltage through resistor: When you insert these numeric values in a table, the results look something like this: Draw these figures in this graph: What mathematical relationship do you see between voltage and current in this simple circuit? Reveal response This is an example of a linear function: where a plot that describes a data set traces a straight line in a chart. From this line, as well as from the numerical figures, you should be able to distinguish a constant ratio of voltage to current. Notes: The numbers of raw data were deliberately noisy in this problem in order to mimic the types of measurement errors encountered in real life. One of the tools that helps to overcome the problems of interpretation arising from such noise is the timetable. Even with noise, the linearity of the function is quite clearly revealed. Your students should learn how to make schedules as tools for understanding their data. When relationships between numbers are represented in a graphical form, it provides a different way of expression for data, helping people to hold patterns more easily than viewing rows and columns of numbers. Question 6 Step by step explain how to calculate the amount of current (I) that will pass through the resistor in this chain: Uncover the current of the answer resistor = 0.02553 amps or 25.53 milliamps (mA). Notes: Just a simple ohm's law calculation here – no tricks! However, the essence of this question is to help students think about the steps they take in their calculations. Many students just want to memorize the procedures and not find out why to do what they need to do to answer such questions. It is your task as an instructor to challenge them not only to memorize, and to understanding. Question 7 Draw the voltage-current relationships between the three different values (1 Ω, 2 Ω, and 3 Ω) in the same diagram: What model do you see, which is reflected in your three plots? What is the relationship between the amount of resistance and the nature of the voltage/current function, as it is shown in the graph? Extended question: In the case of calculation, the instantaneous (x,y) function change speed is expressed using a derived notation: [dy/dx]. How would it be each of these three plots must be properly expressed using a counting notation? Explain how these functions are related to real amounts of electricity. Reveal the answer The greater the resistance, the sharper the slope of the drawn line. Advanced answer: the appropriate way to express the derivative of each of these plots is [dv/di]. The linear function is a constant, and in each of these three cases the constant is equal to the resistance of the resistor to the skins. Thus, we could say that for simple resistor circuits, the instantaneous speed of the voltage/current function change is the resistance of the circuit. Notes: Students need to become comfortable with graphs, and creating their own simple schedules is a great way to develop this understanding. The graphic image of Omo's legal function allows students another view of the concept, which makes it easier for them to understand more advanced concepts, such as negative resistance. If students have access to a schedule calculator or computer software that can draw two-dimensional graphs, encourage them to plot functions using these technological resources. I found this good habit to sneak mathematical concepts into physical science courses whenever possible. So many people's mathematics is an abstract and confusing thing that can only be understood in the context of real-life application. Electrical and electronics studios are rich in mathematical context, so use it whenever possible! Your students will be very helpful. Question 8 What is the value of this resistor in omats (Ω)? Disclose response resistor value = 2700 Ω or 2,7 kΩ. One of the ingredients popular in Europe is the replacement of a decimal point with a metric prefix, so 2.7 kΩ would be depicted as 2k7 Ω. This notage is not only simpler, but also goes beyond the interpretation difficulties faced by Europeans and Americans using the opposite use of comma and decimal marks. Notes: Some students may not realize that commas are used as decimal numbers in Europe and vice versa. Thus, two thousand seven hundred would be written as 2,700 in America and 2,700 in Europe. Conversely, π would be written as 3.141593 in America, but 3.141593 in Europe. Confusing? So!! Question 9 The general saying about electricity is that it always takes the path of least resistance. Explain how this proverb relates to this circuit, in which the battery's current is exposed to two alternative paths, one of which is less resistant than the other: Uncover the answer 250 Ω resistors will experience a current of 40 mA and 800 Ω resistors will experience a 12.5 mA current. Notes: As an instructor, I was very surprised that many novice students claim that the whole current would go through less resistors, and none too Resistor! The proverb about the least resistance path should certainly be understood as proportionally taking pathways of lower resistance. People new to the electric study often misunderstand such basic principles, their mistakes are usually based on such folk wisdom. It is necessary to break through these myths with a difficult fact. In this case, Ohm's Law serves as a mathematical tool that we can use to dispel false ideas. Of course, the circuit is as simple as it can be easily assembled and tested in the classroom so that everyone can see the truth for themselves. Question 10 One light bulb style, very different from the incandescent design, which operates on the light principle of an ultra-heated wire incandescent thread, called a gas discharge pipe. In this light bulb construction, light is produced by directly excusing gas molecules, because the electric current passes between two electrodes: Both types of bulbs have interesting voltage / current plots, none are identical to the resistance voltage / current plot. First, the voltage/current