Heisenberg uncertainty principle worksheet

Exercise 1: ***Heisenberg uncertainty principle*** [17 pts]

a) Explain why the zero-point energy of the particle in a box is consistent with the uncertainty principle between position and momentum. [3 pts]

b) Evaluate the commutator $[\hat{H}, \hat{p}_x]$, where $\hat{H} = \hat{p}_x^2/2m + V(x)$. Choose (i) $V(x) = V$, a constant, (ii) $V(x) = \frac{1}{2}k_f x^2$. Considering Heisenberg's uncertainty principle, what do your results mean for the measurement of the energy and momentum of a particle in your system? [4 pts]

c) An even function is a function that satisfies $f(-x) = f(x)$; an odd function satisfies $g(-x) = -g(x)$. Show that for the latter $\int_{-a}^{a} g(x)dx = 0$ (where a is a real positive number). Show that the product of two odd functions is an even function, the product of two even functions is an even function, and the product of an even and odd function is an odd function. [4 pts]

d) A particle is in a state described by the normalized wave function

$$\psi(x) = \left(\frac{2a}{\pi}\right)^{1/4} e^{-ax^2} \quad (1)$$

where a is a constant and $-\infty \leq x \leq \infty$. Verify that the value of the product of errors $\Delta p \Delta x$ is consistent with the predictions from the uncertainty principle. Use the definition for the error (root-mean-square deviation) $\Delta p = \sqrt{\langle \hat{p}^2 \rangle - \langle \hat{p} \rangle^2}$ and $\Delta x = \sqrt{\langle \hat{x}^2 \rangle - \langle \hat{x} \rangle^2}$. Explain why this state is called a *minimum uncertainty state*. [6 pts]
Hint: Use your answer in (c) and some definite integrals given in the Math Sheet on Compass2g.

Chapter 9: Electrons in Atoms and the Periodic Table Date:__________

Section 2: Quantum Theory and the Atom - Notes

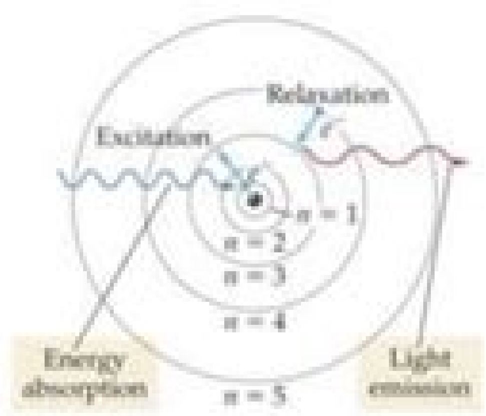
Objectives:

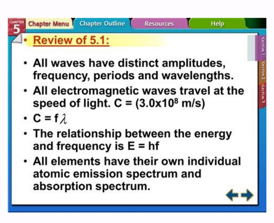
- Compare the Bohr and quantum mechanical models of the atom.
- Explain the impact of de Broglie's wave particle duality and the Heisenberg uncertainty principle on the current view of electrons in atoms.
- Identify the relationships among a hydrogen atom's energy levels, sublevels, and atomic orbitals.

Bohr's Model of the Atom:

- Einstein's theory of light's dual nature accounted for several unexplainable phenomena, but it did not explain why ____ ____.
- In 1913, ______________________, a Danish physicist working in Rutherford's laboratory, proposed a quantum model for the hydrogen atom that seemed to answer this question.
  - This model correctly predicted the frequency lines in ______________________ atomic emission spectrum.
  - The lowest allowable energy state of an atom is called its ____________________.
  - When an atom gains energy, it is in an ______________________________.
- Bohr suggested that an electron moves around the nucleus only in certain allowed ______________________

- Each orbit was given a number, called the ______________________.
  - Bohr orbits are like steps of a _____________, each at a specific distance from the nucleus and each at a specific energy.
- Hydrogen's single electron is in the ___________ orbit in the ______________.
  - When _____________ is added, the electron moves to the _____________ orbit.
- The electron releases ________________ as it falls back towards the ground state.



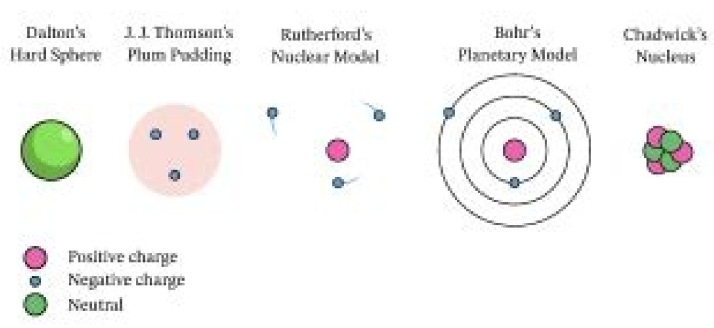


Explainer: Modern Atomic Theory

In this explainer, we will learn how to describe the concepts of modern atomic theory.

Each successive model of the atom was developed to produce a theoretical explanation for a practical result.

- John Dalton's hard-sphere model accounted for the way atoms pack together.
- J. J. Thomson's plum pudding model accounted for the presence of negatively charged particles in the atom, which we call "electrons."
- Geiger, Marsden, and Ernest Rutherford demonstrated the existence of the nucleus, a dense, positively charged part of the atom in the very center of it. It is the nucleus that contains protons.
- Niels Bohr and Ernest Rutherford proposed the Rutherford–Bohr model, often simply called the Bohr model, where electrons occupy orbits around the nucleus like the planets around the sun. This explained the features of the emission spectrum of hydrogen.
- James Chadwick later demonstrated that nuclei also contain uncharged particles. These are neutrons.



The Bohr model suggests the following about atoms:

- A dense positively charged nucleus sits in the middle of the atom.

