

Unit 6 ~ Learning Guide Name: _____

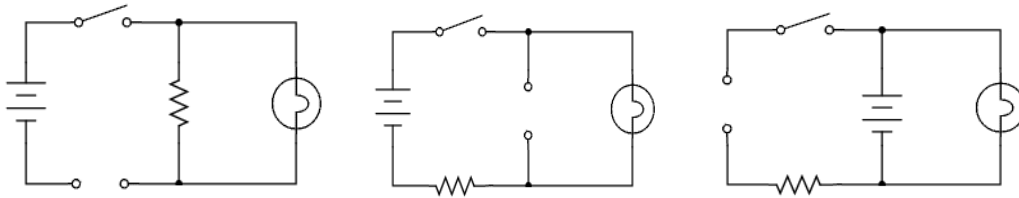
Instructions:

Using a pencil, complete the following notes as you work through the related lessons. Show ALL work as is explained in the lessons. You are required to have this package completed BEFORE you write your unit test. Do your best and ask questions if you don't understand anything!

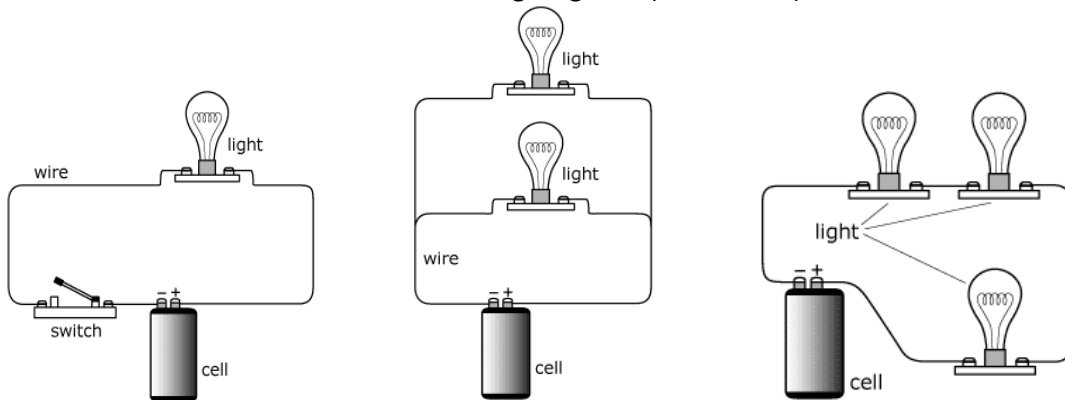
Circuits:

1. What is current?
2. Explain how conventional current would be defined differently if early scientists understood that the current they were "playing with" really was.
3. Why are electrons, rather than protons, the principle carriers of charge in metal wires?
4. How is a conductor different then an insulator?
5. Provide examples of 3 good conductors and describe some typical applications of each.
6. Provide examples of 3 good insulators and describe some typical applications of each.
7. Resistors are most often used in a circuit for either _____ or _____.