plot of the incandescent bulb: Next, the voltage/current plot of the gas-discharge bulb: Based on these two graphs, what can you say about the electrical resistance of each type of bulb within its operating range? To reveal the answer Unlike the resistor, which offers a relatively fixed (unchanging) amount of immunity to electron movement under different operating conditions, the electrical resistance of light bulbs usually changes significantly over their respective operating ranges. From the graphs, determine where each type of light bulb has the highest resistance and where the resistance is the lowest. Notes: Many types of electrical and electronic components experience electrical resistance changes depending on their current and voltage ranges. Resistors, although simple to learn, do not have the behavior of most electronic components. It is important for students to understand that the real world of electricity and electronics is much more complex than what the Os Act can offer (with the implied premise of fixed resistance). It's one of the concepts that graphs really help illustrate. Question 11 Draw an experimental circuit diagram to collect the data needed to plot the voltage and/or current schedule of the gas discharge lamp. Reveal response Notes: One of my goals as a technical educator is to promote the development of experimental skills for my students. The most accurate way to gain knowledge of the operation of the device or the principle of electricity is to create a chain that actually tests it. I have used this technique many times throughout my career to further my knowledge of the subject, and it has proven to be an invaluable skill. This question asks students indirectly to identify a few key points: • Where to connect a meter lamp voltage. • Where to connect the meter to measure the current of the lamp. • How to make the current adjustable so that you can test and draw multiple values. In addition, pupils must determine what voltage and current ranges will be needed to test the gas discharge lamp. Pay attention to the high voltage power supply shown in the diagram. Students who see the answer to the scheme may ask how high should this tension be?. Don't tell them openly. Rather, they do some research and report the next day the typical lamp tension! Question 12 What is negative resistance? The revealing answer to negative resistance is when the electrical component passes less current as the voltage drops during it increases. Notes: Many gas outlets not only have negative resistance to certain parts of their range of operation, but also many semiconductor devices. Question 13 When an electric current passes through a conductor offering a certain electrical resistance, the temperature of that conductor rises above the environment. Why is that? What practical significance does this have? To reveal the answer, the electrical resistance is analogous to mechanical friction: electrons cannot flow freely through the resistance, and the friction they face turns part of their energy into heat, as does the friction of the worn mechanical bearing, turning some kinetic energy of its rotation into heat, or friction between the hands of a person, rubbing them together on a cold day, turning some movements into heat. Notes: This is a good starting point for discussion about work, energy and power. Power, of course, can be directly calculated by multiplying the voltage by the current and measured in watts. It also provides an opportunity to discuss some practical restrictions on electrical conductors. Question 14 On a certain amount of electric current, which resistor will dissipate the maximum power content: low-value (low-strength) resistors or high-value (high-strength) resistors? Explain your answer. Reveal the answer Resistor, which has a high resistance rating (many resistance ohm) will dissipate more heat energy than lower value resistors, taking into account the same amount of electricity over it. Notes: This question is intended to make students think qualitatively about the relationship between current, resistance and power. I found that qualitative (nonnumeric) analysis is often more complex than asking students to quantify their answers (with numbers). Often, simple mathematics is a kind of barrier behind which students seek refuge from a real understanding of the subject. In other words, it's easier to punch the keys in a spreadsheet (or even perform calculations with paper and pencil) than to actually think about the relationship between variables in a physical problem. However, the qualitative the use of electrical systems is vital for the rapid and efficient troubleshooting. Question 15 Draw a link between power and current 2 Ω resister in this graph: What model do you see in the plot? How does this compare to the graphical connection between voltage and current resistor? Reveal the answer The more current through resistors, the more power dissipated. However, this is not a linear function! Notes: Students need to become comfortable with graphs, and creating their own simple schedules is a great way to develop this understanding. A graphic image of Ohm's Law (in fact, The Joule Law) power feature allows students a different image of the concept. If students have access to a schedule calculator or computer software that can draw two-dimensional graphs, encourage them to plot functions using these technological resources. Question 16 Shown here is a scheme scheme for a simple battery-powered flashlight: What can be changed about the circuit or its components to make the flashlight produce more light when switched on? Reveal the answer Somehow you need to increase the diffuse power of the light bulb. Perhaps the most obvious way to increase energy dissipation is to use a battery with higher voltage power, thus providing greater light bulb current and greater power. However, this is not the only option! Think of another way how the output of the flashlight can be increased. Comments: The obvious