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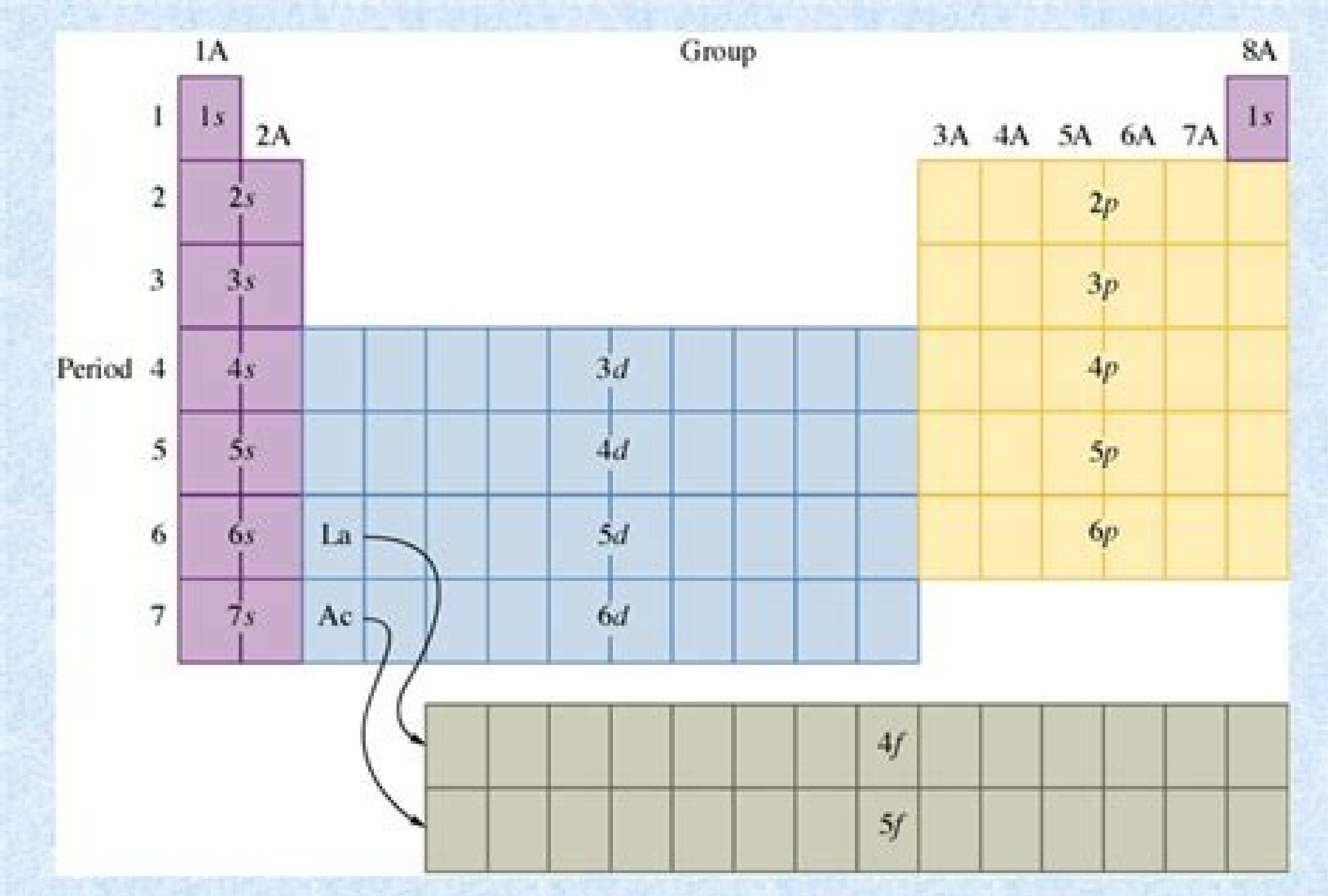