8. Would the light turn on if the switch was closed in the following circuits? Draw arrows showing any expected current.

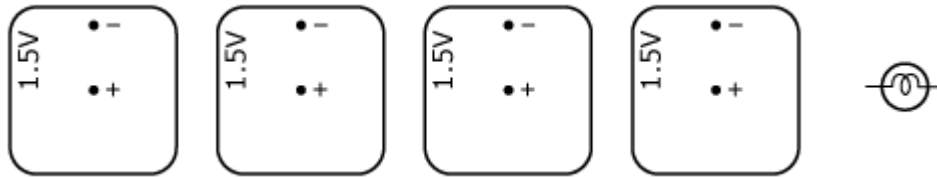


9. Draw a schematic for each of the following diagrams (below each):

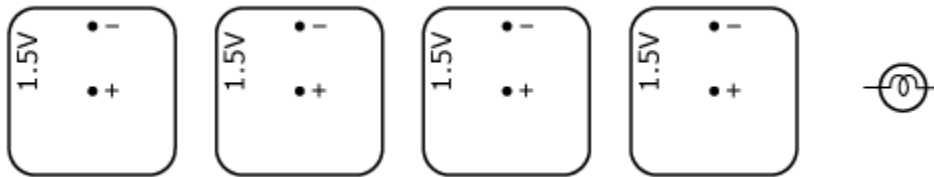


10. Show how to make a circuit where two switches both need to be closed in order for the light to turn on. Include a schematic and some explanation.
11. Explain how to make a circuit where either of two switches has to be closed in order for the light to turn on. Include a schematic and some explanation.

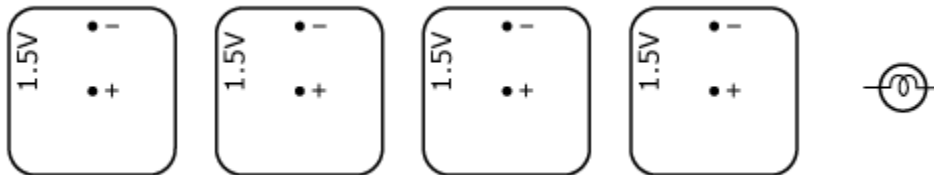
12. Draw wires onto the following diagram to show how you would wire the following batteries if you had a light bulb that required 6V.



13. Draw wires onto the following diagram to show how you would wire the following batteries if you had a light bulb that required 1.5V and you wanted to make the batteries last for a long time.



14. Draw wires onto the following diagram to show how you would wire the following batteries if you had a light bulb that required 3V and you wanted to make the batteries last for a long time.



15. What is the main wiring plan for houses to ensure that each receptacle and light socket is the same voltage (ie. approx. 120 V)? Include a schematic and some explanation.

16. Explain how a string of Christmas lights in series can use a single blinking bulb to make the whole string blink. Include a schematic and some explanation.

17. A light bulb has $120\ \Omega$ of resistance. When switched on (in a house with 110 V), what is the current running through it?
18. A 100 Watt light bulb operates on 110 Volts. What is the resistance?
19. Include a diagram and explanation to describe why a voltmeter needs to be VERY high resistance.
20. Include a diagram and explanation to describe why an ammeter needs to be VERY low resistance.
21. If the voltage across a circuit is held constant while the resistance doubles, what changes occur in the circuit?
22. A small light bulb is connected to a 6 V battery and draws 2 A of current. What is the net resistance of the bulb?
23. A motor with an operating resistance of $32\ \Omega$ is connected to a voltage source. The current in the circuit is 1.5 A. What is the voltage of the source?

24. Determine the amount of current going through a $50\ \Omega$; resistor with a voltage of 120 V.

25. A wire wound resistor has a resistance of 200 ohms. What voltage applied between the terminals will produce a current of 0.08 amperes?

Circuit Protection:

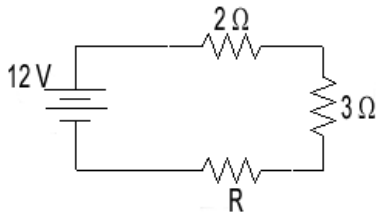
1. Describe the difference between fuses and circuit breakers.

2. What is meant when we refer to a "short circuit?"

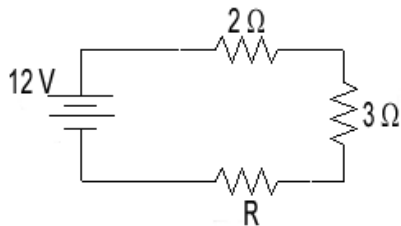
Series & Parallel:

1. Resistors added in series _____ the overall resistance.
2. Resistors added in parallel _____ the overall resistance.
3. Devices in series have the same _____ running through them.
4. Devices in parallel have the same _____ drop across them.
5. Use some sort of water-flow, water-slide, or traffic-jam analogy to explain/remember the previous 4 results. Draw and explain in detail.