solution is the direct application of the Os Law. Other solutions may not be so direct, but they will all be linked back to Ohm's Law somehow. Question 17 Question 17 There are two main equations of the Law of Omo: one concerns tension, current and resistance; and other related voltage, current and power (the latter equation is sometimes known as The Joule Law, not Omo Law): $$E=AND$$$$P=IE$Electronics Tutorials and Information Books, you'll find twelve different options for these two equations, one solution for each variable in terms of a unique pair of two other variables. However, you do not need to memorize all twelve equations if you have the ability to manipulate the two simple equations above in algebraic manipulation. Show how algebra is used to get ten other forms of two Ohm's Law/Joule Law equations shown here. Reveal the answer that I will not show you how to perform algebraic manipulations, but I will show you ten other equations. First, equations that can be obtained strictly from \(E = IR\): $$I= \frac {E}{R}$$$$$$R= \frac {E}{I}$$ Below equations that can be obtained strictly from \(P = I E\): $$I= \frac {P}{E$$$$$E= \frac {P}I{}$$ Next, equations that can be derived using an algebraic substitute between the first two equations are given in the question: $$P=I^2R$$ $$P= \frac {E^2}{R}$$ And finally those equations that can be derived from last two power equations: $$R= \frac {P}{I^2}$$$$$I=\sqrt{\frac{P}}$$$$$$$$$E=\sqrt{}$$$$$$R= \frac {E^2}{P}$$$ Notes: Algebra is a very important tool in many technical areas. One nice thing about electronics research is that it provides a fairly simple context in which basic algebraic principles can be learned (or at least illuminated). The same is true of the concepts of calculation: the basic principles of derivatives and ones (in terms of time) can easily be applied to capacitor and inductor chains, providing students with an accessible context in which these otherwise abstract concepts can be perceived. But the calculation is the subject of later worksheet questions . . . Question 18 In this chain, three resistors receive the same amount of current (4 amps) from one source. Calculate the voltage dropped by each resistor as well as the amount of power dissipated by each resistor: Reveal response E1 Ω = 4 volts E2 Ω = 8 volts E3 Ω = 12 vol P1 Ω = 16 watts P2 Ω = 32 watts P3 Ω = 48 watts Further question: Compare the direction of the current through all the components of this circuit with the polarity of their corresponding voltage fall. What do you notice about the relationship between the direction of the battery current and the polarity of the voltage compared to all resistors? How does it relate to identifying these components as sources or loads? Notes: The answers to this question should not cause any surprises, especially when students understand the electrical resistance in terms of friction: resistors with greater resistance (more friction for the movement of electrons) require higher voltage (pushing) to get the same amount of current through them. Higher resistance (friction) resistance will also dissipate more power in the form of heat, taking into account the same amount of current. Another objective of this question is to instill in the minds of students the concept of components in a simple chain of series, all of which share the same amount of current. Challenge your students to recognize any mathematical patterns for the dissipation of the corresponding voltage fall and power. What can be said, mathematically, about the voltage drop in 2 Ω resistors compared to 1 Ω resistors, for example? Question 19 In this chain, three resistors receive the same voltage (24 volts) from one source. Calculate the amount of current drawn by each resistor as well as the amount of power diffused by each resistor: reveal the answer I1 Ω = 24 amps I2 Ω = 12 amps I3 Ω = 8 amps P 1 Ω = 576 watts P2 Ω = 288 watts P3 Ω = 192 watts Notes: Answers to this question may seem paradoxical for students: the lowest value of the resistor dissipates the maximum power. But mathematics does not lie. Another objective of this issue is to instill in the minds of pupils the concept of components in a simple parallel all have the same voltage content. Challenge your students to recognize any mathematical patterns in the respective currents and power dissipations. What can be said, mathematically, about the current drawn by the resistor of 2 Ω compared to 1 Ω resistor? You may want to mention that in the electric language, the heavy load is one that attracts a lot of current and therefore has great resistance. This circuit, which shows how the smallest resistance in the parallel circuit consumes the most power, provides practical support for the term heavy, used to describe loads. Question 20 The brightness of the light bulb - or the power dissipated by any electrical load - in this regard can be replaced by inserting variable resistance in a chain like this: However, this method of controlling electricity is not without its drawbacks. Consider the example, when the circuit current is 5 amps, the variable resistance is 2 Ω, and the lamp drops 20 volts of voltage through its terminals. Calculate the dissipated power of the lamp, the dissipated power of the variable resistance and the total power of the voltage source. Then explain why this power management method is not ideal. Reveal the answer Plamp = 100 watts Presistance = 50 watt ptotal = 150 watts Further question: note how in the original question I suggested a set of hypothetical values to be used to understand why the series reostat (variable resistance) is not an effective lamp power control tool. Explain how the assumption of certain values is a useful problem solving technique in cases where you are not given any value. Notes: Discuss the concept of energy saving: that energy can not be created or destroyed, but only to replace different forms. In accordance with this principle, the sum of all the dissipations of the power of