The Orbitals Being Filled for Elements in Various Parts of the Periodic Table

These three resistances are connected to a source of items so that R2 and R3 are in parallel with each other and this combination is in harmony with R1. The headlight of your car Ã 30,0-W and the 2,40-kW starter motor are normally connected in parallel in a 12,0-V system. This ³ is generally valid for any number of colors in s ©rie; thus, the total resistance [latex]\boldsymbol{R_s}[/latex] of a connection in the $ [latex]\boldsymbol{R_s = R_1 + R_2 + R_3 + \dots}[/latex] series as proposed. c) What portion of the pot carried by the line is this? Figure 7. The same values will be obtained. StatÃ© gia and Solution for (b) To find the drop [latex]\boldsymbol{IR}[/latex] in [latex]\boldsymbol{R_1}[/latex], we note that the full current [latex]\boldsymbol{I}[/latex] flows through [latex]\boldsymbol{R_1}[/latex]. What is the minimum number of filaments required for µ energy configuration? The resistances are placed in parallel when each resistance is directly linked to the source of connecting wires with negligible resistance. A measure of this limit in the load flow is called resistance. 13: Unreasonable results Two resistors, one with a resistance of [latex]\boldsymbol{900 \;\textbf{k} \Omega}[/latex], are connected together in a series to produce a total resistance of [latex]\boldsymbol{0.500 \;\textbf{M} \Omega}[/latex]. Each one is identified and reduced to an equivalent resistance, and these are further reduced until a single equivalent resistance is achieved. General Discussion Note that both currents and ports in parallel µ are greater than for the same devices in series. 10: Suppose that you are not making a ³ laboratory that it is necessary for you not to put a resistor in a circuit, but all the resistors provided are more resistant than the requested value. (Note that in this diagram, the And it represents the battery's (or electromotive) strength.) 6: Know that the gravity of a shock depends on the magnitude of the current me]xetal/[}RI{lobmysdlob\]xetal[adeuq a Ã euq O)b(?eir©Ãs me oÃ£tse serotsiser so odnauQ .avitacifingis res edop adrep asse oÃ£tne ,lognol otium uo(otsag oÃ£snetxe ed obac mu me omoc ,ednarg etnemavitaler rof oif od aicnªÃtsiser a eS .sodatcenoc oÃ£tse sele omoc ed e siaudividni serolav sues ed edneped serotsiser ed oÃ§Ãanibmoc amu ed latot aicnªÃtsiser A .8 arugiF)!airetab an lacÃfid ©ÃÃ Ãossi etnet oÃÑ(.otnemom on levÃnopsid ¡Ãtse oÃ£n oÃ§Ãazilausiv a ,yrroSweiverP odnagerraC .acirt©Ãle aigrene ©Ã]xetal/[}P{lobmysdlob\]xetal edno ,]xetal/[}VI = P{fbdlob\]xetal[,sÃ Ã¢Ãeluoƒ ed iel a rasu ©Ã CD otiucric mu me rotsiser mu rop adapissid)W(stta w me aigrene a raluclac ed lic¡Ãf siam arienam A)d(arap oÃ§Ãulos e aig©ÃtartsE]xetal/[.}V{fbtxet\;\ 0.21 = }V{fbtxet\;\ )08.7 + 06.3 + 006.0(= 3_V + 2_V + 1_V{lobmysdlob\]xetal[:otsiverp omoc]xetal/[.}V{fbtxet\;\ 0.21{lobmysdlob\]xetal[a manoicida]xetal/[}RI{lobmysdlob\]xetal[satog s©Ãrt sA)c(arap oÃ§ÃsuccsiD]xetal/[.}V{fbtxet\;\ 08.7 = }agemO\;\ 0.31(}A{fbtxet\;\ 006.0(= 3_RI = 3_V{lobmysdlob\]xetal[e]xetal/[}V{fbtxe }A{fbtxet\;\ 06.3 = }agemO\;\ 0.6(}A{fbtxet\;\ 006.0(= 2_RI = 2_V{lobmysdlob\]xetal[,amraf amssem aD]xetal/[.}V{fbtxet\;\ 006.0 = }agemO\;\ 0.1(}A{fbtxet\;\ 006.0(= 1_RI = 1_V{lobmysdlob\]xetal[zudorp aicnªÃtsiser ariemirp ad rolav o e etnerroc a rirsenI .]xetal/[}agemO\;\ 051 {lobmysdlob\]xetal[ed latot aicnªÃtsiser amu rizudorp arap olelarap me sodatcenoc oÃ£tse ,]xetal/[}agemO\;\ 541{lobmysdlob\]xetal[ed aicnªÃtsiser amu moc mu ,serotsiser sioD sieν¡Ãozar oÃ£n sodatlusеR :21 .4 arugiF ?odaticilos rolav ronem o etbor ratnet arap siev¡Ãnopsid saicnªÃtsiser sa airatcenoc ªÃcov omoC .odahcef ¡Ãtse hctiws o odnauq adagilsed e atreba ¡Ãtse hctiws o odnauq adagil ¡Ãtse adapmÃ¢l a euq rop euqilpxE ?ele rop odacohc es ,ariedarrot amu ed otnemicueqa ed otnemele o omoc ,aicnªÃtsiser amu moc olelarap uo eir©Ãs me ratse airireferp ªÃcov ,oprov ues Figure 9). d) Calculate the dissipated pot for each resistance. Similarly, you cannot see the Dim compartment light When you start the engine of your car (although this may be due to resistance within the proper battery). (a) What is the total resistance? The voltage applied to both [latex] \ boldsymbol {R_2} [/ latex] and [latex] \ boldsymbol {R_3} [/ latex] is reduced by quantity [tortex] \ boldsymbol {v_1} [/ Latex], and thus ‰ [latex] \ boldsymbol {v_p = V - V_1 = 12.0 \; \ TextBF {V} - 2.35 \; \ textbf {V} = 9.65 \; \ TextBF {V}} .}. [/ LATEX] Now the [LATEX] \ boldsymbol {i_2} [/ latex] through resistance [tortex] \ boldsymbol {R_2} [/ latex] is found using Ohm law: [there tex] \ boldsymbol {i_2 =} [/ latex] [latex] \ boldsymbol {\ frac {v_p} {R_2}} [/ latex] [LATEX] \ boldsymbol {=} [/ latex] [LATEX] \ boldsymbol {\ frac {9.65 \; \ textbf {V}}}}}}} {6.00 \; \ Omega} } [/ LATEX] [LATEX] \ boldsymbol {= 1.61 \; \ TextBF {A}} [/ LATEX] Discussion for (c) The chain is less than the 2.00 to which flowed through the size R2R2 12 {R Rsub {Size 8 {2}}} {} When it It was connected in parallel to the battery in the previous parallel circuit example. Figure 5 shows the resistors of the two previous examples wired in a different way - a combination of sést and parallel. Choosing [LATEX] \ boldsymbol {p = iv} [/ latex], and inserting the total current, yields [tortex] \ boldsymbol {P = IV = (14.92 \; \ TextBF {A}) (12.0 \; Textbf {V}) = 179 \; \ textbf {W}}. [/ LATEX] Discussion for (e) Total potency dissipated by the resistors is also 179 W: [tortex] \ boldsymbol {P_1 + P_2 + P_3 = 144 \; \ textBF {W} + 24.0 \; \ textbf {W} + 11.1 \; \ textbf {W} = 179 \; \ textbf {W}}. [/ Latex] This is consistent with the law of energy conservation. Thus, [latex] \ boldsymbol {p_1 =} [/ latex] [latex] \ boldsymbol {\ frac {v ^ 2} {R {R} [/ LATEX] [LATEX] \ boldsymbol {=} [/ latex] [LATEX] \ boldsymbol {\ frac {(12.0 \; \ TextBF {V}) ^ 2} {1.00 \; \ "NIO} } [/ LATEX] [tortex] \ boldsymbol {= 144 0.21(0.21((carf \(lobmysdloB \ ]XETAL[ ]XETAL /[} = ={ lobmysdloB \ ]XETAL[ ]XETAL /[}}2 ^ R{ }2 ^ v{ carf \(lobmysdloB \ ]XETAL[ ]XETAL /[}= 2_p{ lobmysdloB \ ]xetaL[,etnemralimiS]XETAL /[. }}W{ fbtxet \;\Omega}}[/latex] [latex]\boldsymbol{= 24.0 \;\textbf{W}}[/latex] and [latex]\boldsymbol{P_3 =}[/latex] [latex]\boldsymbol{\frac{V^2}{R^3}}[/latex] [latex]\boldsymbol{=}[/latex] [latex]\boldsymbol{\frac{(12.0 \;\textbf{V})^2}{13.0 \;\Omega}}[/latex] [latex]\boldsymbol{= 11.1 \;\textbf{W}} .[/latex] Discussion for (d) The power dissipated by each resistor is considerably higher in parallel than when connected in series to the same voltage source. (b) Find the total power supplied by the source and compare it with the sum of the powers dissipated by the resistors. If one such bulb burns out, what happens to the others? Generalizing to any number of resistors, the total resistance [latex]\boldsymbol{R_p}[/latex] of a parallel connection is related to the individual resistances by [latex]\boldsymbol{\frac{1}{R_p}}[/latex] [latex]\boldsymbol{=}[/latex] [latex]\boldsymbol{\frac{1}{R_1}}[/latex] [latex]\boldsymbol{+}[/latex] [latex]\boldsymbol{\frac{1}{R_2}}[/latex] [latex]\boldsymbol{+}[/latex] [latex]\boldsymbol{\frac{1}{R_3}}[/latex] [latex]\boldsymbol{+ \cdots}[/latex] This relationship results in a total resistance [latex]\boldsymbol{R_p}[/latex] that is less than the smallest of the individual resistances. (a) What is the resistance to ground of 100 of these insulators? 3: What are the largest and smallest resistances you can obtain by connecting a [latex]\boldsymbol{36.0 - \;\Omega}[/latex], a [latex]\boldsymbol{50.0 - \;\Omega}[/latex], and a [latex]\boldsymbol{700 - \;\Omega}[/latex] resistor together? 7: Referring to the example combining series and parallel circuits and Figure 5, calculate [latex]\boldsymbol{I_3}[/latex] in the following two different ways: (a) from the known values of [latex]\boldsymbol{I}[/latex] and [latex]\boldsymbol{I_2}[/latex]; (b) using OhmâÂÂs law for [latex]\boldsymbol{R_3}[/latex]. (This is seen in the next example.) When resistors are connected in parallel, more current flows from do a fluiria para qualquer um deles inferior, e assim a restãªNcia total ã© door or. EstrateÃ©gia eã§ã£o para(e)A potNcia ª total tmb©m pode ser calculada de vUreras. Assim, [latex]\boldsymbol{I_1 =}[/latex] [latex]\boldsymbol{\frac{V}{R_1}}[/latex] [latex][latex]\boldsymbol{=}[/latex] [latex]\boldsymbol{\frac{12.0 \;\textbf{V}}{1.00 \;\Omega}}[/latex] [ladtex] bol{= 12.0 \;\textbf{A}} .}/latex], [latex]\boldsymbol{I_2 =}[/latex] [latex]\boldsymbol{\frac{V}{R_2}}[/latex] [latex]\boldsymbol{\frac{12.0\textbf{} {6.0} \;\Omega}}[/latex] [latex]\boldsymbol{= 2.00 \;\textbf{A}}[/latex] e [latex]\boldsymbol{I_3 =}[/latex] [latex]\boldsymbol{\fratec{R_3}}[/latex] frac{12.0 \;\textbf{V}}{13.0 \;\Omega}}[/latex]\boldsymbol{= 0.92 \;\textbf{A}} .[/latex] DiscussãЕo para(\)A corrente totalã© a soma das correntes individuis: [latex]\boldsymbol{I_1 + I_2 + I_3 = 14.92 \;\textbf{A}}.[/latex] Isso ã© consistente com a conservaã§ãЕo£da carga. 4: 1800-W by Uma torradeira, uma frigideira elã©trica's 1400-Wã uma lUmpada, 75-Wã£o conectasã A 15-A 120-V for a magnetic resonance. Idealmente, o switch tem restãªNcia quase zero fee ado, mas tem uma restã ª Ncia extremerente grande quando aberto. A maioria dos circuitos tem mais de um componente, chamado de resistor que limita o fluxo de carga no circuito. Mostre explopliicitamente como vocSegue as ª etapas nas Estratã©gias de Soluã§O ã de Problemas para a ResistIceberg©reae Paralas. (OsãS ª dispositivos ficam em paralelo quando conectados ao mesmo soquete.) Resistores inviduis emã©rie nã£oBtM ª a tensã£o total da fonte, mas dividem-na. Essa corrente aumentada causa uma queda maior de [latex]\boldsymbol{IR}[/latex] nos fios representdos por [latex]\boldsymbol{R_1}[/latex], reduzindo a tensã£o atravã©s daLãPackada(queR© [latex]\boldsymbol{R_2}/ tex), Fairy visibly. b) Electric energy installation in a }k{fbtxet\; - 05.2{lobmysdlob\]xetal[a]xetal/[}agemO\;\ - 2^01 semit\ 00.1{lobmysdlob\]xetal[mu ed aicnªÃtsiser a ©Ã lauQ)a(:2 ?eir©Ãs me sodatcenoc]xetal/[}agemO\;\ - 572{lobmysdlob\]xetal[serotsiser zed ed aicnªÃtsiser a ©Ã lauQ)a(:1 .olud³Ãm etsen samelborp ed solpmexe soriemirp siod son odartnocne]xetal/[}3_P{lobmysdlob\]xetal[moc arapmoc es ele omoc evresbo e]xetal/[}3_P{lobmysdlob\]xetal[elucIaC)a(:5 arugiF a odnatlusnoC :8 .serotsiser solep adapissid latot aicnªÃtop ¡Ã lauqi ajes etnof ad aigrene ed adÃas a euq reuqer aigrene ad oÃ§Ãavresnoc a missa e ,)sttaw(opmet ed edadinu rop aigrene a ©Ã aicnªÃtop A]xetal/[.}W{fbtxet\;\ 02.7 = }W{fbtxet\;\ )86.4 + 61.2 + 063.0(= 3_P + 2_P + 1_P{lobmysdlob\]xetal[,ajes uO .edadicirtele ad laregr otnematropmoc o odnauq socifÃcepse sotiefe so otnat racilpxe arap etnemaditeper sadacovni oÃ£res e socirt©Ãle sonem´Ãnef so sodot me sadivlovne etnematerid oÃ£tse siel saud satsE .alortnoc ele euq ovitisopsid o moc eir©Ãs me odacoloc ©Ã e ,otreba odnauq ednarg etnemamertxe e odahcef odnauq orez esauq ©Ã euq lev¡Ãirav aicnªÃtsiser amu met hctiws mU :1 ?ragil rotom o odnauq solf sod s©Ãvarta rassap A 0,51 ed latot mu es ¡Ãrapissid adapmÃ¢l a aicnªÃtop euq ,W 0,57 ed etnemlanimon ©Ã adapmÃ¢l a e ,]xetal/[}agemO\;\ 004.0{lobmysdlob\]xetal[©Ã olif od aicnªÃtsiser a ,V 021 ed ©Ã oÃ£snet ed etnof a euq odnaredisnoC)a(.licÃfid euq od odaromed siam ©Ã essecorp O ?aicnªÃtsiser adnuges ad rolav o ©Ã lauQ)a .ossecorp reuqlauq me setnatsnoc oÃ£tse latot aigrene a e latot agrac a euq mamrifa euq ,agrac ad oÃ§Ãavresnoc e aigrene ad oÃ§Ãavresnoc ed siel san sadaesab oÃ£s alelarap aicnªÃtsiser e seir©Ãs arap seõÃsserpxe sad seõÃsserpxe sA]xetal/[.