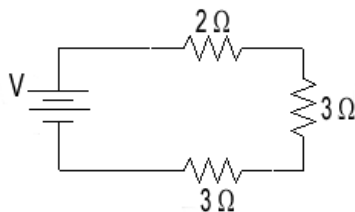
6. If the current flowing through the following circuit was 2 Amps, what is the resistance R?



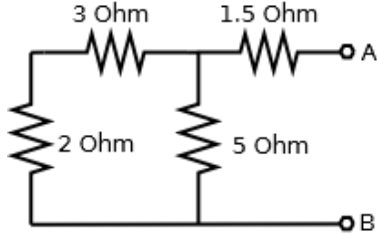
7. What is the current flowing through the following circuit if $R = 11\Omega$?



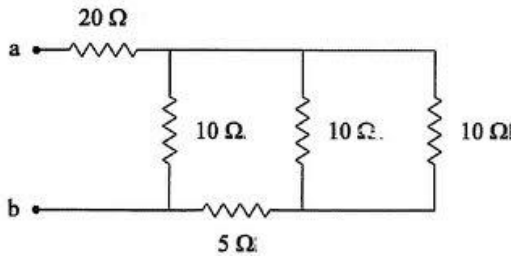
8. What is the voltage, V , if the current flowing in the following circuit is 3.75 A?



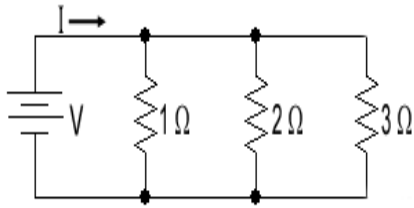
9. If you were to replace the 4 resistors in the circuit below with a single one, what resistance would it have to be? Hint – break down in steps, drawing each circuit.



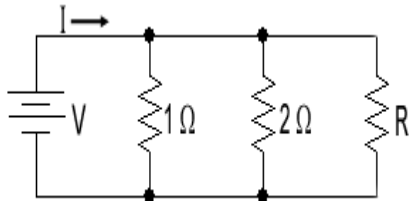
10. If $V = 12$ volts, in the circuit below, what is the current, I (the current flowing through the main branch)? Hint – break down in steps, drawing each circuit.



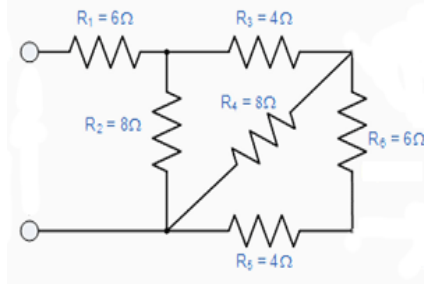
11. If $V = 12$ volts, in the circuit below, what is the current, I (the current flowing through the main branch)?



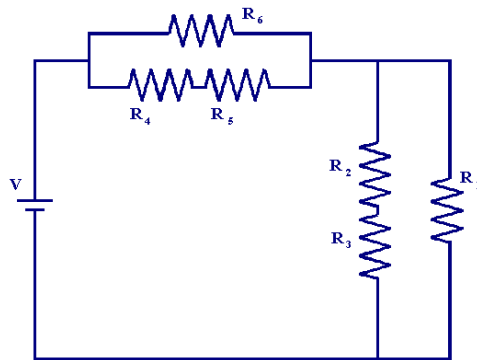
12. When $V = 6$ volts, the current $I = 18$ A, the current through. What is the resistance R ?



13. What is the equivalent resistance of the following circuit?



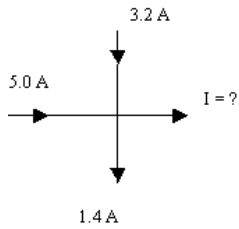
14. If all of the resistors below are 20Ω resistors, what is the equivalent resistance? Show all work and draw your final simplified circuit using the equivalent resistance. Show steps.