the circuit shall be equal to the total amount of energy supplied by the energy source, regardless of how the components are combined. Question 21 The modern method of controlling electricity involves inserting a quick-use switch into the electrical load so that power can be turned on and off very quickly over time. Typically, a solid state device such as a transistor is used: This circuit has been very simplified from a real, impulse control power circuit. Just display the simplicity of the transistor (rather than the pulse circuit needed to order it to be turned on and off). All you need to know is that the transistor acts as a simple, single-pole single-shot (SPST) switch, except that it is controlled by an electric current rather than mechanical force, and that it can turn on and off millions of times per second without wear or fatigue. If the transistor is switched on and off quickly enough, the power of the light bulb may be changed as smoothly as if it were controlled by a variable resistor. the use of fast-switching transistors to control electricity is very low, unlike when alternating resistance is used for the same task. This power control mode is commonly referred to as Pulse Width Modulation or PWM. Explain why PWM power management is much more efficient than load power control with serial resistance. Reveal the answer When the transistor is switched on, it acts as a closed switch: passing full load current, but lowering low voltage. Thus, its ON power \((P = I E)\) dissipation is minimal. Conversely, when the transistor is turned off, it acts as an open switch: there is absolutely no current. Thus, its OFF power dissipation \((P = I E)\) is zero. Load diffuse power (bulb) is the time mean power scattered between on and OFF transistor cycles. Thus, the load power is controlled by wasting power on the entire control unit. Notes: Students may find it difficult to fathom how the bulb can be dimmed by turning it on and off really quickly. To understand this concept, it must be understood that the transistor switching time must be much faster than the time required for the bulb filament to fully heat up or cool completely. The situation is analogous to the car's speed damping by rapidly pumping the accelerator pedal. If done slowly, the result is a varied speed of the car. If done fast enough, though, the car's mass averages on/off bike pedal and causes near constant speed. This method is very popular in industrial power control and is gaining popularity as a sound enhancement technique (known as Class D). The advantages of the minimum wasted power of the control device are many. Question 22 What happens to the brightness of the bulb if the switch in this circuit is suddenly closed? Reveal the answer Ideally closing the switch will not change the brightness of the bulb at all, as voltage sources should maintain constant voltage output regardless of loading. However, as you might have thought, the additional current that the resistor drew when the switch is closed may actually dim the lamp slightly due to battery voltage, killing under the extra load. If the battery is significantly oversized application, though, the degree of voltage sag will be insignificant. Notes: This question illustrates the difference between the ideal conditions, usually those typically made for theoretical calculations, and the conditions encountered in real life. In fact, it is the purpose of the voltage source to maintain a constant output voltage, regardless of the load (current from it), but in real life it is almost impossible. Most voltage sources exhibit a certain degree of sag in their output within the range of load currents, some worse Other. In this example, it is impossible to say how much voltage source output will skimm when the switch is closed, because we have no idea what the current pull of the resistor will be compared to the light puller, or what the rated output current of the voltage source will be. All we can say is that in theory there will be no effect on closing the switch, but in real life there will be a slight dimming when the switch is closed. Question 23 What would happen if the wire, with no resistance at all (0 Ω), were connected directly through 6-volt battery terminals? How much current would score, according to Ohm's Law? Let's say we had a short circuit 6 volt battery as soon as described and measure 8 amps of current. Why do the figures calculated in the previous paragraph disagree with the actual measurement? To reveal the answer Omo Law would suggest an infinite current (current = voltage divided by zero resistance). However, the described experiment yields only a small amount of current. If you believe that the wire used in the experiment is not less resistance (i.e. it has resistance) and that this makes up the difference between the predicted and measured current volumes, you are partially correct. In fact, a small piece of wire, for example, used in the experiment, will have several tenths of the resistance omo. However, if you recalculate a current with a wire resistance of 0.1 Ω, you will still find a big difference between the forecast and the actual measured current in this short circuit. The next question is #1: explain why wire resistance alone does not explain the modest short-circuit current. The question of follow-up #2: to identify at least one safety risk associated with a particular experiment such as this. Notes: Remind students that short-circuit power tests can be dangerous. My student once stuffed a 6-volt lamp battery in her tool bag, only to have it unload the smoke an hour later, after the battery terminals were truncated along the wrench handle! No, Omo's law is not deceived here: shortening the voltage source with a 0 Ω conductor will not increase the infinite current, because there are other sources of resistance in such a chain. The task is to determine where those sources can be and how they might be. Located.

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