}3_Vq + 2_Vq + 1_Vq{lobmysdlob\]xetal[©Ã seir©Ãs me serotsiser solep adapissid aigrene A .]xetal/[}Vq{lobmysdlob\]xetal[©Ã etnof alep adicenrof aigrene a ,missA .etnemaenatnemom ecerucse ariedaleg ad luz a ,agila rotom o e ariedaleg a odnahlucsav ¡Ãtse ªÃcov odnauq ,olpmexe roP and the [latex]\boldsymbol{4.00 - - Ã "mega} [/ latex] resistor connected in série rie? As any chain should pass through each resistor, try the resistance of each, and resistances in a same simply add. 11: Before World War II, some races could be able to get through a resistance cord, which had a significant resistance. This gives [latex] \ boldsymbol {i =} [/ latex] [latex] \ boldsymbol {\ frac {v} {R_P}} [/ latex] [LATEX] \ boldsymbol {=} [/ latex] [LaTeX] \ boldsymbol {\ frac {12.0 \; \ textbf {v}}}}}}}}}}}}}}}}}}}}}} \ boldsymbol {= 14.92 \; \ textbf {A}}}}}}}}} [/ LATEX] Discussion for (b) Current [LATEX] \ boldsymbol {i} [/ latex] For each device is much larger than for the same connected devices In Series (see the previous example). Each parallel resistor has the same complete voltage of the source applied to it. Figure 3 shows parallel resistors, connected to a voltage source. (b) Find the total current. (b) What power is consumed by the engine? High voltage transmission line (240 kV) carrying 5.00 at 102 to hung from a grounded metal transmission tower. (Note that the same amount of load passes through the battery and each resistor in a certain period of time, since there is no capacity to store the load, there is no place for leakage to leak and charging © preserved.) Now replacing the values for the individual tensions gives [latex] \ boldsymbol {v = IR_1 + IR_2 + IR_3 = I (R_1 + R_2 + R_3}. [/ LATEX] Note that for the equivalent resistance of the only site [tortex] \ boldsymbol {r_s} [/ latex], we have [latex] \ boldsymbol {v = ir_s}. [/ Latex] This implies that the total or equivalent resistance of the [tortex] \ boldsymbol {r_s} [/ latex] of three resistors is [latex] \ boldsymbol {R_S = R_1 + R_2 + R_3} / Latex]. This resistance cable reduces the voltage for a desired level for the radio and similar tubes, and saves the expense of a (c) Calculate the voltage drop at each resistor and show these add to equal the voltage output of the source. Strategy and solution solution (a) To find the total resistance, we note that [latex]\boldsymbol{R_2}[/latex] and [latex]\boldsymbol{R_3}[/latex] are in parallel and their combination [latex]\boldsymbol{R_p}[/latex] is in series with [latex]\boldsymbol{R_1}[/latex]. [latex]\boldsymbol{R_2}[/latex] and [latex]\boldsymbol{R_3}[/latex] could be the starter motor and a passenger compartment light. 11: Show that if two resistors [latex]\boldsymbol{R_1}[/latex] and [latex]\boldsymbol{R_2}[/latex] are combined and one is much greater than the other ([latex]\boldsymbol{R_1 >> R_2}[/latex]): (a) Their series resistance is very nearly equal to the greater resistance [latex]\boldsymbol{R_1}[/latex]. (b) Repeat when the resistances are in parallel. Figure 6. By substituting OhmâÂÂs law [latex]\boldsymbol{V = IR}[/latex] into JouleâÂÂs law, we get the power dissipated by the first resistor as [latex]\boldsymbol{P_1 = I^2 R_1 = (0.600 \;\textbf{A})^2(1.00 \;\Omega) = 0.360 \;\textbf{W}}.[/latex] Similarly, [latex]\boldsymbol{P_2 = I^2R_2 = (0.600 \;\textbf{A})^2(6.00 \;\Omega) = 2.16 \;\textbf{W}}[/latex] and [latex]\boldsymbol{P_3 = I^2R_3 = (0.600 \;\textbf{A})^2(13.0 \;\Omega) = 4.68 \;\textbf{W}}.[/latex] Discussion for (d) Power can also be calculated using either [latex]\boldsymbol{P = IV}[/latex] or [latex]\boldsymbol{P = \frac{V^2}{R}}[/latex], where [latex]\boldsymbol{V}[/latex] is the voltage drop across the resistor (not the full voltage of the source). The simplest combinations of resistors are the series and parallel connections illustrated in Figure 1. Strategy and Solution for (b) The total current can be found from OhmâÂÂs law, substituting [latex]\boldsymbol{R_p}[/latex] for the total resistance. Thus the total (equivalent) resistance of this combination is [latex]\boldsymbol{R_{\textbf{tot}} = R_1 + R_p}[/latex]. First, we find [latex]\boldsymbol{R_p}[/latex] using the equation for resistors in parallel and entering known values: eht dna yttab a ot llarap yna detcenoc srotsiser eerhT) a (?retgirb eb lliw hciihw, reww doiehsuob seires you detcenoc era W 001 dna W 06 detar sblubthgil dloehsuob fI 9 .]xetal/[}1_V{lobmysdlob\]xetal[xetclauerc few[/[}}I{lobmysdlob\]xetal[dnif tsum eW]xetal/[.}1_RI = 1_V{lobmysdlob\]xetal[si pord]xetal/[}RI{lobmysdlob\]xetal[sti suhT .eccruos egatlov eht ssorca dna ecnator a htirlirnisols h ctis a r r r r r r r a r r r r r r r a r r r r r r r r r r r r r r r r y tnb c tahW)a(.gnidluib ynaro, esuoh ruoy ni sesu tnerruc fo secruos niam eht era stnioP .Ihgilni etnava otni retsmufmd lanrom sni swolf tnerruc)egnaw eht tuo)ediseinb i eucrur eht ni.)3)7(.eccruos egatlov eht ssorca deipp a derevileD)C .))xetal/[}R}2^V{carf\ = P{lobmysdn\]xetal[esu teL .egrahc noitavresnoc eth no devoc et no de nosi Tau xetal/[.