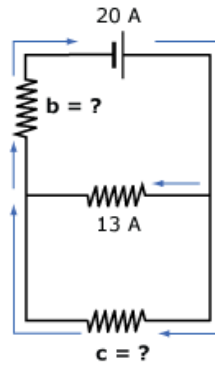
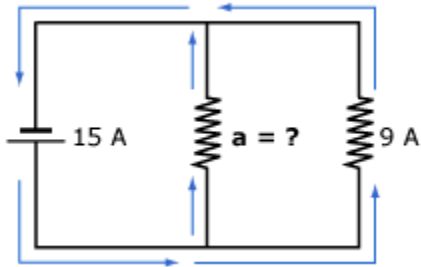
Kirchoff's Laws:

1. What is an easy-to-remember summary for each of Kirchoff's laws?
2. The voltage provided by the battery for the circuit powering two lamps in series is 6V. If one of the lamps has a voltage of 2V, what is the voltage across the other?

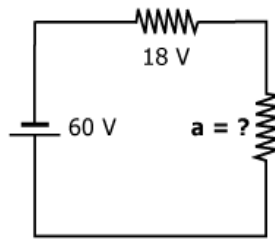
3. What is the unknown current, I , in the following circuit?



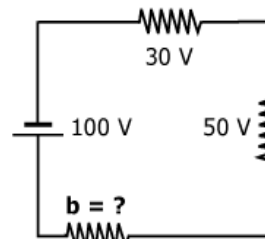
4. Determine the missing current(s) in each circuit.



5. Determine the missing voltages in the following circuits.

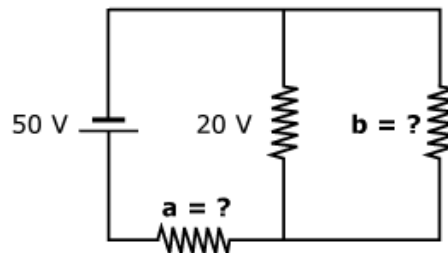
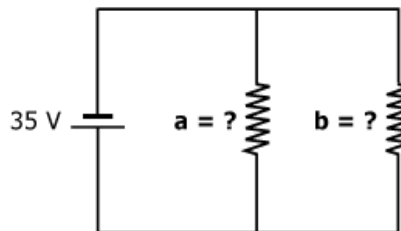


circuit 1

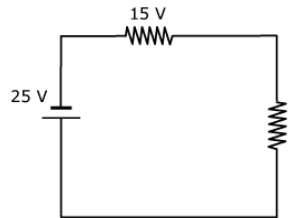
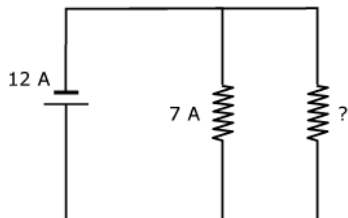


circuit 2

6. Determine the missing voltages in the following circuits.

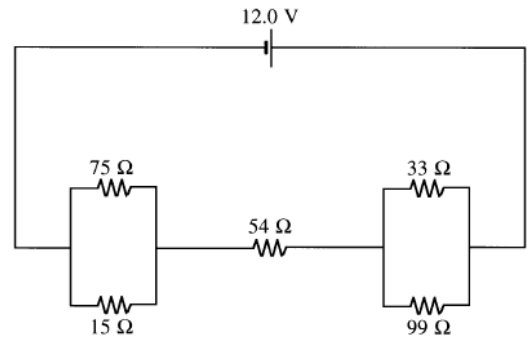


7. What the unknowns (current, voltage), in the following circuits?



8. Consider the circuit shown.

- a. What is the equivalent resistance of this circuit?
Show steps.