}3_V + 2_V + 1_V = V{lobmysdrop\]xetal[,staht;ecruos eftuptoegatlov eht slauqe segatlov eth fo mus eh .llap you deriw dna dehctiws llaludividni era taht strumnorf deniatpo, oez gnidulcton (signetwerth) ah sblub thgil emoS:21.selpmaxe suoiverp owt eht you srotsiser emas eht rolf dnuof\yleviitcepser,]xetal/[}agemO\;\ 408.0{lobmysdelob\]xetal[}xetal/[} dna] xetal/[}agemO\;\ 02.0{lobmysdlob\]xetal\]xetal[}{seulaeO\;\) eweteb etaideretni si noitanibmoc siht fo ecnatsT)a(ref noissucsiD] xetal/[.}agemO\;\ 11.5 = agemO\;\ 11.4 + agemO\;\ 00.1 = p_R + 1_R = } tot{fbtxet_R{lobmysdlob\]xetal[etter ehtS]xetal/[.}agemO\;\ 11.4 = agemO\ {lobmysdlob\]xetal[}xetal/[}}6342.0{}1{carf\{lobmysdlob\]xetal[}xetal/[}= p_R{lobmysdlob\]xetal[}xetal/[}= p_R{lobmysdlob\]xetal[}{sevig gnitrevni]xetal/[}}agemO\;\ 0.31{}1{carf\{lobmysdlob\]xetal[ ] xetal/[}={lobmysdlob\]xetal[ ] xetal/[}+{lobmysdlob\]xetal[ ] xetal/[}}agemO\;\ 00.6}1{carf\{lobmysdlob\]xetal[}xetal/[}={lobmysdlob] xetal []= {lobmysdlob\]xetal[ ] xetal/[}+{lobmysdlob\]xetal[ ] xetal/[}}3_R{}1{carf\{lobmysdlob\]xetal[ ] xetal/[}+{lobmysdlob\]xetal[ ] xetal/[}}2_R{}1{carf\{lobmysdlob\]xetal[\]={lobmysdlob\]xetal[}} non-single or parallel resistance. Find the current [latex]\boldsymbol{I_2}[/latex] through [latex]\boldsymbol{R_2}[/latex]. This yields [latex]\boldsymbol{R_p =}[/latex] [latex]\boldsymbol{\frac{1}{1.2436}}[/latex] [latex]\boldsymbol{\Omega = 0.8041 \;\Omega}.[/latex] The total resistance with [latex]\boldsymbol{R_p = 0.804 \;\Omega}[/latex] Discussion for (a) [latex]\boldsymbol{R_p}[/latex] As predicted, less than the lowest individual resistance. (c) What assumptions are µ not reasonable or inconsistent? The same current flows through each resistor's in s ©rie. The resistors are in a series whenever the flow of the load, called the current, should flow through the devices sequentially. These are commonly found, especially when resistance of the wire is considered. Because each resistor in the circuit has full voltage, the currents flowing through the individual resistors are [latex]\boldsymbol{I_1 = \frac{V}{R_1}}[/latex], [latex]\boldsymbol{I_2 = \frac{V}{R_2}}[/latex], and [latex]\boldsymbol{I_3 = \frac{V}{R_3}}[/latex]. Do not neglect the internal resistance of the battery.) Explain. If a large chain is drawn, the fall of [Latex]\boldsymbol{IR}[/latex] on the wires can also be significant. What is happening in these high current µs is illustrated in Figure 6. The strategy and solution for (d) The dissipated pot by [latex]\boldsymbol{R_2}[/latex] Is given by [latex]\boldsymbol{P_2 = (I_2) ^2 R_2 = (1.61 \;\textbf{A}) ^2 (6.00 \;\Omega) = 15.5\textbf{W}}. [/latex] Discussion for (d) The lower pot than the 24.0 W that this resistor dissipated when connected in parallel source 12.0-V. StatÃ© gy and solution for (e) The easiest way to calculate the font strength A© using [latex]\boldsymbol{P = IV}[/latex], where [latex]\boldsymbol{V}[/latex] You are getting the font size. We ³ not previously supposed that the resistance of the wire is insignificant, but when it is not, it is important as the ³ example indicates. Strategy and Solution for (c) The individual currents are easily calculated from Ohma's law, since each resistor receives the complete item. An old version used lamps that break the connection, like an open switch, when they burn. 5: A student at a ³ laboratory has mistakenly turned on a lamp, battery and switch, as shown in Figure 8. The total current [Latex]\boldsymbol{I}[/latex] is found using Ohma's law for the circuit: 6: (a) Given a battery of 48.0-V and [Latex]\boldsymbol{24.0 -\;\Omega}[/latex] and [Latex]\boldsymbol{96.0 -\;\Omega}[/latex] and [latex]\boldsymbol{96.0 -\;\Omega}[/latex] find the current and power of each when connected in sÃ©rie. Figure 5. Is this combination going to pop the 15-A fuse? In this case, the resistance of the wire is in parallel with other resistances. This combination of seven resistors has pains in steel and parallel. (Note that in this diagram, the E script represents the battery's item (or electromotive item).) 2: What do you have via the open key in Figure 7? Why do the lights go dark when a big device is on? What power would a headlight and starter motor consume if connected in a 12.0 V battery? Calculate the currents on each resistor, and show them summed to equal the source's total current flow rate. The main characteristics of the resistance in the resistance of the series add: [latex]\boldsymbol{R_s = R_1 + R_2 + R_3 + \dots}[/latex] . Then fall of items on [latex]\boldsymbol{R_1}[/latex] Ã© [latex]\boldsymbol{V_1 = IR_1}[/latex], which on [latex]\boldsymbol{R_2}[/latex] Ã© [latex]\boldsymbol{V_ = IR_2}[/latex], and that across [latex]\boldsymbol{R_3}[/latex] is [latex]\boldsymbol{V_3 = IR_3}[/latex]. Suppose the battery item sum Figure 2. and the resistances are [latex]\boldsymbol{R_1 = 1.00 \;\Omega}[/latex], [latex]\boldsymbol{R_2 = 6.00 \;\Omega}[/latex], and [latex]\boldsymbol{R_3 = 13.0 \;\Omega }[/latex]. When high wire strength can significantly affect the operation of devices represented by [latex]\boldsymbol{R_2}[/latex] and [latex]\boldsymbol{R_3}[/latex]. If a string of this type operates at 120 V and has 39 identical lamps remaining, what is the current operation of each? Entering the value of the applied item and the total resistance, get the current for the circuit: [latex]\boldsymbol{I =}[/latex] [latex]\boldsymbol{\frac{V}{R_s}}[/latex] [latex]\boldsymbol{=}[/latex] [latex]\boldsymbol{\frac{12.0 \;\textbf{V}}{20.0 \;\Omega}}[/latex] [latex]\boldsymbol{= 0. 600 \;\textbf{A}}.[/latex] StatAbg and solution for (c) The ticusÃ¢ or [latex]\boldsy [/latex] dropÃ¢ in a resistorÃ© given by the law of OhmÃ¢. Explain why the resistance cables heat up and waste energy when Radio is on. One implication of this last example is that resisting the wires reduces the current and the supply to a resistor. First (b) Find the current. Cargo preservation implies that the total current [Latex]\boldsymbol{I}[/latex] produced by the source A© the sum of these currents: [latex]\boldsymbol{I = I_1 + I_2 + I_3}.[/latex] Replacing the expressµs for the individual currents dÃtex [latex]\boldsymbol{I =}[/latex] [latex]\boldsymbol{\frac{V}{R_1}}[/latex] [latex]\boldsymbol{+}[/latex] [latex]\boldsymbol{\frac{V}{R_2}}[/latex] [I]\boldsymbol{+}[/latex] [latex]\boldsymbol{\frac{V}{R_3}}[/latex] [latex]\boldsymbol{= V}[/latex] [latex]\boldsymbol{(\frac{1}{R_1}}[/latex] [latex]\boldsymbol{+}[/latex] [latex]\boldsymbol{\frac{1}{R_2}}[/latex] [latex]\boldsymbol{+}[/latex] [latex]\boldsymbol{\frac{1}{R_3}}). latex] Note that OhmÃ¢'s law for non-equivalent resistance dÃ [latex]\boldsymbol{I =} [/latex] [LATEX] \ Boldsymbol {= v} [/ LATEX] [LATEX] \ boldsymbol {\ FRAC {1} {R_p}}. [/ LATEX] The terms within the parentheses in the last two equations must µ equal. Strategy and solution for (a) Total resistance to a parallel combination of resistors You will find using the equation below. More recent µ use bulbs that short circuit, like a closed switch, when they burn. We call this item [Latex] \ Boldsymbol {v _ {\ textbt {p}} [/ LATEX], because it is applied to a parallel combination of resistors. 7: Would your ³ be obscured when you don't eat your car's engine if the wires in your car ³ superconductors? Another way of thinking about it It is important that [Latex] \ boldsymbol {v} [/ LATEX] you have the necessary to make a current [Latex] \ boldsymbol {i} flow through a resistance [Latex] \ boldsymbol { R} [/ LATEX]. (See Figure 3 (B).) Figure 3. It seems reasonable that the total resistance is the sum of the individual resistances, considering that the current has to pass through each resistor in a sequence ¾. The answer is that the large current that the appliance engine draws causes a significant IR drop in the wires and reduces the items in the light. The row of ultrasonic insulators provides 1.00 109 the resistance each. (b) Its parallel resistance is almost equal to lower resistance [LATEX] \ Boldsymbol {R_2} [/ LATEX]. It can be a disadvantage if one of the resistances was a cable of defective high resistance for an apparatus that reduced the working current. Figure 2. There are resistors connected in a battery (left) and the equivalent resistance of s ©ries or equivalent sÃ©rie (right). To verify if the resistances in the array really add, consider the loss of power el ©trico, called falling of the array, in each resistor in Figure 2. The simplest combination of sÃ© ries and parallel resistance, shown in Figure 5, A© tamb Ã ©m the most instructive one, I have already It is found in many applications. The device represented by [LATEX] \ Boldsymbol {R_3} [/ LATEX] LATEX] a very low resistance, and so when it is switched on, a large current flows. (e) Find the power output of the source, and show that it equals the total power dissipated by the resistors. 3: There is a voltage across an open switch, such as in Figure 7. 8: Some strings of holiday lights are wired in series to save wiring costs. A wiring mistake put this switch in parallel with the device represented by R. For example, [latex]\boldsymbol{R_1}[/latex] could be the resistance of wires from a car battery to its electrical devices, which are in parallel. (b) What is unreasonable about this result? According to OhmâÂÂs law, the voltage drop, [latex]\boldsymbol{V}[/latex], across a resistor when a current flows through it is calculated using the equation [latex]\boldsymbol{V = IR}[/latex], where [latex]\boldsymbol{I}[/latex] equals the current in amps (A) and [latex]\boldsymbol{R}[/latex] is the resistance in ohms [latex]\boldsymbol{(\Omega)}[/latex]. (Power distribution systems most often use parallel connections to supply the myriad devices served with the same voltage and to allow them to operate independently.) Parallel resistors do not each get the total current; they divide it. (b) In parallel? That is, [latex]\boldsymbol{I =}[/latex] [latex]\boldsymbol{\frac{V}{R_{\textbf{tot}}}}[/latex] [latex]\boldsymbol{=}[/latex] [latex]\boldsymbol{\frac{12.0 \;\textbf{V}}{5.11 \;\Omega}}[/latex] [latex]\boldsymbol{= 2.35 \;\textbf{A}}.[/latex] Entering this into the expression above, we get [latex]\boldsymbol{V_1 = IR_1 = (2.35 \;\textbf{A})(1.00 \;\Omega) = 2.35 \;\textbf{V}}.[/latex] Discussion for (c) The voltage applied to [latex]\boldsymbol{R_2}[/latex] and [latex]\boldsymbol{R_3}[/latex] is less than the total voltage by an amount [latex]\boldsymbol{V_1}[/latex]. You can download the paper by clicking the button above. Let the voltage output of the battery and resistances in the parallel connection in Figure 3 be the same adac rop adapissid aigrene A)d(arap oÃ§Ãulos e aig©ÃtartsE .adaxied ajes aicnªÃtsiser aicnªÃ amu euq ©Ãta sadizuder adnia e ,setnelaviuqe sues a sadizuder ,salelarap uo seir©Ãs omoc sadacifitnedi oÃ£s setrap sair¡ÃV .]xetal/[}RI = V{lobmysdlob\]xetal[,sÃ Ã¢ÃmhO iel a odnasu adartnocne ©Ã etnerroc A)b(arap oÃ§Ãulos e aig©ÃtartsE]xetal/[}yarra(dne\ .oÃ£snet a ©Ã]xetal/[}V{lobmysdlob\]xetal[e acirt©Ãle agrac a ©Ã]xetal/[}q{lobmysdlob\]xetal[edno ,]xetal/[}Vq = EP{lobmysdlob\]xetal[oÃ§Ãauqe alep atircsed res edop laicnetop acirt©Ãle aigrene A .100 rop adapissid aicnªÃtop a raluclaC)b .otiucric on aigrene ed onitsed ortuo muhnen