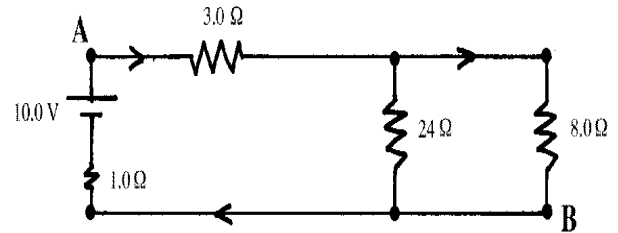


- b. Simplifying circuits by using equivalent resistances often makes calculations of current or voltage easier. Let's consider the following question: *What is the current through the 54 Ω resistor?* BEFORE we answer this let's simplify the circuit.
- i. Redraw the circuit so that we are only left with two resistors; the 54 Ω and the equivalent of the remaining resistors.

ii. Solve the simplified circuit: What is the current through the 54 Ω resistor?

iii. How much power is dissipated in the 54 Ω resistor?

9. Consider the circuit shown:



- a. What is the equivalent resistance of the circuit? Show steps.

- b. What is the total current leaving the battery?

- c. What current exists at A? What is the voltage across the 3 Ω resistor? Why is the current the same as the total current?

- d. What is the potential difference between the ends of the 8.0 Ω resistor? What current?

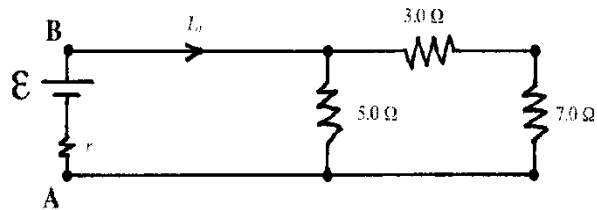
- e. What is the current through the 24 Ω? The voltage?

- f. Using Kirchhoff's Voltage Law and Current Law determine the voltage and current through the remaining 1 Ω resistor.

Terminal Voltage:

1. Describe why people sometimes throw away perfectly good devices after they “check things out” and determine that the battery is good.
2. A 1.5 V source has internal resistance of 1.0Ω , what current must flow through the cell so that the terminal voltage is equal to the EMF?
3. Calculate the terminal voltage of the cell if its EMF is 1.5V, with internal resistance of 0.50Ω and $R=10\Omega$.
4. Power in a resistor is often dissipated as heat. Why does a battery heat up more when connected to a circuit with a low resistance?
5. In this circuit, the EMF of the battery is 6.0V while the terminal voltage (across A and B) is 4.6V.

a. What is the total current I_o ?

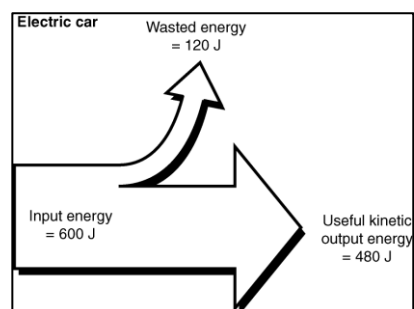
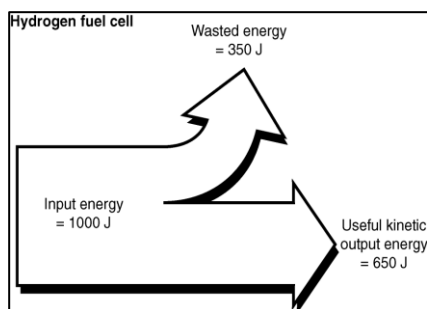


b. What is the internal resistance r ?