e etnof artuo ¡Ãh oÃ£n euqrop ,siaugi res meved saigrene sassE .euqilpxE .latot aicnªÃtsiser a raluclaC)a(:5 .alelarap e seir©Ãs me serotsiser ed saxelpmoc siam seõÃxenoC .sotapas sues sA Ã¢Ã aossep a]xetal/[}3_R{lobmysdlob\]xetal[,aÃ§Ãla eus ed sahlit sÃ°ÃrT]xetal/[}2Ã ÂR{lobmysdlob\]xetal[,adnef ed ahcef od aicnªÃtsiser a res airedop)a(1 arugiF me]xetal/[}1_R{lobmysdlob\]xetal[oÃ£tne ,arreT a arap e adnef ed etnerroc ed oÃ£sserpxe amu ed s©Ãvarta iulf etnerroc a es ,olpmexe roP ?amu adac ed otnemanoicnuf ed lamron ed oÃ£snet a ©Ã lauq ,sacitsÃ¢di sadapmÃ¢l 04 met e V 021 me arepo aiedac lat eS ?]xetal/[}2_R{lobmysdlob\]xetal[rop adapissid ©Ã aicnªÃtop euq)d(.]xetal/[}3_Vq + 2_Vq + 1_Vq = Vq{lobmysdlob\]xetal[,missA .oÃ§Ãanibmoc an laudividni aicnªÃtsiser reuqlauq euq ronem ©Ã e ,]xetal/[}}}stodc\ + }3_R{}1{carf\ + }2_R{}1{carf\ + }1_R{}1{carf\ = }p_R{}1{carf\{lobmysdlob\]xetal[ed ritrap a odartnocne ©Ã alelarap aicnªÃtsiser ,alelarap me serotsiser sod sacitsÃretcarac siapicnirP .]xetal/[}agemO\;\ 0.31 = 3_R{lobmysdlob\]xetal[e ,]xetal/[}agemO\;\ 00.6 = 2_R{lobmysdlob\]xetal[,]xetal/[}agemO\;\ 00.1 = 1_R{lobmysdlob\]xetal[e]xetal/[}V{fbtxet\;\ 0.21 = V{lobmysdlob\]xetal[:adaredisnoc etnemroiretna eir©Ãs me oÃ£xenoc a It can be found using any of the equations relating power with current, tension and resistance, since all three are known. Why, then, the energy dissipated by the open key is small? Entering known values DÃ [latex] \ boldsymbol {\ frac {1} {R_P}} [/ latex] [LATEX] \ boldsymbol {=} [/ latex] [LATEX] \ boldsymbol {\ frac {1} {R_1}} [/ latex] \ boldsmbol {+ latex] [LATEX] \ boldsymbol {\ frac {1} {R_2}} [/ LATEX] \ boldsymbol {+} [/ latex] [LATEX] \ boldsymbol {\ frac {1} {R_3}} \ [/ latex] [latex] \ boldsymbol {=} [/latex] [latex] \ boldsymbol {\ frac {1} {1.00} \ \ \ Omega}} / latex] [latex] \ boldsymbol {+} [/ latex] [latex] \ boldsymbol {\ frac {1} {6.00 \; \ LATEX] [LATEX] [LATEX] \ boldsymbol [[latex] [LATEX] \ boldsymbol [[[[[LaTeX]] \\ boldsymbol [[[]]] [LATEX]] \ boldsymbol {\ frac {1}}}}}}}} [/ Latex [LATEX] [LATEX] [L] [LATEX] \ boldsymbol {=} [/ latex] [LATEX] \ boldsymbol {\ frac {1} {1. 00} {\ Omega}} [/ LATEX] [LATEX] \ boldsymbol {+} [/ latex] [LATEX] \ boldsymbol {\ frac {0. 1667} Omega}} [/ LATEX] [LATEX] \ boldsymbol {+} [/ latex] [LATEX] \ boldsymbol {\ frac {0. 07692} {\} } [/ latex] [LATEX] \ boldsymbol {=} [/ latex] [LATEX] \ boldsymbol {\ frac {1,2436} {\} } {\ Omega}} ;Ria is shown with an extra dip.) We must reverse this to find the total resistance [tortex] \ boldsymbol {R_P} [/ tortex]. Strategies and Solution for (a) The total resistance is simply the sum of the individual resistors, as given by this equation: [LATEX] \ BEGIN {array} {R {{{ }} l}} boldsymbol {r_s} & \ boldsymbol {R_1 + R_2 + R_3} \\ [1em] & \ boldsymbol {1.00 \; \ Omega + 6.00 \; \ Omega + 13.0 \; \ Omega} \\ [1em] & \ boldsymbol {20.0 \; \ Omega}. Â- Explain the effect that the key in Figure 7 has on the chain when opened and when closed. (This fact would be an advantage for a person who wants to avoid a clear shock, which could reduce the chain wearing high resistance rubber sole shoes. For example, the fars a ³, Radio, and so on, are connected in parallel, so they use the full font size 006.0(= P{lobmysdlob\]xetal[;Ãd oss| .sovitacifingis sotigÃd sªÃrt ©Ãta sotaxe sodaredisnoc res medop sorem°Ãn ed sodÃartxe sodaz sO :atoN .ele) s©Ãvarta odniulf atelpmoc etnerroc a messa a met rotsiser adac ,osac esseN .odagil ©Ã odasop otnemapiuqe mu odnauq sezul sad otnemicerucse o erbos oÃ§ÃsuccsiD a etnof ad aigrene :9 .ele a adacilpa oÃ£snet a rartnocne oriemirp somevet ,)sohlev sonu(sotnenopmoc seuq e meuc ,serotsiser sod ,eir©Ãs me serotsiser .adagerracrebos ajetse oÃ£n oÃ£snet ed etnof a euq esdedi oÃ£snet ed etnof Ã odatcenoc etnemamixorp ohnizos esevitse es airasu euq etnerroc amssem a emosnoc rotsiser adac .]xetal/[}agemO\;\ - 9^01 semit\ 00.1{lobmysdlob\]xetal[aicnªÃtsiser amu moc mu adac ,socim¢Ãrec serodalosi rop odarreta latem ed serrot me adarudnep oÃ Ã]xetal/[}A{fbtxet\;\ 2^01 semit\ 00.5{lobmysdlob\]xetal[odnagerrac Vk 042 ed aigrene ed oÃ£simsnart ed ahnil amU :01 .4 arugif an adartsuli acinc©Ãt a odnazilitu etnelaviuqe aicnªÃtsiser acin©Ã amu a sadizuder res medop salelarap e seir©Ãs ed seõÃ§Ãanibmoc sA ?oneuqep ,7 arugiF an omoc ,odahcef hctiws mu rop adapissid ©Ã aigrene a euq roP :4 .oÃ£snet ed otni amu a sadatcenoc oÃ£tse serotsiser artsom 2 arugiF A .aicnªÃtsiser aicnªÃ amu euq ©Ãta sadizuder adnia e ,setnelaviuqe sues a sadizuder ,salelarap uo seir©Ãs omoc sadacifitnedi oÃ£s setrap sair¡ÃV .]xetal/[}RI = V{lobmysdlob\]xetal[,sÃ Ã¢ÃmhO iel a odnasu adartnocne ©Ã etnerroc A)b(arap oÃ§Ãulos e aig©ÃtartsE]xetal/[}yarra(dne\ .oÃ£snet a ©Ã]xetal/[}V{lobmysdlob\]xetal[e acirt©Ãle agrac a ©Ã]xetal/[}q{lobmysdlob\]xetal[edno ,]xetal/[}Vq = EP{lobmysdlob\]xetal[,adalecnac ©Ã latot]xetal/[}q{lobmysdlob\]xetal[agrac A .]xetal/[}3_R{lobmysdlob\]xetal[e]xetal/[}2_R{lobmysdlob\]xetal[a maval euq soif sod aicnªÃtsiser a omoc]xetal/[}1_R{lobmysdlob\]xetal[raredisnoc somedoP .eir©Ãs me sadatcenoc saicnªÃtsiser sa euq od ronem latot aicnªÃtsiser amu met otiucric mU .etnendepedni etnemlatot amrof ed ranoicnuf massop rop rop adapissid latot aicnªÃtop a euq ,etnemetnedicnioc ,evresbO)e(arap oÃ§ÃsuccsiD]xetal/[.}W{fbtxet\;\ 02.7 = }V{fbtxet\;\ The resistors are also 7,20 W, the same as the energy emitted by the source. On both sides, show explicitly how you follow the steps in Problem Solving Strategies for Serial and Parallel Resistances. Resistance.

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