Power:

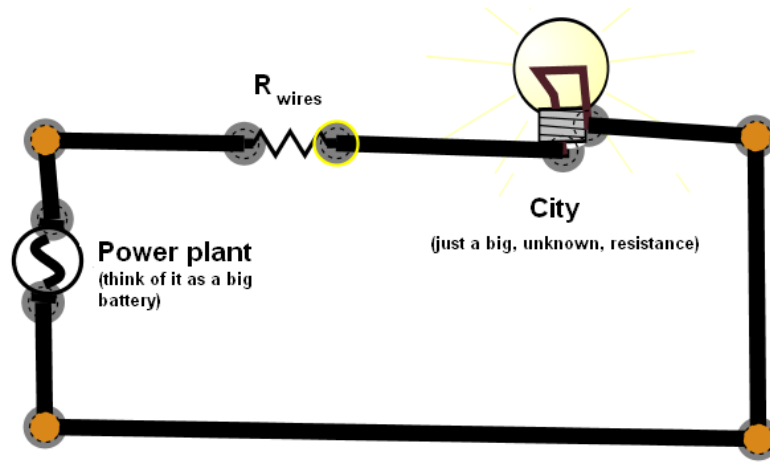
1. The unit for power is _____.
2. The greater the power of a device, the faster it uses up _____.
3. Starting with $P=VI$, derive two others formulae for calculating power.
4. Find the voltage needed to run a 10 watt cordless phone that draws 0.25 amps of current.
5. A $2.2\text{ k}\Omega$ resistor is rated at ' $\frac{1}{2}$ W'. What is the highest voltage you could safely apply to the resistor without risking damage to it from overheating?
6. A table lamp is wired so that only 0.5 A of current can flow through its wires before they overheat. What is the highest power light bulb that can be used in this lamp, if it is plugged into a 120 volt outlet?
7. A TV draws 30 amps of current from a standard household 120 volt outlet. How much power does it consume?
8. Why is $P=I^2R$ the most commonly used formula for determining power lost due to heat?
9. A 600 W electric heater is connected to a 120 V source. What current flows through the heater?

10. A portable hair dryer, plugged into a 110 V outlet, has a current of 10 A flowing through it. What is the power rating of the hair dryer?
11. A DVD player that is not being used still uses energy at a rate of 25 W. What current is passing through it if the DVD player is plugged into a 110 V electrical outlet?
12. The European Union (EU) has banned the sale of 100 W filament light bulbs because about 92 per cent of the input energy is wasted as heat. What is their efficiency?
13. A hair dryer has an energy input of 1500W and gives out 1300W of useful energy. What is the efficiency of the hair dryer?
14. Look at these energy diagrams. Work out the efficiency of each device.



Transmission Lines:

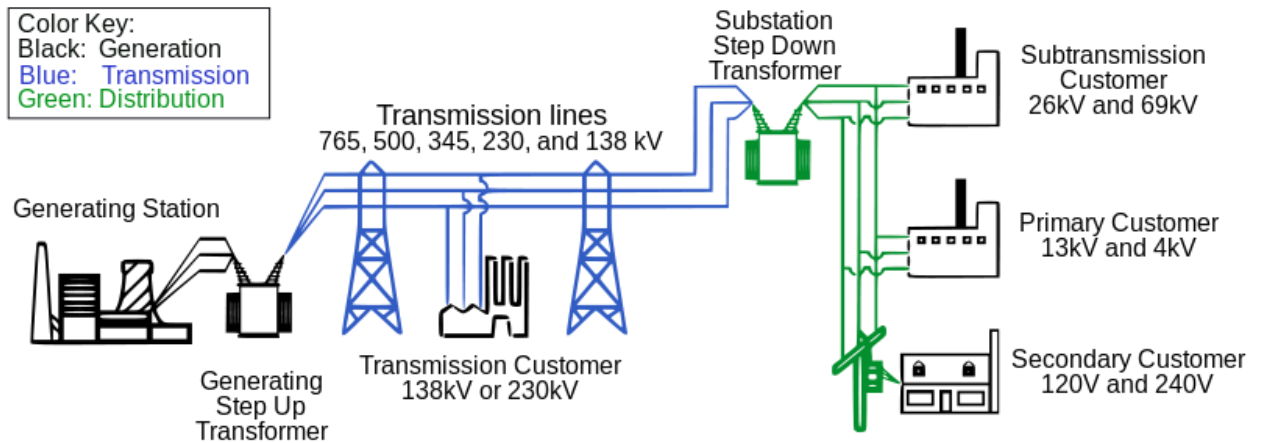
1. At its most basic level transmission lines can be considered as a simple circuit depicted below:



- a. What type of circuit is depicted above? Series or Parallel?
- b. What remains constant in this type of circuit?
- c. R_{wire} is the resistance found in the transmission lines. We want the wires to remain as cool as possible since heat is considered a waste of energy (a loss). Discuss why it is better for a Power Plant to transmit 100 MW of power at a high voltage and low current (recall: $P = VI$) as opposed to a high current, low voltage.
- d. If the Power Plant is delivering 5×10^7 W of power to the lines using 2.5×10^5 V, how much current is travelling through the lines?
- e. The resistance of the lines themselves is 2 Ohms. How much power is dissipated (used up) by the lines? This is considered to be the “Power Lost”.
- f. Therefore, how much of the original power ends up at the city? You’ll recall that efficiency is a ratio of output/input using either energy or power. What is the efficiency of the lines?

2. Why are “step-up” and “step down” transformers used for transmitting power more efficiently?

Explain the rationale for the transmission design shown.



3. Suppose a company decides to ship 150 000 W over 2.0Ω transmission lines at 560 V.

a) How much power is lost?

b) What is the efficiency of transmission?

c) Compare the power lost above to the power lost in #1. Discuss which mode of power delivery (high voltage at low current OR low voltage at high current) is more efficient. Why?

4. Transmitting electricity is most efficient when _____ is high and _____ is low.
5. Transmitting electricity is most safe (in most ways) when _____ is high and _____ is low.
6. What are three ways in which electricity can be generated?
7. How is the electricity being generated for your home? A little research may be required.
8. Where is the last transformer found, prior to electricity entering your home? On a pole or in a box – quick description? Take a look around (you won't need to open or touch anything).
9. What are the current trends regarding electrical generation? Why?
10. Calculate the efficiency of 25 000 W of power shipped at 500 V over 10Ω transmission lines.
11. A power station delivers 455 kW of power at an input voltage of 4.00×10^4 V to a factory through lines whose total resistance is 5.00Ω . If the same power was required, but the input voltage was reduced to 1.00×10^4 V, by what factor would the power wasted in the lines be multiplied? Show ALL work!

Answers:

Circuits

7)converting energy, controlling current 8)N,Y,Y 12)3inseries 13)4inparallel 14)2parallel sets of 2 in series 15)parallel sets of “switches and resistors(lights)” and “receptacles” 16)series 17)0.92A 18)121 Ω 19-20)not change circuit during reading-explain 21)current/2-explain 22)3 Ω 23)48V 24)2.4A 25)16V

Series & Parallel

1) increase 2) decrease 3)current 4)voltage 6)1 Ω 7)0.75A 8)30V 9)4 Ω 10)0.48A 11)22A 12)0.67 Ω 13)10.1 Ω 14)26.6 Ω

Kirchoff's Laws

2) 4V 3) 6.8A 4)6A,7A 5)42V,20V 6)35V,35V 7)5A,10V 8)a) 91.25 Ω b)0.132A,0.934W 9) a)10 Ω b)1A c)1A, 3V d)6V,0.75A e)0.25A,6V f)1V,1A 10)40V24V,24V 11)27V 12)1.2V

Terminal Voltage

2) 0A 3) 1.43V 4) higher current 5) a) 1.38A b) 1.01 Ω

Power

1)Watts 2)energy 4)40V 5)33V 6)60W 7)3600W 9)5A 10)1100W 11)0.23A 12)8% 13)87% 14)65%,80%

Transmission Lines

1a)series b)current c)efficiency,explain d)200A e)80000W f)4.99x10⁷W, 98% 3)1.44x10⁵W b)4.2% 4)voltage,current 5)current,voltage 10)0% 11) 16X